THE ELECTRIC AGE

DEVOTED TO ELECTRIC LIGHTING, TELEGRAPHY, TELEPHONY AND ALLIED PHASES OF ELECTRIC DEVELOPMENT.

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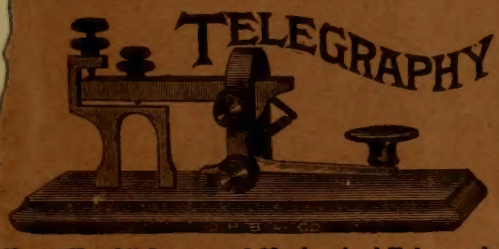
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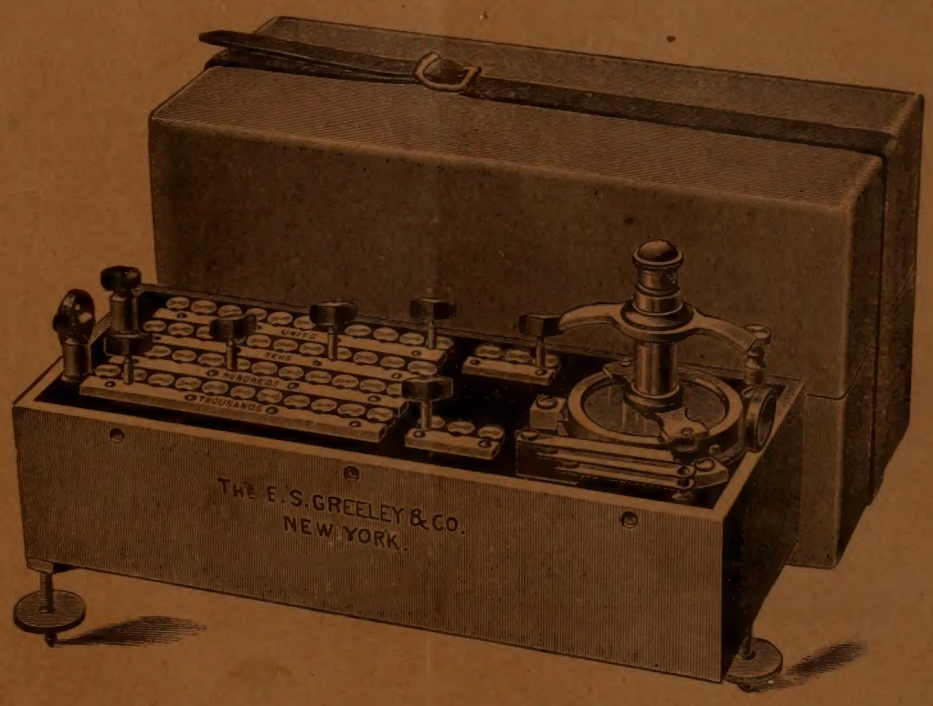
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THE BEGINNING OF THE END.

Edison Company Sustained. Westinghouse Company Defeated.

Sawyer-Man Patent Decided by the Court to be a Fraud and Absolutely Valueless.

Extracts from the Decision of Justice Bradley, Oct. 5, 1889.

Circuit Court of the United States for the Western District of Pennsylvania.

THE CONSOLIDATED ELECTRIC LIGHT COMPANY
(WESTINGHOUSE COMPANY)
versus
McKEESPORT LIGHT COMPANY
(EDISON COMPANY).

No. 5, May Term 1888.
On Bill and Final Hearing.

EXTRACTS FROM OPINION OF THE COURT.

"The great question in this suit is whether the patent sued on is valid, so far as involves a general claim for the use in electric lamps of incandescing carbon conductors made of fibrous or textile substances. If it is, the complainant must prevail. If it is not, the bill must be dismissed".....

"Is the patent valid for such a broad claim? The defendants contend that it is not; first, because no such invention was set forth in the original application, but was introduced more than four years after it was filed, and after the same material had been used by Edison, and claimed by him in application for a patent; secondly, because Edison, and not Sawyer-Man, was really the original and first inventor of an incandescent conductor made of fibrous or textile material for an electric lamp."....

"It is very clear to us that in the original application for the patent sued on the applicants had no such object in view as that of claiming all carbon made from fibrous and textile substances as a conductor for an incandescing electric lamp. Nothing on which to base any such claim is disclosed in the original application. We have carefully compared it with the amended application, on which the patent was issued, and are fully satisfied that after Edison's inventions on this subject had been published to the world there was an entire change of base on the part of Sawyer & Man, and that the application was amended to give it an entirely different direction and purpose from what it had in its original form."....

"By an adroit amendment made in 1885, they say: 'Our improvement relates more especially to the incandescing conductor, its substance, its form and its combination with the other elements composing the lamp.' The purpose of this amendment is obvious, and needs no comment."....

"The fact is that Sawyer & Man were unconscious that the arc was not new, and supposed that they could get a patent for it; but, as their eyes were opened, they changed about and amended their application, and made the material of the conductor the great object—carbon made from fibrous or textile material. Compare the original with the amended application, as first stated in this opinion, and this purpose most obviously appears."....

"The fact that the whole object of the application was changed is evinced by the correspondence of the parties."....

"This testimony of Mr. Broadnax, which is undoubtedly to be relied on, in connection with the letter just quoted, shows that the idea of claiming carbons made from fibrous and textile materials was an afterthought, and was no part of the purpose of the original application. The amendments relating to this new and broad claim were made afterward, in February and March, 1885."....

"We are of the opinion that the changes made in the application in this regard were not justifiable, and that the claim in question cannot be sustained."....

"We are not at all satisfied that Sawyer and Man ever made and reduced to practical operation any such invention as is set forth and claimed in the patent in suit. Their principal experiments were made in 1878, and perhaps the beginning of 1879. The evidence as to what they accomplished in the construction of electric lamps is so contradictory and suspicious that we can with difficulty give credence to the conclusions sought to be drawn from it. **We are not satisfied that they ever produced an electric lamp with a burner of carbon made from fibrous material, or any other material, which was a success."**....

"The application for the patent in suit was not made until January, 1880, nearly or quite a year after all their experiments had ceased, and after the inventions of Edison had been published to the world."....

"The explanations made by the complainants for the delay in applying for the patent in suit fail to satisfy our minds that Sawyer & Man, or their assignees for them, have not sought to obtain a patent to which they were not legitimately entitled."....

"But, suppose it to be true, as the supposed inventors and some of the other witnesses testify, that they did in 1878 construct some lamps with burners of carbon made of fibrous material, and of an arched shape, which continued to give light for days or weeks or months; still, were they a successful invention? Would any one purchase or touch them now? Did they not lack an essential ingredient which was necessary to their adoption and use? Did they go any farther in principle, if they did in degree, than did other lamps which had been constructed before? It seems to us that they were following a wrong principle—the principle of small resistance in an incandescing conductor, and a strong current of electricity—and that **the great discovery in the art was that of adopting high resistance in the conductor with a small illuminating surface, and a corresponding diminution in the strength of the current. This was accomplished by Edison in his filamental thread-like conductors, rendered practicable by the perfection of the vacuum in the globe of the lamp.** He abandoned the old method of making the globe in separate pieces, cemented together, and adopted a globe of one entire piece of glass, into which he introduced small platinum conductors, fastened by fusion of the glass around them, thus being able to procure and maintain perhaps the most perfect vacuum known in the arts. In such a vacuum the slender filaments of carbon, attenuated to the last degree of fineness, may be maintained in a state of incandescence without deterioration for an indefinite time, and with a small expenditure of electric force. **This was really the grand discovery in the art of electric lighting, without which it could not have become a practical art for the purposes of general use in houses and cities."**....

"The principle and great thing described is the attenuated filament and its enclosure in a perfect vacuum."....

"We think we are not mistaken in saying that but for this discovery electric lighting would never have become a fact. We have supposed it to be the discovery of Edison because he has a patent for it. This may not be the case. It may be the discovery of some other person; but, whoever discovered it, it is undoubtedly the great discovery in the art of practical lighting by electricity."....

"THE BILL MUST BE DISMISSED."

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NEW YORK, JANUARY 4, 1890.

IMPORTANT ANNOUNCEMENT.

We are pleased to announce that beginning with the New Year the electrical edition of THE ELECTRIC AGE will be issued weekly. The rapid growth and development of electrical industries render it absolutely necessary that we take this step, in order to keep abreast of the times. We find that a semi-monthly publication is heavily handicapped in the fast race of electrical development, and, in order that we may keep our patrons fully and promptly informed of what is going on in the world of electricity, we have decided to make this change, trusting that the confidence reposed in THE ELECTRIC AGE by its friends up to the present time may continue to increase. It is the purpose of the management of this paper to make it one worthy of the confidence and support of every one interested in any manner with electricity. Every department of electrical industry will receive proper attention, and to this end we invite correspondence on all subjects in that line.

We also have the pleasure to announce that on the first of the year Mr. Thomas R. Taltavall, for some years past superintendent of telegraph of The Associated Press, is to assume the editorship of THE ELECTRIC AGE.

Mr. Taltavall's long service in the news business, and his practical and expert knowledge of electricity will be of special value to the paper, and it is our purpose to concentrate all of the forces and energy necessary to make it an electrical journal second to none.

We wish each and every one of our friends a happy and prosperous NEW YEAR.

The case of the Cincinnati and Suburban Telegraph and Telephone Association against the Mt. Auburn Electric Street Railway Company, at Cincinnati, is attracting a great deal of attention among electrical people. A large number of electrical experts and gentlemen interested in street and other railways, some of them from distant cities, are in attendance to witness the experiments for which apparatus has been set up in the court-room and elaborate preparations made, and which promise to be the prominent feature of this case. The suit is an attack against the single trolley system, which, as claimed by the telephone association, results injuriously to the operation of its wires. The single trolley system is at present in use by the electric railway company. The telephone company claims that the double trolley system, like that of the Colerain Avenue Electric Road, does not interfere with the operation of the telephone lines, and were this system used by the Mt. Auburn Company the trouble now existing with the telephones would be obviated.

The story that Jay Gould is becoming alarmed at the prospective rival of the Western Union Telegraph Company in the Long-Distance Telephone, and is ready to dispose of his Western Union holdings, is again going the rounds. A prominent Wall-street operator said recently, "You will see a great turnover or revolution in telegraphic matters before many moons. It is well known to all telegraph men that the coming opponent of the telegraph monopoly is the equally greater monopoly of the telephone. The telephone people have a trump-card which they are holding back until the proper moment. This is nothing less than an improved telephone which will astound the public when it is placed on the market."

At Milwaukee, Wis., on the 12th of December, the Wisconsin Telephone Company filed suit against the Eau Claire Electric Railway Company and the Sprague Electric Railway and Motor Company at Eau Claire praying for an injunction to restrain the defendants from longer operating their system, alleging that the same is dangerous and destructive to both life and property. The complaint sets forth that the defendants are destroying the plaintiff's business by direct crosses of wires and by leakage and induction. A score of affidavits set forth the interruption of telephone service, burning out of instruments and injuries to employés and citizens.

The Chief Signal Observer, in his annual report to Congress, says that since electric lights have been used for public buildings the display of cautionary signals by means of ordinary oil lanterns is rendered ineffective on account of the greater brilliancy of electric lights, and, to remedy this difficulty requests an appropriation of $1,000 for electric cautionary signal lights at Boston, New York, Chicago and other important cities. An appropriation of $120,000 is asked to pay the telegraph companies for transmitting weather reports during the coming year.

The statement of the earnings of the Western Union for the last quarter is said to make the best showing of any in the history of the company, and the executive commitee has recommended the regular dividends of 1¼ per cent. and an extra dividend of ¾ per cent It is reported also in financial circles that the Postal Telegraph Company is earning 12 per cent. on its capital stock. This is a pretty good indication that people in this country believe in patronizing the telegraph and that such patronage is continually increasing.

The *Milwaukee Sentinel* suggests that everything that happens that is not understood should be charged to electricity, just as everything from a headache to an earthquake used to be charged to the gulf stream. A Janesville man whose disappearance is still a mystery was last seen in his back yard stroking a cat. What is more likely than that the electricity set free in the cat's fur reduced the unfortunate man to ashes?

For a long time the Russians have made great efforts to obtain a concession for the construction of a telegraph line between Kiakhta, in Southern Siberia, and Pekin, and recently they thought they had been successful. The Chinese government seems, however, to have changed its mind unexpectedly, and it is now asserted on good authority that China has definitely resolved to grant no such concession.

On the 19th ultimo the telegraph companies were badly crippled in New York City, and along the Atlantic coast by the dense fog. Their wires were in many cases rendered almost useless, on account of the difficulty in getting the battery through them even for short distances. Good, bad and indifferent wires suffered alike, and business was greatly retarded.

A dispatch from London on Dec. 9th says: The report that a breach had occurred in the relations of the Anglo-American Telegraph Company and Direct United States Cable to the Western Union Telegraph Company is authoritatively denied. The officials of the Anglo-American Company further state that the opening of an independent office in New York has no significance, except as indicating the purpose of the associated Atlantic cable companies to give to the public every facility for the promptest transmission of its messages. All the companies have always had separate offices in London and will now have them in New York, the laying of the short cables to Canso, N. S., by the Western Union Company having given to them ample facilities for doing so.

The opinions of prominent electrical experts on the question of making electric light wires safe, printed elsewhere in this issue, make very valuable and interesting reading. This subject is one of paramount importance these days, and no doubt the views expressed in these papers will be very helpful to those who are grappling with this problem. One very important fact is brought out in these expressions of opinions, and that is, that placing electric light wires under ground will by no means lessen the dangers incident to overhead wires; on the contrary, the general opinion seems to be that the dangers would be rather increased. This is something for electricians to ponder over. As these replies are received they will appear in this paper, and we trust that our efforts to open a way for the solution of this important problem will be productive of good results.

The single trolley system of electric street railways is passing through a trying period. The telephone people in several cities are suing against the use of this system on account of the serious disturbances it creates on telephone lines by induction. According to a press dispatch from Milwaukee, in reference to the suit against the Electric Railway Company in Eau Claire, the defendants are advised to "insulate" their wires to overcome the objections raised by the telephone company. The interests represented in these cases are large, and we hope the difficulties between them may soon be adjusted in a manner satisfactory to both parties.

THE ELECTRIC LIGHT IN NEW YORK.

The work of destruction of electric light lines goes on in this city, and it is evident that the end will not be reached until all the wires are down, whether they be good, bad or indifferent. No such thing as discrimination is exercised on the part of the authorities. To those who have charge of the work removing the wires all electric light lines are dangerous, consequently they are all falling.

It is to be regretted that such a state of affairs exists on the side of the city authorities. Miles and miles of wire, absolutely safe, are being wantonly destroyed in spite of the protests of the companies interested. And yet there is no power to stop it. There will be a day of reckoning, however, and suits for damages against the city and certain authorities will presently be entered.

There is no doubt that a more healthy state of affairs will succeed the present turbulence. The people want and must have the electric light. Its vast superiority over all other methods of illumination is acknowledged and unquestioned, and our citizens are not the kind to allow the name of their progressive city to go on record as retrograding, particularly in so important a matter as this. Well lighted streets are a protection to life and property. The value of the electric light is appreciated now, while we are compelled to use gas in the streets.

It is hopeful that the end of the crusade is at hand and that the work of reconstruction will soon begin. The future lines, no doubt, will be more substantially built, and on the whole good will result from the temporary demoralization of the electric light business.

THE INTERIOR ELECTRICAL CONDUIT COMPANY'S SYSTEM OF WIRING.

The necessity for a perfect system of wiring the interior of buildings for lighting purposes has long been felt. Indeed, this branch of electrical lighting seems to have been almost entirely neglected in the rapid march of improvement in every other feature of the business. Dynamos have been made more efficient, lamps improved, and wire made cheaper, and insulation made more perfect, but few have given any thought to the subject of properly wiring buildings. The usual method of conveying the current to lamps is either by enclosing the wires in the plaster, or in attaching a molding to the walls and ceilings on which the wires are run. The first method is unreliable on account of the liability of leaks due to the destruction of insulation by the plaster, and the objection to the second is the unsightliness of the strips of molding, which cannot, at the best, be laid in such a way as to be pleasing to the eye. Every objection to all present methods of wiring is overcome in the system of the Interior Electrical Conduit Company, of this city, and its many advantages are the result of a long familiarity with the difficult conditions existing, and great ingenuity is shown in the evolution of details and special devices.

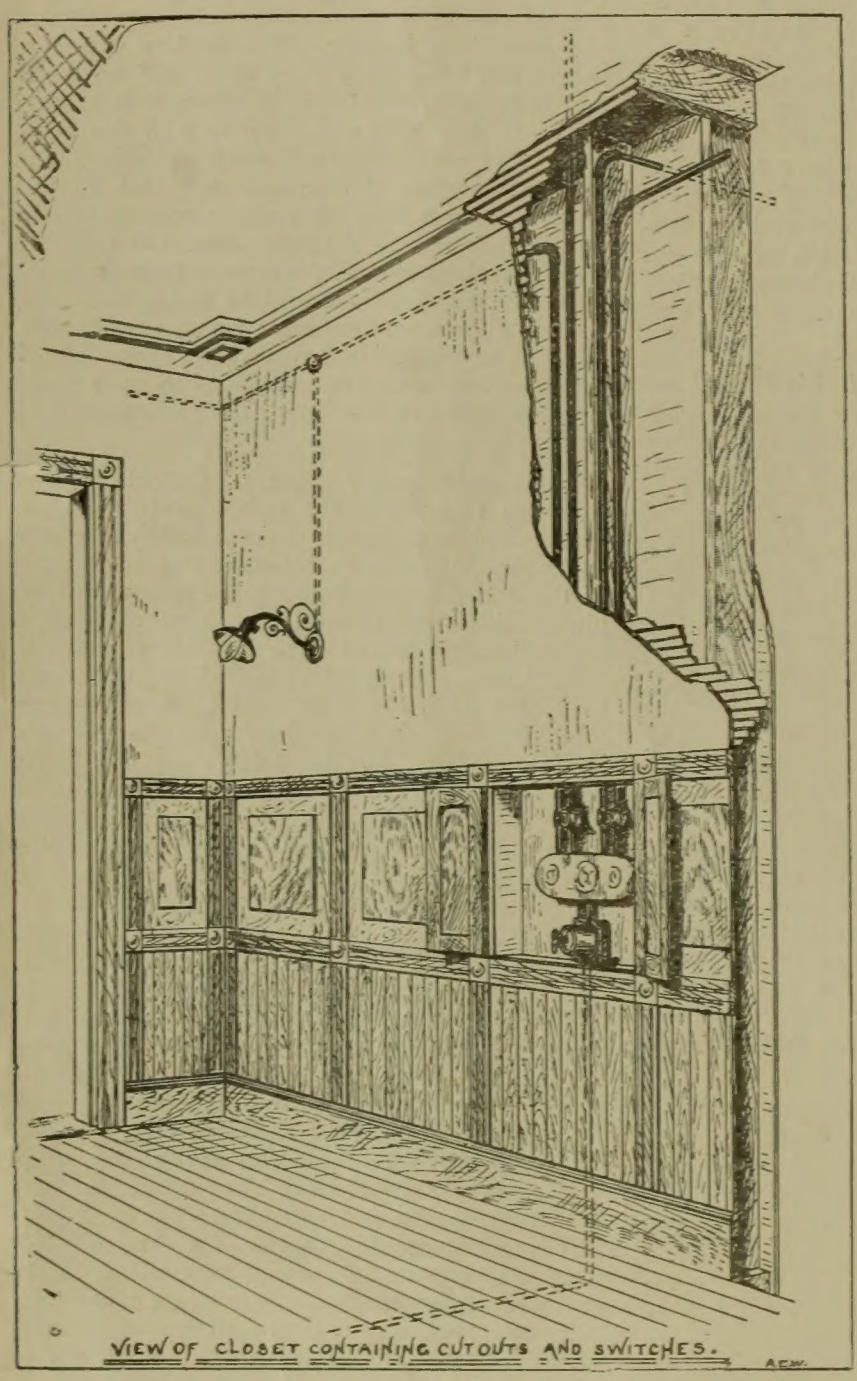
Broadly stated, the system of the Interior Electrical Conduit Company consists in the use of a light flexible insulating tube, or conduit, which is carried through a building, pretty much as gas pipe or water pipe is, and which serves as a duct or repository for the distribution wires.

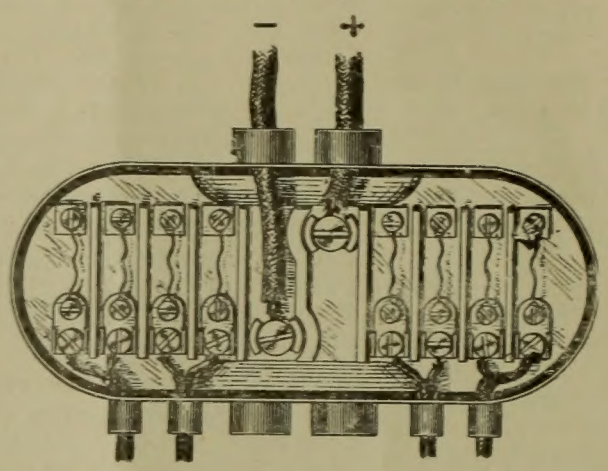
But the idea of the tube, or conduit, has combined or associated with it the use of a new and ingenious insulated wire known as the "safety conductor." These special features are, in turn, the appropriate and adequate complements of a scientific "system of distribution."

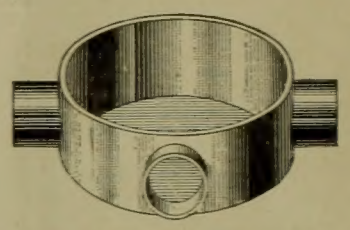
As a result of the combination of these three features—the conduit, the safety conductor and the system of distribution — five important points are secured, namely, *Safety*, *Convenience*, *Accessibility*, *Economy* and *Durability*.

The tube used by the Interior Electrical Conduit Company is made of a species of paper or papier maché, and combines flexibility with great power of resistance to strain. After it has been made to special process, it is subjected to treatment with some secret bituminous, asphaltic compound that renders it thoroughly non-conducting and impervious to moisture. The tube, when cut with a knife, exhibits every evidence of complete impregnation, and stubbornly resists every attempt to permeate it with water. This tube is made in sizes of ¼ inch to 1¼ inches inside diameter, and in lengths of 10 feet. These lengths are joined together by sleeve couplings and are threaded, and can be right-angled or be fitted with elbows for rounding curves and corners. Here at once, in such a tube, we have, beyond the mechanical shield from injury, such a protection against internal or external fire as has never before been provided. In order to insure positively the operation of the safety devices employed in electric circuits, the conductors, composed of stranded copper wires, are separately insulated, then laid up together and jacketed in a common sheathing of suitable material.

Thus, while the wires are normally and properly insulated, there is no absolute bar to a short circuit; and instead of a slow smoldering, there is instantaneous compulsion to short circuiting and blowing out of the safety fuse, so that any trouble instantly declares itself and disappears. The conduits all lead into main junction boxes, while smaller junction and

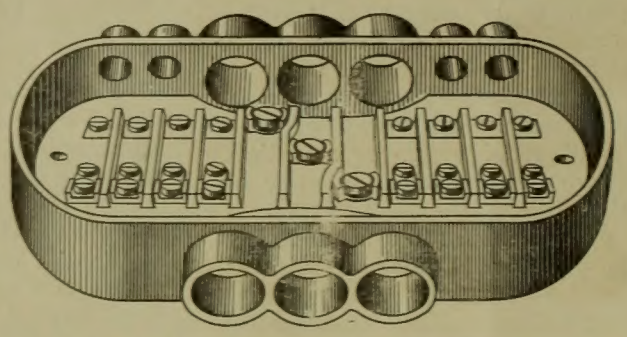






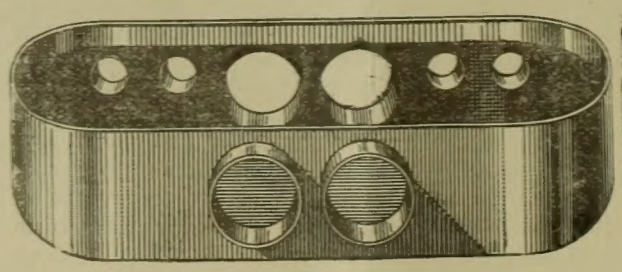
BRANCH LINE. THREE HOLES.

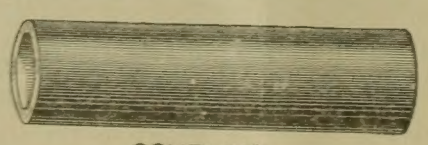




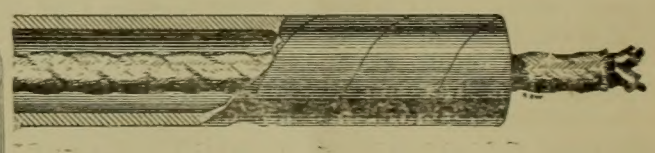
INTERIOR AND EXTERIOR OF JUNCTION BOX.



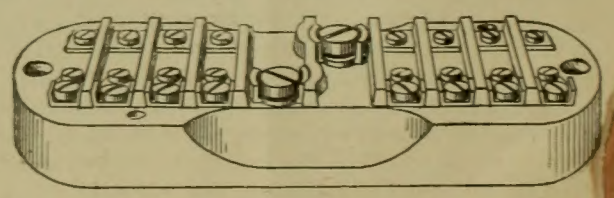




COUPLING.



SECTION OF CONDUIT WITH TWIN CONDUCTOR.



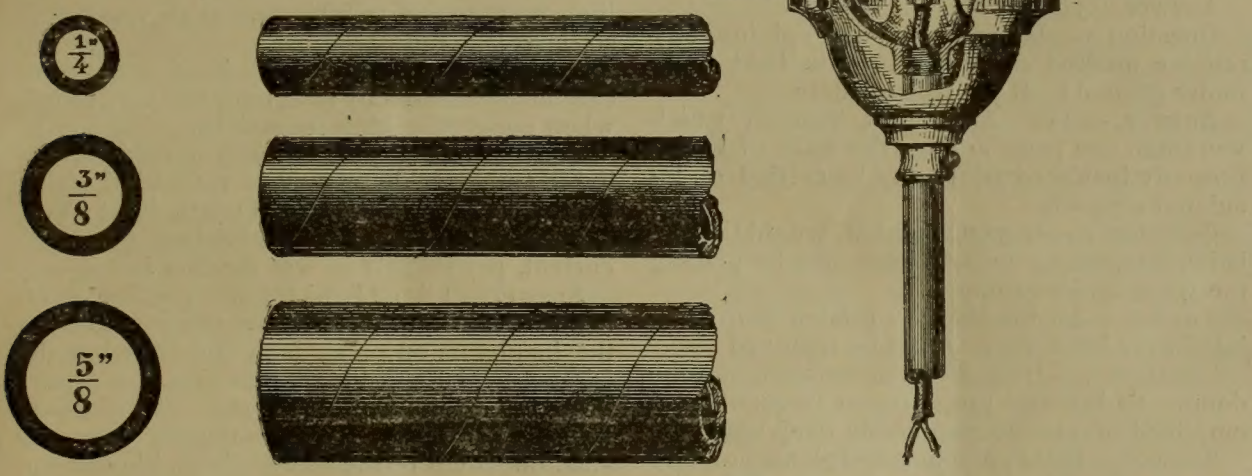
tersection boxes and outlet terminals make safe and ample provision for the ramifications and convenience of the service.

Wiring by the old plans is decidedly inconvenient, but the new system changes this. Every architect is familiar with methods of disposing of piping in his plans, and he has simply to carry out the same method applied to these electric conduits. Thus decorations and plastering are spared.

In the matter of accessibility the system of the Interior Electrical Conduit Company is preeminently one which provides for the future. There is no other that does. The carrying capacity of the circuits can be increased or changed in any way according to requirements.

It is noteworthy, too, that the conduit possesses marked advantages as a speaking tube, and that in this department alone it is expected to gain pre eminence, being cheaper than metal, and at the same time being perfectly smooth inside and free from the seams and joints that impair the transmission of sound through metal tubes.

This company has also wired and conducted the following well-known gentlemen's houses : J P. Morgan, for 750 lights ; Elihu Thomson, Lynn, Mass., 100 lights ; also the Metropolitan Telephone building, 600 lights ; Union Trust Company's new building, 2,000 lights, and have contracts for conducting and wiring the new *World* building in Park Row and the new Madison Square Garden when completed. This system, as will be seen, is gaining great popularity, and a large number of prominent architects demand it upon their specifications.



SIZES OF STRAIGHT TUBE, AND AN ELBOW TO OUTLET.

THE ELECTRIC LIGHT IN LONDON.

Much complaint is heard of the frequent tearing up of the streets of New York to lay subways for electric wires While the horrible condition of our streets is sufficient cause for bitter complaint, there is consolation in the fact that New York is not the only place that is suffering from this state of affairs. London is having similar experience, and from the accounts we read in the papers of that city the patience of the Cockneys must be severely tried. According to one writer, Londoners are not very enthusiastic over the new light. They have taken Mr Edison's words expressed in a recent number of the *North American Review* too much to heart, and they ask, if 110 volts are sufficient to "melt paving stones," what will 10,000 volts do should the current get on a rampage? If our London friends are going to use a pressure of 10,000 volts they must see that their lines are properly constructed and wires properly insulated. If every precaution is taken to insure safety to life and property, 10,000 volts will be no more dangerous than 1,000. However, the constructing companies are prosecuting their work, and it will not be long before London will be made resplendent with the greatest light of the age.

The "dead" wire is by all odds the liveliest corpse now on the streets of American cities.

Mr James F. Kelly, the genial sales agent of the Edison Machine Works, has been appointed General Sales Agent in the United States for Mr. Edison's new battery. Should the business receive the same push and energy as has the wire interests under his supervision, the battery will soon be found everywhere where electricity is known and needed. Recent tests of the Edison Battery, by electrical experts, verify the statements made recently concerning the merits of this cell The title of the company will be the "Edison Manufacturing Co.," and the New York office is located at 19 Dey street.

The Canadian Electrical Society proposes to hold an invitation conversazione during the winter, at which several interesting exhibits will be displayed and explained to visitors, such as the telegraph, telephone, fire alarm, electric light, phonograph, medical electrical apparatus, etc.

At a recent meeting of the Mexican Northern Telegraph and Telephone Company, the following directors were elected : John W. Weed, Winthrop Pond, William T. Patterson, Robert Colgate and John J. McGinty. Mr. Weed will be elected president and Mr. McGinty secretary, at the first meeting of the Board.

The telegraphers of Toronto will hold their first annual ball in that city on Friday evening, January 10th, 1890.

The new warerooms of the Bergmann Electric Light and Gas Fixture Company, at 79 Fifth avenue, are a model of beauty. A large room is devoted to both electric light and gas fixtures and a smaller one to gas fixtures alone. The designs represented therein are only about one-quarter of the different styles made by this company, but the artistic manner in which the electroliers and gas fixtures are arranged upon the ceiling and side walls show them off to great advantage This company has always had the name of turning out the finest goods ever placed on the market, and we understand they are now unable to keep up with the demand for their fixtures. Their works on 34th street are manned by the most skilled workmen; hence the superior quality of work done by them.

The Pacific Telephone Company, of San Francisco, has purchased the Mercantile Library building on Bush street for $157,000, and will make it a six-story brick building. The alterations will cost over $50.000. The telephone company proposes spending $150,000 in underground conduits; and will also put in a new switchboard costing over $100,000.

At the next military manœuvres in France a new application of telegraphy will be made, which innovation, it is thought, will be of the greatest utility in time of war.

The Holtzer & Cabot Electric Co., of 111 Arch street, Boston, although only in its infancy, has grown to such an extent during the past year that it now ranks as one of the first representatives in the electrical line in the East. The work done by this company is performed by the most experienced and expert workmen, and as they only handle the finest goods, the popularity into which they have sprung is well earned, and their work is highly appreciated by their customers. Their growth has been phenomenal. They represent some of the best electrical houses in the United States and are turning out new and valuable articles to the electrical field, many of which are important additions to these interests.

A glazier in the employ of the Lake Shore Railway at Toledo, Ohio, was instantly killed on the 16th of December, by coming in contact with electrical light wires. He was on the roof of the freight-house doing some work, and it is thought that he slipped, and in his efforts to regain his feet he must have taken hold of the wires which were close by. He was forty years of age, and leaves a wife and one chiid.

Mr. George Shaver, of the Shaver Corporation, has just returned from Buffalo, N. Y., where he has been for the past three months erecting two exchanges, one a nine and the other a ten-station plant. He also put in three factory plants of nine stations each. Fifty-nine stations are now in operation in Buffalo, and as many more orders for Shaver telephones remain to be filled. General satisfaction has resulted in all cases.

After three years of the incandescent light in the house of a gentleman in England, in which was a collection of fine water-colors, he finds that some of the more delicate pigments have begun to fade The arc light has been found far richer in actinic rays than the incandescent. Magnesium light approaches nearest to that of the sun in the proportion of colored rays.

The Western Union Telegraph Company are establishing a dynamo plant in their Chicago office to supply the current for their wires. About 30,000 cells of battery will be thus displaced. Sixteen No. 2 Edison dynamos and four Edison special dynamos will constitute the electrical outfit. It is expected to have the plant in operation about the first of the new year.

Senate bill 208, introduced by John C. Spooner, of Wisconsin, and referred to the Committee on Interstate Commerce proposes to place all telegraph companies, whose business is not confined to the limits of one State, in substantially the same position before the Interstate Commerce Commission as that occupied by the railroads.

There is talk of an electrical railway between Athol and Orange, Mass. The distance of the proposed line is 5½ miles, and the line is estimated to cost $75,000. Those in a position to judge say the road would pay. Considerable interest is manifested in the project in both towns.

Bill in equity was filed at Boston December 18, in United States Circuit Court by the American Insulator Co. for injunction to restrain the Electrical Glass Corporation from making double petticoat insulators, same being an infringement of patents held by the plaintiff.

An Edison central station will furnish Buenos Ayres with 30,000 Edison electrical lights and some 6,000 arc lights. Other smaller works of the same company will be established in other parts of that city.

The claim that telephone business is conducted on sound principles seems plausible, but really it is supported merely by hearsay evidence.

The wires of the Western Union Telegraph Company in Philadelphia are to be placed under ground.

CAN ELECTRIC CURRENTS BE MADE SAFE?

WHAT PROMINENT ELECTRICIANS HAVE TO SAY ON THE SUBJECT.

Recently we sent out a number of circulars containing a series of questions pertaining to the above subject, to prominent electricians through out the country. It read:

In view of the frequent and increasing number of deaths by accidental contact with electric light wires, and the fires alleged to have occurred from similar causes, we have conceived the idea of procuring from the most prominent electricians throughout the United States their opinions as to the manner in which electric-light lines could be rendered safe and harmless to life and property, and the dangers incident to the condition of some existing lines removed. The publication of these views would, we are sure, make very interesting and valuable reading, not only for electrical people, but the public in general. This collection of opinions would be of great value to those who are directly concerned, and, no doubt, valuable hints would thus be given to those who are endeavoring to better the existing state of affairs.

Any information on points not covered by these questions, which you may deem of special value in the premises, we will be very glad to have added.

With this end in view, we have prepared a series of questions, hereto subjoined, which we would be pleased to have you answer and return to us as early as convenient.

If any of our readers desire to discuss these opinions, our columns are open to them for that purpose. Any information on points not covered by the questions submitted, which anyone may deem of special value, will also be acceptable and appear in these columns. The questions asked and the answers received were as follows:

BENJAMIN RHODES,

ELECTRICAL EXPERT AND GENERAL MANAGER ELECTRIC LIGHT PLANT, NIAGARA FALLS, N. Y.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times?

Answer.—Yes. Use good insulation.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—Yes. Several kinds of good insulation in the market.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—No. There is no insulation which has been proven good for under ground use for any long time.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—No. Made much worse.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—Use good insulation.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—Use good insulation.

GEO. B. PRESCOTT, JR.,

ELECTRICAL EXPERT, ELECTRICIAN, ACCUMULATOR CO., 44 BROADWAY, NEW YORK.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes. By proper construction, insulation and the use of suitable safety appliances

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—I believe there is, if properly erected.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—No doubt many. The conditions are: 1st, mechanical protection; 2d, insulation and isolation.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—Not necessarily.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—Answered in answer number one.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—Suitably protected automatic cut-outs and fuses.

J. FRANK MORRISON,

ELECTRICAL EXPERT, BRUSH ELECTRIC LIGHT CO., BALTIMORE, MD.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes. High fixtures and good insulation.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather!

Answer.—yes.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—Yes. A conduit through which workmen can pass, and on the walls of which properly insulated wires may be carried on insulated supports.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—All the dangers arising from insulated over-head wires would be removed.

Question 5,—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—Build your lines and plants properly and handle them intelligently; the latter includes thorough inspections at short intervals.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—Automatic cut-out on outside of building.

M. D. LAW.

ELECTRICAL EXPERT, BRUSH ELECTRIC LIGHT COMPANY, PHILADELPHIA, PA.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes. By the use of well insulated wire, and close attention to grounds and leaks, which should be cleared night or day, as soon as discovered.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather.

Answer.—No.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—No.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—No. The danger of fire and to employees would be increased.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—By allowing no grounds or leaks on lines, and putting only careful and reliable men to work on lines and not allowing them to be opened at any time, whether live or dead wires.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—If properly erected, and inspected from time to time, there is no danger from fire. Arc light wires should never be allowed to be placed in moulding or cleats; but should be run entirely on porcelain knobs or glass insulators. All arc light lines should be tested at least every two hours by some reliable method, and all grounds cleared as soon as discovered. Incandescent wire should only be run with the best quality of insulation and fused wherever the size of wire changes, and these fuses carefully looked after, from time to time, to see that the sizes have not been changed. No building should be wired for a greater potential than fifty volts. Neither should a wire be used that will carry less than two ampères, safely. All telephone and telegraph wires should be fused, or have some reliable automatic cut-out placed on them where entering buildings. This is a great source of danger and should be carefully looked after.

W. H. MARKLAND,

ELECTRICAL EXPERT AND ELECTRICIAN FOR THE PENNSYLVANIA RAILROAD CO., ALTOONA, PA.

Question 1—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—I don't think over-head or any wire can be made perfectly safe, under all conditions, when conveying high potentials.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer—I don't think the escapes from over-head electric light lines, where the wire touches the insulators on poles, is nearly as bad as the escapes at hanger-boards, cut-outs, converters through partitions or walls, etc. If more care was used to insulate hanger-boards, better insulation would be the result. As an illustration, take a five-mile loop with fifty arc lamps; in very unfavorable weather the insulation resistance will be below 2,000 ohms per mile. On telegraph lines the insulation resistance very rarely falls below 100,000 ohms per mile, yet most electric light lines, as far as pole line is concerned, are fully as well put up as telegraph lines. Using better insulated wire would improve insulation, of course. While I heartily approve of the best insulated wire that can be afforded, I believe if more money was spent to properly insulate hanger-boards, cut-outs, etc., much better insulation would be the result.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—I don't want any under ground for high potential electric light. Put all the other wire under ground, if necesssry.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—Dangers of fire and personal injury would be increased by putting the wires under ground, unless wires of different kinds are laid several feet apart.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—Danger can be largely overcome by placing proper guard wires, so in case of telegraph, telephone or other wires falling they will not come in contact with electric light wires. The most rigid inspection should be

insisted on; not by a test once or twice a day by a second-hand magneto bell, but by inspection of the wire and frequent tests while lights are burning, by the proper means, such as incandescent lamps, etc. No grounded or partially grounded circuit should be used for light potential currents.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—Don't let your wires get deranged. There is no more excuse for wires being out of place than for a railroad to have its tracks out of place.

PROF. C. F. BRACKETT,

ELECTRICAL EXPERT, PRINCETON, N. J.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes. By proper insulation (which will be expensive) and by such selection of route as shall render accidental crossing of wires impossible. It is a mere question of cost in the installation.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—There may be if the above precaution is observed and the companies will pay for it.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—Yes; only let there be suitable conduits prepared, and then exercise proper engineering skill in arrangement and insulation.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—Not necessarily, unless with extreme care as above. All the present dangers will, however, disappear when properly trained and conscientious engineers and linemen are employed.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—By following strictly the precautions already indicated, and never for a moment departing from them. Installations ought never to be made in a *hurry*, nor should temporary expedients be resorted to.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric circuits running into buildings?

Answer.—Have no concealed conductors and employ every precaution to prevent derangement. Employ proper "safety plugs" and so avoid all danger of fire.

EDWARD WESTON,

ELECTRICAL EXPERT, NEWARK, N. J.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes. By limiting the tension and doing good work in the construction.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—No. There is none that will absolutely prevent escape of current.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—For low tension currents, yes. The Edison iron tube system.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—No.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—The danger to life, by limiting the E. M. F.—The danger to property, by the best workmanship.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—Good workmanship and properly placed cut-outs.

SAMUEL M. PLUSH,

ELECTRICAL EXPERT, GENERAL MANAGER BELL TELEPHONE CO., PHILADELPHIA.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Reasonably so, by placing them on well constructed poles, used for no *no other* purpose; employing conductors of sufficient electrical capacity, well protected by an insulating covering, and having one or more guard lines placed along on the top of the poles to prevent other *wires* from sagging or falling on the electric light lines.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—No; but they can be sufficiently well insulated by glass, at their supports, to prevent a harmful leakage.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—No. There is a possible but not a feasible one; the expense would be too great.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—No; the dangers would be augmented.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—By proper construction and intelligent supervision, the danger to life and property can be made very small. Accidents, however, can never be entirely prevented.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—Every electric light wire should be guarded where it enters a building, so that when the normal current is largely exceeded, from any cause, the guard will open the circuit automatically.

EDWIN R. WEEKS,

ELECTRICAL EXPERT, PRESIDENT NATIONAL ELECTRIC LIGHT ASSOCIATION, KANSAS CITY, MO.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes; by best construction and maintenance. This answer also covers questions 2, 5 and 6.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—Yes; by tunnelling.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—No; they would not.

F. E. PETTINGELL,

ELECTRIC EXPERT, BOSTON, MASS.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes; the high grade insulation "okonite" will do.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires and will absolutely prevent any escape of current, particularly in wet weather?

Answer.—Yes; "okonite" insulation is the remedy.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—Yes. P. and B. Conduit, with "okonite" wire, we believe the best. The above also answers questions 4, 5 and 6.

EUGENE T. LYNCH, JR.,

ELECTRICAL EXPERT AND CONTRACTOR, 120 BROADWAY, NEW YORK.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times?

Answer.—Yes.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—Yes.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—Electrically (for a short time), yes. Commercially (in the present state of the art), no.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—No.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—Fewer wires, better insulation and construction, and by strict business management.

CHAS. J. KINTNER,

ELECTRICAL EXPERT AND ELECTRICAL ENGINEER, 45 BROADWAY, NEW YORK.

Reply to question 1.—Yes; by transmitting all high tension currents through concentric conductors insulated from each other, the outer shell being connected directly to earth at each point of support, thereby giving to it the same potential as the earth, said outer shell, and hence the earth, constituting the return circuit for all currents sent through the inner concentric conductor or conductors, the consumption circuits being taken off from converters on the supports, and low tension currents being taken to the houses. For arc lights, the circuits being directly through the lights on the poles, either in series or multiple arc; if in series the inner concentric conductor would have to be carried out through the outer shell, through the light, and back again inside the shell.

Second.—Yes; with the system of concentric conductors which I have just described, the insulation between the concentric shells being of okonite, or any of the well-known forms of insulating material, and being fully protected from the weather by the outer shell, would prevent leakage to earth.

Third.—Yes; by the system of concentric conductors which I have just named, the outer concentric shell or conductor being always in contact with the earth, and the inner conductor being either permanently or temporarily located.

Fourth.—Yes; by the converter system and concentric conductors.

Fifth.—Answer same as Fourth.

Sixth.—By transmitting high tension alternating currents through concentric conductors, with low tension converters located in manholes, the electric motive force of the secondary circuits not being more than from 30 to 50 volts.

CONTINUED ON PAGE 8.

AN ALLEGED NEW SOURCE OF DANGER.

The excitement incident to the destruction of the electric light lines has had a bad effect on a reporter for a daily paper in this city. His imagination has evidently received an electric stimulus, judging from a story with which he tried to shock the public a few days ago. He speculates upon the awful things that might happen were the Elevated Railroads to become charged with the current from electric light wires, many of which are strung under the railroad structure. "Suppose," says the writer, "a stray current from a loose or broken wire should get loose upon the road some day * * * it would not be impossible for a bad shock to be given to a person who chanced to lean against a pillar or other piece of the iron work near where a high tension wire was rubbing against it."

Blessings sometimes come to us in disguise, and who knows but what a catastrophe of the sort just depicted might be one of them? A shock or two of this kind might cure the habit some men have of leaning against lamp posts and Elevated Railroad pillars at a time when they should be at home asleep.

But this is not all that "might happen." The "rubbing" of a loose wire against the elevated structure "might" easily lead to a disaster more serious.

"A locomotive passing over a spot where a high tension wire was pouring a current into the iron work would undoubtedly get a good-sized portion of the current, and the engineer, with his hand on the throttle and his feet on other iron work, would be doubled up and temporarily paralyzed, if not more seriously hurt. The first effect would in nine cases out of ten be to fling him back, yanking the throttle wide open at just the moment, very likely, when the train ought to be stopping, and if there were a a train just ahead a terrible accident would follow."

Just how the engineer could receive a shock while his hand was "on the throttle and his feet on other iron work," is not explained It would interest electricians to know. And how the writer figures it out that the engineer, in being "doubled up" in this unceremonious fashion, would yank the throttle open instead of closing it up tight, is another point that requires explanation. Suffice it to say, that the people of New York may rest assured that the Elevated roads are not at all likely to play such a terrible part in the extinction of the human race.

The new Talmage Tabernacle in Brooklyn will be lighted by electricity, and there will be special illuminating effects in connection with the organ, which will be surmounted by a crown of electric jewels, while on the huge sounding-board will be either a lamp or a star in incandescent lamps.

A wonderful electric invention is an automatic stamp to control the payments and receipts in factories, banks and hotels. A company has been formed, with a capital of three millions of francs. It is stated that orders have already been received for about 2,000 stamps in Brussels, Belgium.

The Danish government is moving actively in the question of electrical communication with light vessels, and has in many cases established connection with isolated lighthouses and life-saving stations.

The polytechnic institute at Worcester, Mass., has introduced a new course of electrical engineering, leading to the degree of bachelor of science in electrical engineering.

Texas Siftings : It is the woman who loves to hear herself talk who ought to invest in a phonograph.

Boston Gazette: There is a great deal of sparking done on the electric-car routes.

INGENIOUS USE FOR THE PHONOGRAPH.

Edison's phonograph has found a new application at the Milwaukee College, says the *Sentinel*, of that city. It will be used as an assistant in teaching the French and other foreign languages.

The originator of this idea is Prof. Amedee C. Baillot de Guerville, teacher of French. In cogitating over the question how to make the pupils remember the correct French pronunciation, he concluded to try the phonograph.

A machine was promptly secured, and M. de Guerville went to work at it. He spoke his lesson into the phonograph, and the latter reproduced it with astonishing accuracy. Then he told his pupils that they must study their lessons at the phonograph. No matter whether M. de Guerville was present or absent, the phonograph corrected the pronunciation of the pupils without his assistance.

The effect was surprising, and President Kingsley, of the college, at once decided to procure several machines for the practice of the pupils.

In giving a lesson to his pupils M. de Guerville reads it before the phonograph, at the same time addressing the pupils, and the lesson is reproduced whenever wanted.

"The Application of Electricity to Works and Mills," was the subject of a recent paper read before the South Stafford Institute of Iron and Steel Works Managers at Dudley, England, in which it was stated that there was everything to recommend an electrical transmission plant Waste heat from blast furnaces could be used miles away; steam boilers could be placed near the colliery to save hauling the coal; the power of a river or stream could be used, and hundreds of horse-power conveyed along small copper wires, while the places could be lighted by electricity at a very low cost.

The Edison Machine Works at Schenectady, N. Y., already employ some 1300 men, and when the extensions are completed probably twice that number will be required. A one-story brick building, 602 x 72 feet, is now being erected, and in it will be made all kinds of wire. A new three-story brick building, 167x50, will be used for carpenter shop, pattern shop, etc. The present wire works will be used for machine work. The company also has under contract a new brass foundry, an iron foundry, and, it is said, a building for the manufacture of glass globes.

A dispatch from Ottawa, Ont., on the 13th inst., quoting Clarence W. Ashford, attorney-general of the Sandwich Islands, says a liberal concession for fifteen years has been granted English capitalists by the Hawaiian government, "providing they lay a cable to Vancouver within two years."

"Them 'lectric currents is a killin' so many people in New York that I won't run any risk with them green currants I put up last summer," said a dear old lady, and she therefore emptied six large jars which had been reposing in the pantry.

Electric lights have been adopted to such an extent in the cities and towns of Guatemala that the importation of mineral oils has largely fallen off. At the capital the use of oil has diminished one-half.

The phonograph has already been adapted to the hand organ. They have the advantage that they can be refilled at very moderate rates.

The Bell Telephone Company has declared a dividend of $3 a share, payable January 15th, to stockholders of record of December 31st.

The hood covering of an electric light has been utilized as a home by a sparrow at Allentown.

ELECTRICAL PATENTS GRANTED DEC. 10, 1889.

416,712. Electrical annunciator; Franklin S. Carter, Burlington, N. J.

416,720. Commutator; J. Allen Dalzell, Hartford, assignor to the Schuyler Electric Co., Middletown, Conn.

416,732. Telegraph transmitter; Orville D. La Dow, Mechanicsville, N. Y., assignor of one-half to Frederick T. Bickford, Washington, D. C.

416,742. Circuit-closing device for matrix-making machines; Caspar L. Redfield, Minneapolis, Minn., assignor by mesne assignments to the Chicago Matrix Machine Co.

416,746. Coupling electric motors; Edwin W. Rice, Jr., Lynn, Mass.

416,754. Telephone Switch; Joseph Sack, Dusseldorf, Germany.

416,762. Induction coil transformer, etc.; Elihu Thomson, Lynn, Mass.

416,847. Hanging device for electric arc lamps; James McLaughlin, Chicago. Ill.

416,862. Electric light support; Benjamin Schardt and William Lutzenberger, Dayton, Ohio, assignors of one-third to Herman Fretzinger, same place.

416,873. Cutting metal by electricity; Benjamin C. Tilghman, Philadelphia, Pa.

416,947. Thermostat; William P. Powers, La Crosse, Wis.

416,971. Electric door alarm: Edwin W. Taylor, Charlottetown, Prince Edward Island, Canada.

417,013. Electrical pipe or metal welding machine; Herbert E. Fowler, New Haven, Conn.

417,018. House telephone exchange; William M. Goodridge, Highland Park, assignor to the Western Electric Co., Chicago, Ill.

417,055. Secondary battery; Chas. H. Logan, Toronto, Ontario, Canada.

417,075. Electric gas lighter; Nelson Newman, Springfield, Ill.

417,088. Method of preparing electrodes for secondary batteries; James K. Pumpelly, Chicago, Ill.

417,089. Compound dynamo-electric machine; Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place.

417,095. Electric conductor; John J. Saville and James H. Winspear, Omaha, Neb.

417,117. Electric indicator for grain bins; Adrial C. Thompson and Horace E. Newton, Quelly Center, Neb.

417,120. Drop-switch for electric conductors; Chas. J. Van Depoele, Chicago, Ill.

417,121. System of switching for conduit electric railways; Chas. J. Van Depoele, Lynn, Mass.

417,122. System of supplying currents to electric railway systems; Chas. J. Van Depoele, Lynn Mass.

417,158. Secondary battery plate; Victor H. Ernst, Jersey City, N. J.

417,188. Electric danger alarm for railway block signals; James H. Hunter, New York, N. Y.

417,198. Electric gas lighter; Nelson Newman, Springfield, Ill.

It was announced recently that a Catholic church in this city was to be lighted by electricity, and the lamps were to be disposed wit' a view to giving unique effects. At a confer ence of priests, however, Archbishop Corrigan made a special request to the rectors that no electric lights be used in Catholic churches until their safety be clearly demonstrated.

The electric cars in use in various cities are believed to be a great help to people afflicted with chronic rheumatism.

President Bates, of the Accumulator Co., says his company received the only gold medal for accumulators at the Paris Exposition.

OBITUARY.

Edward Nicoll Dickerson, a widely-known and eminent member of the bar of New York, died December 13, at his residence in Far Rockaway, L. I., at the age of sixty-five. Mr. Dickerson was one of the most prominent and successful patent attorneys and advocates of the country, and was associated with Mr. Storrow in the famous American Bell Telephone cases. At the time of his death Mr. Dickerson was vice-president of the Electric Club of this city, and had recently delivered a very interesting lecture before the club on the steam engine.

DEATH OF M. W. GOODYEAR.

Miles Watt Goodyear, one of the best known men in the electrical trade in this city, died suddenly of heart disease, on December 15th. Although he had been in poor health for some time, no one ever expected so sudden a termination of his life, and the shock to his friends was great.

Mr. Goodyear had been for over 20 years connected with electrical work and electrical manufacture, commencing with L. G. Tillotson & Company, and remaining with the company when it was changed to The E. S. Greeley & Company, as manager of the electrical department. The deceased leaves a widow, and a daughter aged 19. There will be universal regret in electrical circles over the untimely death of Mr. Goodyear, who was generally liked, and numbered his friends by the score.

Deceased was about 50 years of age, and a prominent Mason. He was also one of the founders of the Electric Club, being a member of the board of managers of the club since its organization in 1886. One of the most distressing features of Mr. Goodyear's death was the disgraceful and shameless manner in which certain of the daily journals in this city jumped at conclusions, which were subsequently proven unfounded, detailing the alleged circumstances of his death. It is one of the most cowardly traits of man to defame and tarnish the character of another after he is dead and powerless to defend his good name. How the editors of reputable journals permit such slanderous stories to be published without question is a mystery.

It is a deplorable state of affairs that a man's character should be blackened for mercenary considerations. This is true in this case as in hundreds of others. When a daily paper is made the instrument of defamation of character, the editor becomes liable for damages Several papers have retracted what was published in connection with Mr. Goodyear's death. One morning journal, however, *The Press*, has not yet summoned up sufficient courage to publicly acknowledge, in an honorable manner, the error made. Such dishonorable practices on the part of many newspapers cannot be too severely condemned, and we speak for a large clientage in the electrical profession when we enter this, our protest against this last act of disgrace—

> "Man's inhumanity to man
> Makes countless thousands mourn."

STAMPING LETTERS BY ELECTRICITY. —A new letter-stamping machine has been put on trial in the Philadelphia Post-office. It is run by electricity, will cancel about 25,000 letters an hour, and has a register that keeps count of each letter stamped. This machine may do away with the services of a few stampers.

Phonographs are to be put in the post-offices of Mexico, to be used by persons unable to write, in order to send messages to friends through the mails.

Malone Wheless of Washington, D. C., has invented a new electric system which is now being experimented with at the Capitol.

ELECTRICITY IN THE CENSUS.

Robert P. Porter, superintendent of the census, has issued a circular relating to electrical industries. After speaking of the appointment of A. R. Foote as special agent to take charge of the department of electricity, the superintendent says:

It is the purpose of this office, without seeking data which may be irrelevant or unimportant, to make the statistics of this industry complete and accurate, so that its real condition and true importance may be known and understood by the general public.

All persons to whom inquiries may be addressed are assured that the requirements of law, that answers to census inquiries shall be treated as strictly confidential, will be faithfully observed; each employé of the census office specifically makes oath not to disclose improperly that which he ascertains, and severe penalties are imposed for a violation of the obligations to secrecy. Consequently, all persons addressed may have confidence that their compliance with the requests for information as to certain details of their business will in no case be followed, either in the report of the special agent or in the tabulation of results, by the disclosure of matters which they properly desire to withhold from publicity.

The census for 1880 makes no mention of the industry of generating and distributing, from central stations, electric currents for the uses of light and power. The investigation of this industry for the eleventh census will be the first official census report made on the subject in this or any other country.

ELECTRIC LIGHTS FOR CHINA.—The unexpected arrival of two distinguished Chinamen among their countrymen in New York has created a sensation in Chinatown. They are Wong and Fong, both middle-aged men, and they were sent here, it is said, by a wealthy syndicate of Canton merchants to buy electric light plants for the Empire of China. Wong and Fong told a reporter recently that the sydicate has secured a ninety years' contract with the Imperial Government to furnish all the public buildings and offices with electric light. It also owns the exclusive right to supply the rest of the empire with the light. Wong and Fong are stockholders in this new enterprise and came here to purchase the necessary machines to supply only the largest cities of China, Hong Kong, Foo Chow, Shanghai, Nanking, Hankow, Ning Po, Tientsin and Pekin. They brought a large bill of credit with them to the rich firm of Wing Wah Chong & Co., importers.

THE OVERHEAD ELECTRIC LIGHT WIRE QUESTION. —In Cleveland, Ohio, and Minneapolis, Minn., as well as in New York city, the overhead electric light wire question holds the attention of the citizens. In Cleveland the authorities are forcing the settlement of the matter by chopping down the poles and destroying the lines. In Minneapolis, however, there is a disposition on the part of the authorities to regard the rights of the electric light companies.

A press dispatch from Pittsburgh, Pa., says: A new system of electric arc lighting has just been invented by the Westinghouse Electric Company, and will be exhibited for the first time on the streets here within a few days. The system is an entire departure in many respects from any arc light apparatus existing. The dynamo differs materially from other arc-light machines, and has special improvements in the way of safety, economy and efficiency. The present arc-lamp carbon will not burn more than ten hours. The new Westinghouse lamp will last forty hours, or about three nights. There is also a safety device connected with the lamp which allows a person to touch the wires anywhere without giving anybody a shock.

ELECTRIC LIGHTING IN MEXICO.

Mr. Theo. Plate, President of the Interstate Gas and Water-Works Co., of St. Louis, has recently secured franchises extending over long terms of years for erecting and operating incandescent electric light plants in the cities of Durango and Aguas Calientes, Old Mexico. In both cases the franchises are accompanied with contracts for lighting the streets and other public places. In Durango, the authorities use 200 32-candle power lights, and 150 16-candle power lights, and at Aguas Calientes, 150 32-candle power lights and 175 16-candle power lights. These lights are to be operated in the neighborhood of 240 hours per month. The Heisler System of Long Distance Incandescent Lighting has been adopted for these plants, and orders have been placed with the St. Louis office of the company for complete outfits of central station apparatus. The plants will be models in every way, and on account of the high cost of fuel, compound condensing engines of the high speed type will be used. The plants are to be in operation in time for the annual festas, which take place early in the spring. Mr. Plate and his engineer, Mr. Andrews, left for Mexico on the evening of the 21st of Dec. to begin active operations.

WABASH, Ind.—It will be remembered that the city of Wabash, Ind, was among the first to adopt the plan of lighting by arc lights on towers. This system was a few years ago displaced by the Heisler Incandescent System, and the lights distributed all over the city. For some time this plant was operated solely for public and domestic lighting, but a demand having sprung up for incandescent lights for commercial and domestic lighting, the company has decided to make considerable enlargements and have placed their order with the Heisler Electric Light Co., of St. Louis, for one of their latest improved dynamos, having a capacity of 350-32 C. P. lights.

HOLDEN, Mo.—The City Council of Holden, Mo., has granted a franchise for electric lighting to Mr. Theo. Plate, president of the Holden Water Company. The franchise extends for a long term of years and includes a contract for 32-candle power lights. The plant will be operated in connection with the water-works. Orders for the necessary electrical apparatus have been placed with the Heisler Electric Light Co., of St. Louis, whose long-distance system will be used. It is intended to have the plant in operation by the middle of December.

Superintendent Morris Mead, of the city bureau of electricity, Pittsburgh, Pa., is completing a system of signals whereby the entire police force can be instantly notified of an alarm. The signals consist of a flash of light at night and semaphore arms for use during the day. One of these signals will be erected in a few days at the corner of Seventh Street and Duquesne way, where it will be given a practical test. By the use of this system it will greatly lessen the escape of people who desire to leave the city after committing crime.

Mr. A. A. Knudson, the well-known electrician, formerly of this city, but now of St John, N. B., suggests for a feature of the World's Fair a sort of modern and American edition of the hanging-gardens of Babylon, with a horseshoe-shaped waterfall 160 feet high, the height of Niagara, pouring from one of its sides. Electricity is to bear an important part in the scheme.

The Heisler Electric Co., of St. Louis, have decided to change their standard lamps from 30 to 32-candle power, and from 15 to 16-candle power, thus falling in line with other manufacturers in this respect.

A crossed woman is nearly as dangerous as a crossed electric wire.

CONTINUED FROM PAGE 5.

HAROLD P. BROWN,

ELECTRICAL EXPERT AND ELECTRICAL ENGINEER, 45 WALL STREET, NEW YORK.

In reply to your questions will say :

1. Over-head electric light lines for arc light currents can be made reliably safe for the general public up to at least 2,000 volts by

(*a*). Using separately excited dynamos.

(*b*). Using a ground detector, which will indicate the slightest leakage above 5 per cent. of above maximum.

(*c*). Using a complete system of guard wires which will prevent any chance of contact between the lighting circuits and other lines in case of any sagging, swaying or breaking.

From many tests I believe that the high tension alternating current lines cannot be made safe above ground in wet weather. This is not a question of insulation but of induction. Under ground work in metal tubes simply intensifies this trouble. The arc lighting companies have made a great mistake in allowing themselves to be classed by the public with this dangerous current.

2. I know of no insulation that will absolutely prevent escape of current for any long period; constant testing and repairing of defective points is the only safeguard for overhead arc light circuits.

3. The system used in Chicago seems to me to be the most promising for under ground work, using an insulating material for the conduit itself. I do not believe in metal-protected wires for high pressures and especially not with undulating or alternating currents.

4. Putting the wires under ground would simply intensify the danger in the use of the high tension alternating current.

5. Safety to the general public can be secured by adopting suggestions *a*, *b* and *c* for arc circuits; limiting the pressure for continuous currents to 2,000 volts; limiting the pressure of the alternating current to 300 volts; putting as many of the wires as possible under ground in crowded cities, and promptly discharging any employee who grows careless in his handling of high pressure circuits.

6. By abolishing the grounding of any light or power circuit of more than 100 volts, and arranging suitable fuses on both ends of all other circuits for electric service.

P. B. DELANY,

ELECTRICAL ENGINEER, 34 BROAD ST., NEW YORK.

As I am the inventor of a system of insulation designed to overcome the difficulties heretofore existing in the way of distribution of high pressure currents, I must ask you to excuse me from answering your questions, as categorically put forth in your circular.

Speaking generally, I do not think that safety and economy combined can be realized in an overhead lighting system, in large cities.

It is my belief that the current pressure which has been causing so much trouble in this city of late can be safely and economically conducted under ground. Safety for life and property is all that concerns the general public. If the authorities will attend to these important considerations, all other questions will settle themselves, as they are purely commercial.

ELIHU THOMSON,

ELECTRICIAN, LYNN, MASS.

In my opinion very many of the accidents so-called, which have been attributed to electric lighting are due to gross carelessness and recklessness, and in some cases the carelessness of the victim of the accident, or ignorance combined with carelessness. There are still people who blow out the gas and become suffocated, and this character of accident, if it may so be called, is very similar to what occurs in electric work in some cases. Such accidents are difficult indeed to prevent. Many others, however, are due to faulty installation and faulty superintendence, and could no doubt be prevented.

ELECTRIC LIGHT DISCUSSIONS.

BY WM. HOCHHAUSEN.

In reference to your circular submitted, which I have answered elsewhere, I might add that it is not easy to give an unqualified answer to your questions. Wires strung over head or under ground can be made reasonably safe if enough money is spent for the purpose. Owing to close and fierce competition the tendency has been to put up the circuits in the cheapest possible manner.

When the question of fire risks on electric installations was brought before the New York Board of Fire Underwriters, that body came to the conclusion that the wires should be covered with a fire-proof insulation to make them safe, disregarding the fact that water, not fire, causes all the trouble that may be experienced with electric circuits.

A number of differently insulated wires were submitted to the Board and preference given to a wire which was covered by an insulation that could not be made to burn with a flame, but which would take up moisture like a sponge. As it was necessary to defer to the wishes of the Insurance people on this matter, a great many circuits were constructed with this, so-called, Underwriters wire.

These circuits are not safer than those made of naked copper wire would be, except when the air surrounding them is absolutely dry. If wires with a thin rubber coating are used and this coating protected from mechanical injury by a heavy coating of strong vegetable fibre, made waterproof, no trouble need be expected.

A coating of rubber 1-16 of an inch thick, will resist an electric pressure capable of driving a spark through a clear airspace of 2 inches.

The wires should be insulated with as much care as is bestowed on a submarine cable and they should receive as much care during the process of stringing up, so that the covering is not injured by abrasion.

Pulling wires into underground ducts by main force is not conducive to this reliability.

Mr. Samuel M. Plush, general manager of the Bell Telephone Co. of Philadelphia, writes as follows :

There is little doubt but that these questions will give rise to considerable discussion, which must result, in the end, in eliciting many facts which, although familiar to all, are in the present confused state of affairs, entirely overlooked.

The Richter Electric Construction Company gave a very interesting exhibition of their new system of electric railways at their headquarters, 18 Cortlandt street, on Tuesday, December 10th. About one hundred feet of track had been constructed, on which a miniature car was run. There are a great many features about this system that were shown to advantage. The current from the dynamo that propels the car is also used for lighting the car with incandescent lamps, and the route with arc lights. By the means of an electric brake and a generator placed in the cars, they are also heated. Another good feature connected with this system is a sweeper placed in front of each car which keeps the conduits always clean and clear of all obstruction. Resistance boxes, placed about five hundred feet apart along the route, avoids all possibility of short circuiting the line. Mr. Charles Richter, the inventor, and General Manager Walton were kept busy explaining the merits of their system, which they did to the entire satisfaction of all present.

The Richter Electric Construction Company is comparatively a new concern, having been organized but a short time; but Mr. Charles Richter, after whom the company is named, has been identified with the construction of dynamos and motors for about ten years, and in that particular department of enterprise he stands exceedingly high. The company became incorporated on August 21, 1889. The general manager is Mr Frank R. Walton, and other prominent gentlemen are identified with it, both in New York and Philadelphia.

ADJUSTABLE SUPPORT FOR SWINGING LAMPS.

Mr. L. F. Jordan, of 133 Oliver street, Boston, Mass., has just been granted a patent for an adjustable support for swinging lamps. The accompanying cut gives an excellent idea of the apparatus in place with lamps attached. It consists of a base piece, into the top of which are secured two upright tubular columns, their tops being united by a cap piece which carries the supporting pivot for the yard-arm.

The yard-arm is of skeleton form and consists of two bearing pieces, carried one on each end of the supporting pivot and outside of the cap piece, two arms extending outward side by side, and joined at their outer end by a cross-bar which supports the swinging lamp, and a pair of extension bars extending outward in the opposite direction and forming supports for counter weights. This arm may for increased strength be reinforced by a truss rod, if necessary, extending as shown in the figure, from the lamp to the counterweight and passing over an arched brace which rests upon the ends of the supporting pivot.



ADJUSTABLE SUPPORT FOR SWINGING LAMPS.

In order that the lamp, which is to be carried at the end of the yard-arm, may be lowered to within a convenient reach of a workman for necessary repairs and for cleaning, the yard-arm with its bearing pieces is made rigid with the pivot at the top of the mast so that any motion of the pivot will impart a similar motion to the arm. A sprocket wheel is keyed to this pivot, as seen in the figure, and over this passes an endless chain, extending down the tubular columns or supports to within an easy reach of the workman, and is there operated by passing around a second sprocket wheel, mounted in the mast and provided with a crank for turning it.

The sprocket wheels and chain are entirely enclosed in the hollow standards, which thus afford not only a housing for them but bearings for the axles of the wheels. Both the cap piece and the lower part containing the sporcket wheel are made in two sections for convenience and bolted together.

With this mast arm for supporting arc lamps, it is not necessary for the trimmer to climb the pole, a feature which will readily be recognized as an economical one for the central station having a large number of arc lamps which must be trimmed and cared for each day. The workman will also have the advantage of standing upon solid ground while making any necessary repairs.

The New York Electric Club passed suitable resolutions on the death of Vice President E. N. Dickerson and Miles W. Goodyear.

NEW ENGLAND LETTER.

BOSTON, Dec. 2, 1889.

The superiority of the electric street car to the horse car during a snow storm was practically demonstrated in this city on the occasion of the recent heavy fall, Dec. 14. By the aid of the four new snow sweepers recently designed especially for the West End Street Railway Company, and completed just in time to be put into service on the above date, the tracks were kept clean, and the cars ran as smoothly as on a clear summer day. The evident preference for this mode of locomotion was evinced from the fact that the electrics were crowded all Saturday evening during the worst of the storm, the horse cars on the same lines receiving only the overflow from their newer rivals. The sweepers are run, like an ordinary motor car, by two 15-horse power motors, and weigh about twelve tons each. The brush, which is made of rattan, crosses the track diagonally at an angle of about 45 degrees, and is run by a 20-horse power motor, with a speed of 100 revolutions per minute. A common sight during the evening was a train of three cars, all filled with passengers, the forward car only equipped with the motor power and acting in the place of a locomotive to the train, towing the other heavily-loaded cars up a steep grade with the greatest ease. Before the winter is over 135 motor cars will be in operation in Boston. The company is preparing against any possible accident from the falling of wires in heavy storms by stringing guard wires along all the electric lines, and in the neighborhood of 20 miles of this guard wire has already been put up. A new device has been arranged for the company, whereby each trolley wire will be guarded by two No. 6 steel wires. All the work is being done thoroughly, and accidents so far have been, all things considered, exceedingly rare.

THE RAILWAY TRAIN DESPATCHERS' SIGNAL CO. has been formed in this city for the purpose of pushing an electrical device for notifying the train despatcher of any trouble existing on any point of the road. The signal also serves as a check upon both brakemen and conductors, when it is necessary to flag other trains, as the brakeman must ring in a signal from the rear of the train, while the conductor goes to one ahead and there rings, and by the use of a Morse telegraph key, may also send a code signal to the despatcher, informing him of the nature of the trouble and the help needed. The system is a simple one and comparatively inexpensive, and the company's prospects are apparently very good. The headquarters are at 113 Devonshire street; Mr. F. E. Atteaux is president, and Mr. Herbert Radclyffe, treasurer.

THE CHADWICK LEAD WORKS of this city, a company with unlimited capital, with Mr. J. H. Chadwick at its head, control a very valuable patented process for encasing electric wires and cables for telegraph, telephone, or light purposes, with lead. It is applicable to either aerial or underground wires, and the company claim to be able to cover the most delicate insulation without the slightest injury to the insulating material. By its use the wire is perfectly protected from rust or any form of corrosion, and its cost is saved many times over in the increased wear and durability obtained by its use.

THE REDDING ELECTRIC CO., of Boston, whose offices and salesrooms are at 48 Hanover street, are building up an enormous business in the several electric specialties which they manufacture and control. One of their most valuable patents is the Redding Electric Watchman's Register, the only one in the market which gives a plain, printed record. It is claimed that wherever it is used special reduction in the insurance rates are made, such is the value of the device as a safeguard. The electro-plating dynamos manufactured by the Redding Co., combine several valuable patents and are in many ways superior to anything of the kind manufactured. Their electro-mechanical gongs are the most reliable for the price of anything of the kind we have yet seen. The company also manufacture electric bells, burglar alarms, annunciators, batteries, and all electric supplies, and are rapidly extending their business in new directions.

CANTON, MASS.—An interesting case is now before the gas commissioners of the town of Canton. The Canton Electric Light Co., representing the Thomson-Houston interests, have made an appeal to that body from the decision of the selectmen granting the Blue Hill Electric Light Co., representing the Westinghouse interests, right to erect poles and string wires in the principal streets of the town. The appealing company have a capital of $30,000, and will push their claim of a better service at lower rates to the bitter end. The result is awaited with interest.

THE THOMSON-HOUSTON ELECTRIC CO. is making further extensive additions to its already enormous factory at Lynn. W. F. M.

USED DRAWBAUGH'S TELEPHONE IN 1873.—Examiner Ott, appointed to take testimony in the case of the Government against the Bell Telephone Company, heard James Brooks, of Shiremanstown, near the home of old Daniel Drawbaugh, who testified that he saw and used a telephone at Drawbaugh's house in 1873 or 1874.

WASHINGTON WIRES TO BE BURIED.—Among the provisions of the District of Columbia Appropriation bill favorably reported, was one authorizing the commissioners to grant permission to companies to lay underground telephone, telegraph and electric light wires, and after the termination of the Fifty-first Congress a license fee of $25 per pole per annum is to be levied.

It is claimed that in London the great electrician Ferranti has in operation a 2,000-light incandescent station, using 2,400 volts alternating current, and is installing a new station with a dynamo capacity of 240,000 incandescent lamps, using an alternating current of 10,000 volts.

KANSAS CITY ELECTRICAL ASSOCIATION.

On Dec. 14th the Kansas City Electrical Association was organized. The originators of the society were Mr. D. K. Smith, superintendent of telegraph of the Belt Line Railway, and D. A. Williams, of the Western Union. The meeting was called to order by Mr. W. W. Smith, general manager of the Missouri and Kansas Telephone Company, who was nominated and elected temporary chairman. Mr. Woodring, formerly chief operator for the Western Union in that city, in a brief address suggested that the formula of the Magnetic Club of New York be followed to a certain extent. After a few short and impromptu talks relative to the object of the association, the following officers were put in nomination and elected: President, W. W. Smith; vice-president, H. C. Sprague; second vice-president, G. W. Brownson; A. M. Barton, secretary, and F. K. Holtzinger, treasurer. On motion put and carried initiation fees were fixed at $2.00, and monthly dues at 25 cents. When the Association gets under fair headway, all kinds of electrical apparatus will be placed on exhibition. Newspapers and magazines pertaining to electrical affairs will also be placed on file. It was decided to incorporate social features as one of the attractions of the society. Next September the old-timers and military telegraphers will meet in Kansas City, at which time Thomas A. Edison and Andrew Carnegie are expected to be present. The entertainment committee of the society will take care of these distinguished lights of the electrical world in a manner befitting the occasion. Among the notable telegraph people in attendance were: F. K. Holtzinger, manager, and A. D. Fairo, assistant chief operator of the Postal Telegraph Company; M. D. Wood, manager; G. W. Brownson, chief operator; H. M. Scholes, assistant chief operator; D. E. Martyn, night chief; C. E. Bacmeister, all-night chief; P. F. Depew, traffic chief, and W. Wood, Wheatstone chief, from the Western Union; Mr. Gamp, of the Electric Light Co.; A. M. Barron, general manager of the "Home Telegraph Co.," and many other well-known and prominent people engaged in electrical affairs.

EXCELLENT WORK IN WIRING.

The new building of Bernheimer & Bauer, corner 3d and Mercer sts., has been wired throughout for incandescent lighting, by Messrs Zimdars & Hunt, of 237 Mercer street, New York City.

The wiring is all on the outside of the plaster incased in moulding, which runs the entire length of the building. Each circuit is run direct to the cut outs, which are located in the centre of the building.

The central point of distribution is on the second floor, from which all the circuits in the building can be controlled, independently of their individual cut outs. There are 240 outlets and 550 lamps.

The wire used throughout is that known as the New York Insulated Company's "White Core." The gauge of the wire used for the heaviest circuit is No. 6 and for the lightest No. 10.

The excellent quality of the insulation used on the "White Core" wire is so well known that it is hardly necessary to enlarge upon it here.

These wires are as near being absolutely perfect in point of insulation as it is possible to make them, and the large demand for these goods is ample evidence of the high standard which they have attained.

With regard to good workmanship and perfect distribution of the wires Messrs. Zimdars and Hunt have evidently realized the importance of good installation, without which the best insulated wires would be useless.

The building is fed by two pairs of No. 00 wire. The two wire system is adopted. The feeders enter the building in the basement under the sidewalk, where the converters are located. These are enclosed in a small brick chamber which is perfectly fire proof. This ensures absolute protection against fire in the event of derangement of any of the circuits.

We understand that the firm has been instructed by the Manhattan Electric Light Co. to fit up this building with a view of making it a model of incandescent lighting, and with their reputation and perfect familiarity with the subject to back them there is no doubt that it is so in every respect.

One of the features in this new building is the pneumatic bell system of which Messrs. Zindars & Hunt are the patentees, and which is worked entirely without wires or batteries. It is fitted up throughout the building including the two elevators.

The great success of the pneumatic bell for such purposes has been so thoroughly demonstrated during the last five years that it is gradually superseding the electric system.

ACCIDENT TO AN ELECTRIC LIGHT LINEMAN.

Daniel Montague, a lineman in the employ of the United States Illuminating Company, fell from the top of a pole, at the corner of Warren street and Broadway, on the 16th of December, and received very severe injuries, from which it is doubtful if he will recover. He was one of a gang engaged in going in advance of the city's wire destroyers to take down the company's wires to save them from utter destruction and ruin by the employés of the city. While thus employed a cross-arm, on which he was standing, snapped off close to the pole, and he was precipitated to the sidewalk, striking on the side of his head.

Mr. E. H. Johnson has resigned his position with the Sprague Electric Railway and Motor Company to accept the presidency of the Interior Electric Conduit Company of New York.

The Interior Electrical Conduit Company, of 154 and 156 West 27th street, New York, has just issued a new catalogue and price list of the goods manufactured by this company. The catalogue is fully illustrated, and can be had on application at the above address.

SEEING TO A DISTANCE BY ELECTRICITY.

A correspondent of *La Lumiere Electrique* thus comments upon M. L. Weiller's paper which appears in *Le Génie Civil*, vol. xv., p 573:

The writer endeavors to solve the important question of vision to a distance by electricity, by means of a combination consisting of a selenium cell, a gas telephone and revolving mirrors, forming a special apparatus which he designates a phoroscope, and which we will briefly discuss.

The question of vision to a distance by electricity is governed by the two following fundamental principles. In order to get the impression of the form, outlines and details of one or several objects, it is not necessary—1. That the eye should receive all the rays proceeding from it. 2. That it should receive at the same time, the luminous rays necessary for vision.

Some very simple examples will demonstrate the first principle. We can see an object very clearly through wire gauze, and the image is perfect if the interstices are large and the wire fine. Carpets and mosaic seen at a certain distance do not seem to be formed of a number of parallel lines, or by the juxtaposition of little stones. An engraving, a picture, and especially a chromo-lithograph, show at a distance no discontinuity in the work, although the engraving is composed of lines and the chromo-lithograph of separate little dots.

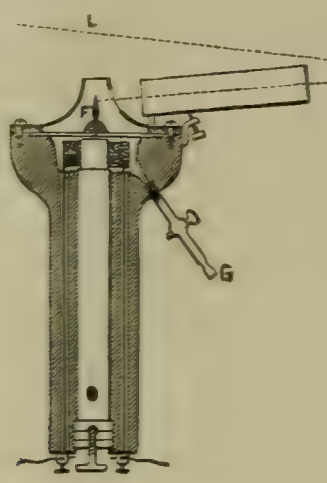


FIG. 1.

L, lunette. F, flame; G, gas; G, glass.

We see thus that it is possible to have a sufficiently clear perception of an object by the vision of a system of more or less luminous lines forming a kind of pattern.

The second principle is quite as well-known and as deduced from the duration of the luminous impressions upon the retina, a period of about $\frac{1}{10}$th of a second.

A series of impressions succeeding one another in a very short time produces the effect of simultaneous impressions, and it follows that in order to perceive the image which we have called the pattern, it is sufficient to receive the luminous impressions of the different lines that constitute it in an interval of time less than $\frac{1}{10}$th of a second.

It was by taking this principle as a basis, that Lissajons studied from an optical point of view the vibratory movements of bodies. His experiments are so well known that we need not enter into them here. Lissajons' curves are produced in a rectangular portion of a picture If, on the other hand, this object possesses the power of lighting, all the rays proceeding from the space occupied by the curve will, in an excessively short space of time, converge at one point after having been subjected to a double reflection on the mirrors of the two tuning forks that were employed for this experiment.

We may substitute for these forks any movable system whatever, bearing a series of mirrors arranged in such a manner that the displacement of each of them brings upon the same straight line all the rays projected from a portion of an illuminated object. Let us suppose these mirrors to be placed on a circle turning upon an axis perpendicular to its plane, and each of them making a different angle near 90° with this plane. To each mirror there will be a corresponding series of parallel lines in the picture, and if the rotation is sufficiently rapid all the rays proceeding from the object represented in the picture will meet at the same time, in as short an interval of time as required. It is thus possible to bring to one point all the luminous rays proceeding from a pattern, and each portion of the image thus producing its impression upon the retina in succession, it is sufficient that the interval in which these impressions succeed one another, should be sufficiently short for them to be rendered simultaneous.

The transformation of the luminous waves into electric currents is performed by means of a radiophonic receiver forming part of an electric circuit. This receiver may be a cell of selenium lamp-black, hydrogenated palladium, etc., the resistance of which varies with the quantity of light received. The different portions of the pattern will act differently according to the quantity of light emanating from them and in an interval of time less than $\frac{1}{10}$th of a second; the variations of resistance of the circuit will correspond to the image observed.

In order to solve the opposite problem, *i. e.*, to extract this image from the circuit at the receiving station, the writer proposes to employ

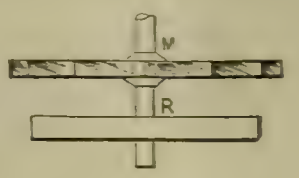


FIG. 2.

M, mirrors; R, regulator, 30 revolutions per second. 300 glasses on the side instead of 10.

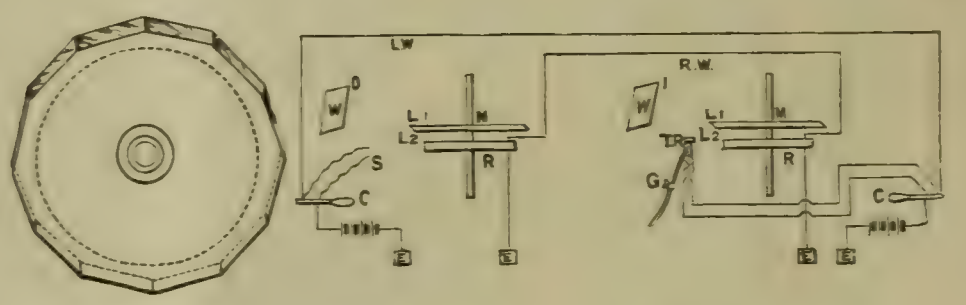


FIG. 3.

L W., line wire; R. W., regulator wire; L1, L2, lenses; M, mirrors; R, regulators; O, object; I, image; S, selenium cell; C, commutators; G, gas; T. R., telephone receiver; E, earth.

the gas telephone, which is an instrument of extreme sensitiveness. It consists of an ordinary telephone (fig. 1) in which the portion comprised between the plate, bobbin and the inner sides is in communication with a gas pipe; the vibrating membrane is pierced in the centre with a little hole, through which escapes the gas which is lighted; this little flame will undergo a variation of brilliancy at each movement of the membrane, and it will produce a continuous succession of rays similar to those arriving upon the radiophonic receiver. In order to show them and form an image similar to the pattern, a system of mirrors is employed (fig. 2) similar to that used at the first station, but acting in the reverse way. It is evident that these two apparatus must act synchronically like the Hughes and Baudot regulators employed in telegraphy.

Station 2 will reproduce upon a sheet the lines taken upon the image at station 1.

The writer gives the name of phoroscope to an apparatus of this description, the different parts which we have described being combined according to the plan shown in fig. 3. The image that we wish to transmit is broken up into a series of parallel lines, the different points of which act in succession upon a selenium cell making the intensity of the current connecting the two stations vary. These variations in electrical intensity are transformed by the gas telephone into variations of luminous intensity, and the successive changes of brilliancy of the little flame are projected upon a sheet at points corresponding to the various points of this sheet.

Theoretically, nothing can prevent the double transformation of luminous intensity into electric intensity, but the realization of the experiment is surrounded with difficulties which make us fear that it will be long before a practical phoroscope is produced, but this should not discourage enterprising and persevering physicists.

A Victory for the Brush Company.—On Dec. 25, at Indianapolis, Ind., Judge Gresham decided a case of general interest to those connected with electrical matters. It was a suit brought by the Brush Electric Company of Cleveland against the Fort Wayne Electric Light Company for infringing the Brush patent upon the so-called double carbon lamp. The case has been vigorously prosecuted and defended, and has been pending about three years. All of the claims of the Brush patents are sustained. The patent was attacked by the defense mainly upon the grounds that its claims were too broad and sweeping. Electric lamps controlled by this patent are in use throughout this country and in fact, the world over wherever street lighting by electricity is had.

At Troy, N. Y., a temporary injunction has been granted to the Hudson River Telephone Company against the Watervliet Turnpike and Railway Company. The telephone company seeks to restrain the railroad company from operating its cars by the single-trolley electric system. A motion to make the injunction permanent will be argued at a special term.

The John A. Roebling's Sons Company has accepted the agency for McIntire's electric wire connectors and terminals.

A New Insulating Substance.—A product resulting from the treatment of asphalt with sulphuric acid, which has hitherto been considered of no value, has, says *La Lumière Electrique*, been found to furnish an excellent insulating material. This substance, which resembles ordinary asphalt, becomes, after exposure to great heat, as hard as ebonite or vulcanite and possesses high insulating properties.

At a special meeting of stockholders of the Thomson-Houston Electric Light Company, at Middletown, Connecticut, Dec. 22d, it was voted to increase the preferred stock $3,500,000, making a total of $4,000,000 preferred stock and a total capitalization of $8,500,000. The price will be decided by the Board of Directors.

The big engine at the Montpelier (Vt.) Electric Light Works is now in running order. A coffer-dam is being built in the Winooski River to assist in setting up the new water wheel. The new dynamos are being placed.

William E. Gilmore has been appointed secretary of the United Edison Manufacturing Co., vice Hutchinson, who is now assistant general manager of Bergmann & Co.

The Westinghouse Machine Co. is to erect a brick and stone building in Pittsburgh, Pa. It will cost $40,000.

THE ESSICK PRINTING TELEGRAPH CO.

While in the office of the above company, at 169 Broadway, a few days since, we were a witness to the following transmission over a Boston circuit of the Empire and Bay State Telegraph Co., the circuit being worked at the New York end by Mr. Abner McKinley, the treasurer and general manager of the company, and at the Boston end by a young lady, neither of whom are conversant with Morse characters.

New York Dec 24.

Miss Mooar: Please send J. B. Taltavall, editor of the ELECTRIC AGE, a message. Do it up in fine shape. A. McKinley.

Boston, Mass., Dec. 24.

To J B. Taltavall, Esq., Editor ELECTRIC AGE: This is a specimen of the work of the Essick Page Printer over a single line of wire from Boston to New York, a distance of two hundred and eighty miles.

The instrument is an electrical type-writer, by means of which the message is printed in page form in the presence of the transmitting operator, and a duplicate is printed at all receiving stations on the line, whether the circuit be long or short.

If you were to place an Essick transmitter on the floor of the New York Stock Exchange, the quotations might be sent to all subscribers, whether in New York, Boston, Chicago, or at any other point in the circuit, by a single transmission. Yours truly,

N. E. Printing Telegraph Co.

[The above was in the form of typewriters.]

It is said that Miss Mooar has attained by this system a speed of 25 words per minute. The keyboard resembles that of a typewriter, and it is operated in much the same manner.

SING SING, Dec. 26.—The electrical execution machines at the State Prison were tested to-day by a committee for the State, composed of Dr. Carlos F. MacDonald, Dr. A. D. Rockwell, Dr. P. H. Laudy and electrical assistants.

The Grand Jury, Dec. 27, found an indictment for manslaughter against Charles W. Pierce, Superintendent of Lamps of the Brush Illuminating Company. He is charged with causing the death of Henry Harris, the Eighth avenue dry-goods clerk, who received a fatal shock from an electrical wire, Nov. 30.

Mr. E. T. Gilliland, president of the Electric Club of this city, has resigned on account of ill health. Mr. Gilliland goes south to recuperate. General O. E. Madden has been unanimously elected president to fill the unexpired term.

Jerome Hennessey, superintendent of Telegraphic Construction at San Juan del Norte, Nicaragua, committed suicide by shooting himself on November 22d. Hennessey had been suffering from fever for some time.

CATARRH,

CATARRHAL DEAFNESS—HAY FEVER.

A NEW HOME TREATMENT.

Sufferers are not generally aware that these diseases are contagious, or that they are due to the presence of living parasites in the lining membrane of the nose and eustachian tubes. Microscopic research, however, has proved this to be a fact, and the result of this discovery is that a simple remedy has been formulated whereby catarrh, catarrhal deafness and hay fever are permanently cured in from one to three simple applications made at home by the patient once in two weeks. N. B.—This treatment is not a snuff or an ointment; both have been discarded by reputable physicians as injurious. A pamphlet explaining this new treatment is sent free on receipt of stamp to pay postage, by A. H. Dixon & Son, 337 and 339 West King St., Toronto, Canada. —*Christian Advocate.*

Sufferers from Catarrhal troubles should carefully read the above.

The United States Electric Lighting Company of Washington has recently authorized an increase of its capital stock from $500,000 to $700,000 Notwithstanding the extraordinary outlay which the company has been compelled to make in changing its lines from poles to conduits, it has continued to pay six per cent. dividends. It is expected that a large increase in the number of public street lights will be made, provided legislation permitting the necessary extension of underground wires is not impeded. About six miles of streets are now lighted by arc lamps which have displaced 460 gas-lamps. Owing to the natural growth of the city, the improvement of new streets, and the education of the people up to a higher standard of illumination, the number of gas-lamps has not decreased. The number now in use is 5,500. The local company is making strong efforts to secure contracts for lighting the more important government buildings, while isolated plant advocates are not unmindful of the advantages which may be gained from active work in that direction.

A POSTAL TELEGRAPH BILL.—Mr. Cullom of Illinois, in the Senate, and Mr. Bingham of Pennsylvania, in the House, have brought in a bill establishing a postal telegraph service. The measure authorizes the Postmaster-General to contract with any existing telegraph company for the use of its lines for postal messages between free-delivery offices. The Postmaster General is to decide the extent and location of the proposed service, and to fix the rates, which are to be prepaid by stamps. The telegraph messages are to be delivered by the regular carriers at the first mail delivery following and "at such other times as the Postmaster-General may direct."

The representative of the Westinghouse Electric Company in Texas, has secured a contract for alternating current apparatus for a central station plant of 500 lights capacity at McKinney, Tex. The Westinghouse Electric Company operates now fifteen central station plants in Texas.

Sacramento is having a fight with the local gas and electric light company over the moving of city lights. The municipal corporation threatens to put in a plant of its own if the local company refuses to move the masts as required by the city authorities.

The San Antonio and Aransas Pass Telegraph Company has been organized in San Antonio with a capital of $200,000. The officers of the new company are the same as those who manage and control the San Antonia and Aransas Pass Railway.

A new company with a capital stock of $10,000 has been incorporated to build a telegraph line from Mott, Siskiyan county, Cal., to the Oregon line, to be called the Eastern Union Telegraph Company.

Articles of incorporation have been issued to the Calumet and Michigan Telegraph Company, at Chicago, to construct and maintain a line for the transmission of all kinds of electric signals.

A brick, stone-trimmed electric light central station, at a cost of $30,000, is to be built for the Thomson-Houston Co. at Cincinnati, O.

Bay City, Mich., has an incandescent plant. A 1,000-light Thomson-Houston alternating dynamo has been installed and is giving satisfaction.

An electric light plant will be installed at Eureka Springs, Ark., by a St. Louis Gas Company. An incandescent system will be introduced.

Contracts have been awarded for machinery for an electric light plant at Eagle Pass, Tex., by a newly organized electric light company.

Col. S. H. Taylor has closed a contract with the Santa Rosa Thomson-Houston Electric Light Company for a 650-light alternating plant.

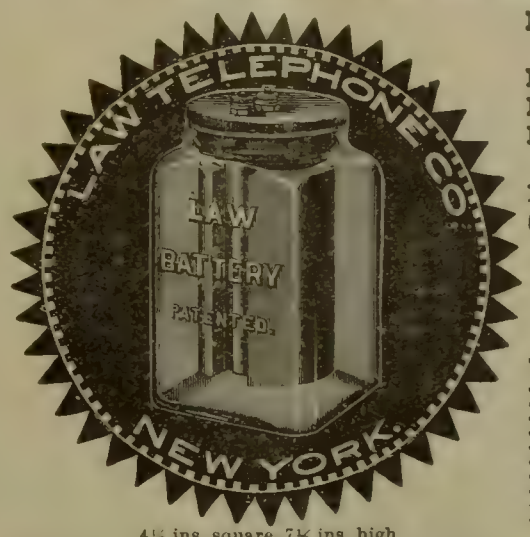
Santa Cruz., Cal., is now lighted by the incandescent system and there is general satisfaction therewith.

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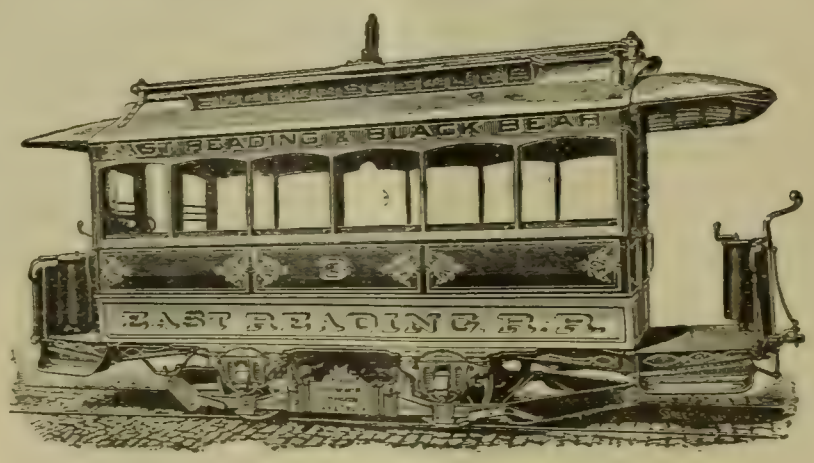
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NEW YORK, JANUARY 11, 1890.

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Mr. L. O. Weber, of the Edison Machine Works, Schenectady, N. Y., was in town last week.

Crookston, Minn., and Dowagiac, Mich., are about to establish an incandescent light plant for 750 lights each.

The cable steamer Faraday has repaired in mid-ocean one of the Western Union cables which were broken some time ago.

In this city during the year 1889 there were nine deaths from electric shock, and 80 persons were run over and killed by cars and wagons.

The Buckeye Engine Company, of Salem, Ohio, has received orders for a 60 horse-power engine from the Tokio Electric Light Company, of Tokio, Japan, to run an electric light plant.

The electrical commission in Cleveland, at a recent meeting, adopted a motion requiring that all wires hereafter run into buildings in that city shall enter through the roof or basement.

The Thomson-Houston Electric Company has secured a contract for equipping the Concord, N. H., street railway with motors. That system will be used for lighting in New Bedford.

It is expected that the plant of the Robinson-Foster Electric Motor Company at Peabody, Mass., recently sold to O. W. Norcross of Worcester for $9500, will be started soon, under the management of O. A. Foster of the old company.

Mr. Allen R. Foote, of Washington, D. C., says of THE ELECTRIC AGE: "A weekly issue indicates prosperity. I congratulate you. * * * I shall be greatly interested in watching the development you make on the subject of safe electric wires."

Surgeons are finding constantly increasing opportunities for making use of electricity in the service of their profession. It is said to be admirably adapted for the treatment of neuralgic pain, and its application in chronic cases is very beneficial.

There are seven dynamos now at work in the electric plant at Great Falls, N. H., and another is in readiness to be set up. The company has added to its schedule of prices some new rates, taking in lights burned only until six o'clock, and 20 and 25 candle-power incandescents.

At the sixth annual meeting of the American Historical Association held in Washington, D.C., December 28–31, a very interesting paper on "Correspondence of the Pelham Family and the Loss of Oswego to the British," was read by Hon. Wm. Henry Smith, general manager of The Associated Press.

Scientists anticipate that the recent discovery of a rich lode of uranium in Cornwall, Eng., will enable some very important applications of the metal to be followed up. Uranium may be used as a substitute for gold in electro plated ware. Moreover, because of its high electrical resistance, it is likely to be largely used in electric insulations.

The electric light station at Southington, Ct., has now a 75 horse-power Russell engine. The improved quality of the lights is very noticeable. Previously one engine was used for both tramway and lighting purposes, resulting in unsatisfactory light service. The company is thoroughly equipped now, and has a model plant.

In Paris, electric wires are laid under ground beneath the sidewalk, and not under the roadway as in New York. For some days the footpaths on the boulevards leading from the Madeleine to the Place de l'Opera have been confined to half their dimensions owing to the fact that trenches have again been dug for this purpose. Parisians are probably more systematic in tearing up their streets than we in New York, and the inconvenience incident thereto is likely small in comparison.

The efficiency of the dynamo to be used for the execution of murderers at Auburn, N. Y., was practically and successfully tested on Dec. 31. A commission of experts and representatives of the State and other interested parties conducted the tests. A horse and a calf were sacrificed in a most expeditious manner for the benefit of science and humanity. Both animals were killed instantly. A Dr. Fell was present with a patent contrivance to restore life to the calf, on the theory that electricity did not kill, but simply temporarily suspended animation. Dr. Fell's theory, however, proved to be a decidedly fallacious one, and he was compelled to yield to the fact that electricity does kill, and does its work instantly, when it is applied properly.

Herr Siemens, Germany's foremost electrician, publicly announces that America is in advance of that country in the matter of electrical inventions, and advises the promoters of the World's Electrical Exposition to be held in Frankfort, in June next, to postpone the exhibition for 18 months in order that the electrical disparity between the two countries may become "less startling." Our German friends have evidently had their attention diverted for a short period from their favorite pastime of increasing the army and placing it on a war footing in order to maintain peace, and during that interval the startling revelation has broken upon them that America is 18 months ahead of Germany in the electrical race. Herr Siemens evidently is in possession of the knowledge that German inventors are preparing a surprise in electricity, and that it will require about 18 months for the Fatherland to make a record in the electrical field. There must be something in store, or why should so eminent a scientist advise a postponement for a definite length of time? We think the exhibition ought to be held at the appointed time, as America does not intend to lag a moment in order to let Germany or any other country catch up with her. Americans are not built that way. We lead all other countries in electrical matters in general, and we propose to keep to the front, and let follow who may.

ELECTRIC STREET CARS IN LONDON.

A line of electric tramcars on the North Metropolitan Tramway at Barking Road, London, was recently opened. The road is about a mile and a half in length, and has several considerable gradients. Electricians are watching closely the operation of the new motive power, which so far has fulfilled every expectation of its promoters.

The old car shed has been transformed into a complete electrical power station. When a car comes in to change batteries, the side flaps are let down, the trays pulled out, and charged batteries put in—all in the space of three minutes, and the car is back again on the road in seven minutes. The charging is done at night for convenience.

The dynamo is of the Immisch type, and the motors used on the cars are by the same engineers.

The daily working expenses of these cars on the Barking road will eventually prove, it is claimed, that electric traction is more economical than horses. Already the North Metropolitan Tramway Company have applied for power to use electricity for traction purposes on the whole of their system.

An electric bell-buoy is proposed, one of its chief attributes being that the action of salt water produces a current sufficiently strong to ring a bell. A secondary bell, to be rung in rough weather, is also an attachment to the buoy.

The latest development of the electric light is likely to prove of great use for vehicular traffic. A small incandescent globe and reflector are placed on the forehead of a horse, insulated wires are carried along its body to a small battery stowed in the trailing vehicle. The current is turned on at pleasure, and an unmistakable blaze of light illumines the murky surroundings.

The city's wire destroyers having nearly annihilated electric light property in the city, excepting the dynamos and the titles of the different companies, have turned their attention to telegraph and telephone wires. How these wires become dangerous with electric light wires out of the way is known only to the Board of Electrical Control and the Commissioner of Public Works. These functionaries are, no doubt, enjoying the work of destruction.

It is with extreme gratification that we note the very hearty and general interest taken by electrical experts in the object of our circular recently sent out to these gentlemen on the subject of making electric light lines safe. The promptness with which the answers to our inquiries are given is unmistakable evidence of an earnest desire to further our efforts, and see the realization of the object in view, namely, rendering electric light wires safe to life and property. The daily press, which reflects public sentiment, has taken the subject up and has given it wide publicity. The press in this city gave the opinions in considerable detail, and an item sent by the Associated Press, and The United Press, found its way into the columns of hundreds of daily papers throughout every section of the United States.

The destruction of the Pearl street station of the Edison Company, in this City, on Thursday last, was not surprising, in view of the inflammable condition of the floors of the dynamo room. Apart from the little inconvenience caused to the users of the light supplied from this station, the loss will be more than counterbalanced by the experience gained. It is hardly necessary to say that such a disaster will not occur again. The Edison Company know full well the essential requirements of a perfect lighting plant and that a fire-proof building is one of them. The Pearl street station, however, was the first one established by this company, and the structure in which it was located was not built for the purpose, and probably was chosen under stress of necessity. The new station will, we are safe in saying, be a model of convenience, efficiency and safety.

DESTRUCTION OF EDISON'S PEARL STREET STATION.

On the morning of the 2d instant, the Edison Company's Lighting Station on Pearl-street, near Fulton, was completely destroyed by fire, involving, with adjoining property, a loss of $200,000. The fire started in the dynamo room, undoubtedly from sparks from one of the machines. Through some means the "load" on one of the dynamos was suddenly released, causing the machine to burn itself out. A circumstance of this sort is analogous to the pitching of a screw steamer at sea. The propeller makes the regular number of revolutions when immersed, but when the vessel pitches, and the wheel is thrown out of the water. the sudden release of the load causes the engine to "race" and do damage to itself and the ship, unless proper means are adopted to cut off the steam at the moment the wheel comes out of the water. This is similar to what occurred in the case of this dynamo. The sudden increase of speed and current destroyed the insulation and caused a shower of sparks. The building in which the plant was located was formerly a warehouse, with wooden floors. These during the course of years had become saturated with oil from the machines, etc., and, owing to its inflammable condition, the sparks instantly started the fire. It was about six o'clock when the fire broke out, and the engineer and other employés who were in the boiler room, hearing the crackling and spluttering of the machine, made haste to the dynamo room. This was in a blaze. So quickly had the fire spread on the oily floor, that the employés were compelled to beat a hasty retreat for their lives. It was nearly three hours before the fire was subdued.

This station supplied the current for 18,000 lights in the lower part of the city, but its destruction did not cause much inconvenience, as connection was very soon established with the auxiliary station at 60 Liberty-street. The supply from this latter station was directed, as far as possible, to giving light to those buildings where the loss of it would be most felt. While the fire was in progress, orders were sent to the company's factory at Schenectady for the immediate shipment of new dynamos, and necessary arrangements were made for the power to drive them. The boilers were not seriously damaged. It was said by the officers in charge of the station that a temporary plant would be in running order in a few days.

The Pearl-street station was the only one of the Edison plants that was not fire-proof, this being due, as before stated, to the fact that the building was an old warehouse adapted to the uses of an electric lighting station. All other stations of this company were built especially for the purpose, and made absolutely fire-proof, with stone floors, etc., consequently a fire in them is impossible.

Death of a Noted Physicist. — Prof. Luigi Pacinotti, well known in electrical circles, died recently in Pisa, Italy. As a scientist and mathematician he was celebrated in the scientific world. His name is intimately connected with electrical investigation through the "Pacinotti Ring." He was 82 years of age.

Mr. J. Harris Rogers is the inventor of a new system of rapid telegraphy. He employs an entirely new method of obtaining perfect synchronism at a very high rate of speed. This method, together with a new telegraphic code and transmitting and receiving mechanism, constitute his invention, and he has also added a simple and effective punching attachment to be applied to any type-writing machine, so that the messages may be written by a type-writer and simultaneously cut in the transmitting strip, the whole being combined into a system which can be operated by any person of ordinary intelligence at a speed far greater than that attained by any other system of telegraphy.

ELECTRIC CARS IN CLEVELAND.

The East Cleveland Street Railway Company has been assiduously extending the electric motor service on its lines for the past year, and it is now operating 40 cars. The cars are running 5,000 miles per day, and the time per trip has been reduced 20 per cent. The company has erected wires over 32 miles of track, and are now waiting to secure the necessary number of motors to put the complete system into operation. Compared with horse power there have been fewer accidents and injuries to persons on this line during the past year than during any like period heretofore. The length of the line is six miles, and there is a saving of 20 minutes per trip over horse power.

The Brooklyn Company is operating 30 motor cars, on 24 miles of wired track, running 3,000 miles per day, at an average saving in time of 20 per cent. per trip. The Broadway line has 16 motors in daily service, on 12 miles of wired track. The total run per day is 1,000 miles, with the same saving per trip as the other lines, and with double the seating capacity of horse cars.

The following from the Baltimore *Sun* will be of interest to those engaged in the stationary electric motor business: "Creditors and stockholders of the Baxter Electric Manufacturing & Motor Company of Baltimore, have completed negotiations for the organization of a new corporation and for continuing operations upon a strong basis. These negotiations have been in progress for months, and those interested in securing the results have had plenty of work. A year ago the old company executed a deed of trust and the concern has been continued under the receivers or by other arrangements in which the receivers were the advisers. An auction sale of the entire property and assets at receivers' sale took place on December 30 by J. Frank Morrison and Luther M. Reynolds, with Alfred J. Carr, attorney. The purchase by creditors and stockholders has stopped the receivers' sale, and the new company will be incorporated. Principals in securing the establishment of the new enterprise state that the corporation will be in the hands of men whose names as directors will be a guarantee of strength. A capital stock of $200,000, of which about $150,000 will be direct working capital, including material on hand, will give a good start, and as the business demands it more money will be forthcoming. Creditors will get stock for the amount of their claims, and the property passes into the possession of the new company free of incumbrance. These Baxter works are extensive in their proportions, and with the capital to develop the business they will become among the most important in the country. That capital is now understood to be forthcoming. Messrs. Deford, Bartlett, Hilles, Hight and other Baltimore business men are said to be interested in the reorganization.

Commissioner of Patents Mitchell, recently rendered a decision the effect of which will be of importance to electricians. It frequently happens that an inventor, after having made an application for a patent, applies for a patent on an improvement on the original before the latter has been granted. The Commissioner holds that where an application is detained in the office to contest priority, or for any other reason, not involving the inventor's own neglect to comply with the rules, and meanwhile the inventor applies for, and takes out, patents for an improvement upon the invention first applied for, the improvement patents referring to the earlier application and reserving the right to obtain a patent thereon, such intermediate patents do not bar the right to a patent upon the subject matter of the earlier application whenever the office is ready to grant the same.

Electric motors are attracting attention at St. Joseph, Mo, where they are being introduced in large numbers.

TANNING BY ELECTRICITY.

Groth's electrical tanning process has been in operation for some time at Messrs. Tebbit Brothers' factory, Bermondsey, and the experiments have been highly successful. By the new process sole leather is manufactured in one-sixth of the time required under the usual method of treatment, at a cost of 2½d. per lb., as against 4½d. on the old plan, while the saving in labor is estimated at 80 per cent. The hides are suspended on a frame in a large vat containing the ordinary oak bark solution, which frame is kept revolving by a steam engine. The engine also drives a dynamo connected with copper terminal plates placed at the side of the vat, and a constant current of electricity is maintained through the liquor, the action of the current being to effect a chemical union between the gelatinous tissues of hides and the tannic acid of the liquor in a comparatively short time.—*London Ironmongery.*

A Phonograph Ball.—The Carson (Nevada) wheelmen gave a phonograph ball on New Year's Eve. Between each dance Edison's perfected phonograph played delightful melodies. The guests of the club were able to listen to Schubert's serenade from Gilmore's band; selections from the popular operas by the First regiment band in San Francisco; a piano solo by Mrs. Louis Glass, San Francisco; a letter from Thomas Edison in London; a letter from Bill Nye; a recitation by George Bromley of San Francisco; the voices of Gen. Boulanger, P. T. Barnum, President Harrison, Levi P. Morton, Henry Grady, Gladstone, Parnell, Phœbe Davis and Mrs. Langtry. A receiver was arranged over the orchestra, and the music of the dance, including the shout of the caller and the shuffling of feet, was all faithfully recorded.

The Telephone in Japan.—The Mikado has had constructed, at the cost of the State, a line of telephone between Yokohama and Striznoka, a distance of about 100 miles. It is the first telephone applied to the public service in Japan, and has so far been completely successful.

A Phonographic Doll.—It is stated that Mr. Edison sent as a Christmas gift to Archduchess Elizabeth, daughter of the late Archduke Rudolph, Crown Prince of Austria, a phonographic doll, which talks a great deal and recites some verses.

A useful application of the telephone to military, railway and other purposes has been effected by a firm of telegraph engineers in Berlin. This apparatus is contained in a case 12 inches long by 6 inches wide and 8 inches deep, which, for general purposes, is slung by a strap in front of the user. The case contains a dry cell battery, a magnetic bell and an induction coil. In some instances where it is desirable that the sound of the bell should not be heard, the Neef hammer is substituted, and is used as a means of calling attention between the communicating parties. The case also contains a combined receiving and transmitting apparatus, which is fitted with a microphone as a transmitter, the apparatus being conveniently made for application to the ear and mouth. For field purposes, an outpost equipped with the apparatus proceeds to the front, his telephone being in communication by a wire with that of the field watch, the latter being again in communication with headquarters to the rear.

Mr. Sharpe, representing the Sprague Electric Company, was in Toledo, Ohio, recently, and accompanied by Superintendent Gilmartin and the city civil engineer, went over several of the principal streets traversed by the Consolidated Company with reference to the putting up of wires for the use of electricity.

CAN ELECTRIC CURRENTS BE MADE SAFE?

WHAT PROMINENT ELECTRICIANS HAVE TO SAY ON THE SUBJECT.

Recently, as stated in our last issue, we sent out a number of circulars containing a series of questions pertaining to the above subject, to prominent electricians throughout the country, and in the same issue many replies were given in detail. We give below the answers received since.

S. S. LEONARD,

ELECTRICAL EXPERT, GENERAL MANAGER MINNESOTA BRUSH ELECTRIC CO., MINNEAPOLIS, MINN.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—I think they can. 1st, by taking the utmost care in constructing; 2d, by subjecting them to a rigid, daily inspection; 3d, keeping off of buildings, as far as possible; 4th, by testing for grounds and crosses with a stronger current than that obtained from a magneto.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—This is somewhat diffiult to answer. Have seen circuits that showed no leakage when wet; a great deal of leakage may be prevented by using the same kind of wire as that used on the lines for tieing them to the glass; bare wires should never be used.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—Have had no experience. Seems to work very well in some places, while in others it don't.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—Some of them undoubtedly would, but think their places would be taken by new ones fully as great.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—Don't believe it can be entirely overcome, for as long as electricity or anything else is used that can kill, some one will be sacrificed on the altar of progression.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—Incandescent lights, safety fuses; for arc lights, switches that will cut current out of building completely.

WM. HOCHHAUSEN;

ELECTRICAL EXPERT, ELECTRICIAN EXCELSIOR ELECTRIC CO, NEW YORK.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes, if properly insulated and carefully fastened, and not allowed to deteriorate.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—A rubber coating protected aga.. mechanical injury by a water-proof covering of great strength.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—An iron-clad submarine cable is a reliable conductor under ground.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—No; the methods employed at present for putting wires under ground are not reliable.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—By removing all telegraph and telephone wires not in use (dead wires), and keeping up rigid and frequent inspection of all wires.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—Put a reliable cut-out in circuit before it enters the house.

F. W. JONES.

ELECTRICAL EXPERT.

F. W. Jones, Assistant General Manager and Electrician of the Postal Telegraph Cable Company, expresses his views on the general subject in a manner that demonstrates his perfect familiarity with and thorough technical knowledge of the important subject under discussion. He says:-

"As I am not directly in the business of electrical lighting or supply of power, it might be deemed supererogatory in me to venture opinions upon the subject at this time, when so much angry discussion is going on between interested parties.

"It seems to me to be a question to be settled properly by a competent board of electrical engineers not in the pay of the capitalists who are blindly pushing this system or that.

"Your questions as put cannot well be answered with much brevity and go to the bottom of the subject.

"The insulation resistance of an aerial or underground wire is not the same for 100 volts that it is for 1,000 volts, nor is it the same for 2,000 volts that it is for 1,000 volts. It is much less for the higher pressures. It therefore is a matter to be decided by intelligent electricians what insulation is necessary for safety in using high pressures.

"In the case of steam the Government of States and the United States employed capable engineers to formulate rules as to water-gauges, thickness of iron in boilers and water tubes, number of rivets, etc., and such rules are enforced by law. No limit is put on the use of steam pressure so long as conditions of safety are observed.

"The introduction of electricity for light and power commenced in earnest in 1880, and capitalists exploited all kinds of systems to ascertain if they could be made commercially and financially successful. Lack of capital, electrical knowledge, and the eagerness of everybody to go into a new business, resulted in very defective appliances.

"New York City secured the passage of State laws to control the use of wires in the city, and has three politicians appointed to regulate all electrical wires. No such laws were passed as already appertain to the use of steam. The various electric light companies were invited to occupy the streets and bridges to give a better and greater street illumination than had been done by the gas companies, and the latter were driven from the streets. It turns out that the electrical light companies failed to keep their wires within the bounds of safety, and a loss of life occurred. The Press takes advantage of the situation to fan the flame of public sentiment into a frenzy, and the machinery of the city is set to work to destroy without discrimination the expensive wires which occupied its streets through the permission and invitation of its Council and officials. Should competent men decide that such a demolition was necessary to protect life and the public weal then the City and the Commissioner should assume the responsibility, as they never prescribed any rules to indicate what currents should or should not be used, but employed dangerous currents to light public streets and buildings. It looks cowardly to hide behind their power and destroy the investments of eminent citizens."

SCHUYLER S. WHEELER.

ELECTRICAL EXPERT AND ELECTRICAL ENGINEER, NEW YORK SUBWAY COMPANY.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Yes, by using first-class insulation and line construction.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will practically prevent any escape of current, particularly in wet weather?

Yes, by good gum insulations.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Yes, with well-insulated cables, lead covered, with plumbers' wipe joints.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires underground?

No.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

No opinion.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Cut outs and good wire.

FRANK C. MASON,

ELECTRICAL EXPERT, SUPERINTENDENT OF TELEGRAPH, POLICE DEPARTMENT, BROOKLYN, N. Y.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes. By using the best-insulated and most durable wire, caution being used with the wires and splices. Inspect wires frequently and put in new wire where insulation has been damaged. Guard wires might also be used with good results.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—Yes.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—Yes. Any one of a score of durable conduits now on the market, solely for mechanical protection to the wires, and a specially manufactured "okonite" wire *without* lead covering.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—Not entirely; the same precautions would have to be taken as in your first question.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—Electric lighting can be made as safe to life and property as any other mode of lighting. Insulation must be frequently inspected and kept perfect. A gas main is unsafe if full of holes.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—An automatic switch that cuts off the current before entering the building. All other wires in a city where electric lighting is used should be provided with a fusible wire, cut out outside of building; in case of wire being crossed with electric light wire, no damage can occur.

FRANK R. UPTON,

ELECTRICAL EXPERT, NEWARK, N. J.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—Yes. By limiting the tension and doing good work in the construction.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can

be applied to over-head electric light wires and will absolutely prevent any escape of current, particularly in wet weather?

Answer.—No. There is none that will absolutely prevent escape of current.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—For low tension currents, yes. The Edison iron tube system.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—No.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—The danger to life, by limiting the E. M. F.—The danger to property, by the best workmanship.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—Good workmanship and properly placed cut-outs.

The Column Printing Telegraph Machine.—The Comptroller of Patents had before him on the 16th inst., at the Law Courts, London, the opposition of the Exchange Telegraph Co. to the Column Printing Telegraph instrument, patented by Messrs. Wright and Moore, and owned by the Column Printing Telegraph Syndicate (Limited), which has an arrangement with the well-known Central News Agency for supplying news to newspapers, clubs, exchanges, news rooms, etc. This machine is intended to supersede the present "tape" system of delivery of news, by giving it in the form of a printed page. Mr. Moulton, Q. C., appeared for the Column Printing Syndicate. The counsel for defendant applied for the seal to their patent, which was opposed by counsel for the plaintiff. The fact that the instruments of the Column Printing Telegraph Company had long been in operation was, in Mr. Moulton's opinion, contradictory to the claim of the plaintiff that the machine was an infringement. The application of Messrs. Wright and Moore was granted, and the case dismissed. Mr. J. E. Wright, one of the defendants in this suit, is the well-known electrician and is now in this country.

Edison's Phonographic Address.—The fact that Edison is to deliver a phonographic address at the meeting of the National Electric Light Association, to be held in Kansas City next month, has been pretty widely published. The circumstances which led to his decision to talk by proxy are given by the Kansas City *Times*: "Mr. Weeks, the president of the association, on his recent trip, called upon Mr. Edison and insisted on the latter attending the convention and reading a paper. Mr. Edison's reputation for bashfulness and modesty is well known, and he informed the president of the association that he could not possibly comply. President Weeks insisted, and at last Mr. Edison said: 'I tell you what I will do, if it is satisfactory to you. I will talk to my phonograph and send it to Kansas City to lecture for me. It will make no gestures, but the tone will be perfect, and I will warrant that it can be heard all over the opera house.' This agreement was satisfactory to President Weeks, as very few persons have ever heard Mr. Edison speak in public."

Government Telegraph Rates.—The annual report of the Postmaster-General for the fiscal year ending June 30, 1889, recently presented to Congress, contains all of the correspondence between that department and the various telegraph companies in regard to government telegraph rates during the current year. This includes the correspondence during the controversy between the Postmaster-General and President Norvin Green, of the Western Union Telegraph Company, which was published in the daily press and attracted so much attention.

To the Kansas City Convention.—The following preliminary railway schedule has been arranged for the meeting of the National Electric Light Association at Kansas City on February next. Should there be any change from this, the Committee on Transportation will announce it in good time:

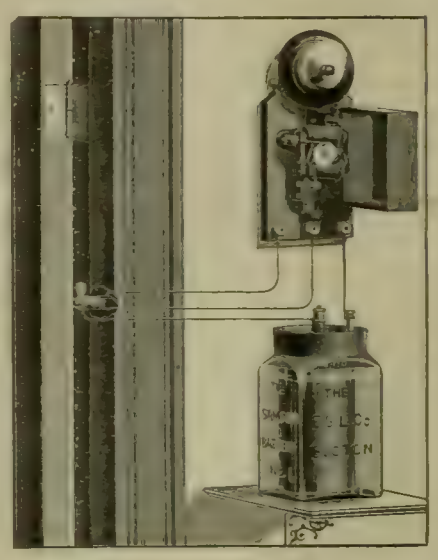
Leave Jersey City.....9.55 A. M., Sunday, Feb. 9th
Arrive Chicago.....9.00 A. M., Monday, Feb. 10th
Leave Chicago.....9.20 A. M., Monday, Feb. 10th
Arrive Kansas City.....9.45 P. M., Monday, Feb. 10th

This will be the quickest time ever made between New York and Kansas City, if the schedule can be carried out.

A NEW AND USEFUL ELECTRIC BELL.

The Electric Gas Lighting Co., of 35 and 56 Arch street, Boston, have brought out a novel and reliable vibrating bell, which has many advantages over the ordinary instruments of this class.

By means of a simple ratchet cut-out device contained in the bell, it is made to give an alarm of limited duration when a door is opened, and again when it is closed; still, the battery cannot be grounded by leaving the door partly open, as is the case under the ordinary system.



It gives a sure alarm for each movement of the door to open and to close. A special door spring is used and furnished with each bell.

The Limited Alarm Bell is preferable to the continuous ringer, being not only less noisy and offensive to occupants, but when used as a front door bell callers may pull the door knob as long as they like, but the bell will only ring a limited time; while, on the contrary, a short push or pull will give the full limited alarm.

The following illustration shows the bell and its connections.

The Electric Light Company of Berlin, says the London *Electrical Engineer*, is introducing sewing machines driven by small electric motors supplied from its central station. The price for a strong tailoring machine is not over six cents per hour, and quite a number are being employed.

The New York Electric Club kept "open house" on New Year's day. The season's greetings were exchanged between the members and their friends, and altogether the occasion was a most enjoyable one.

We are pleased to learn that Mr. Meadowcraft's book, *A, B, C, of Electricity*, has reached its fifth edition.

The Milwaukee Electric Railway Company has been organized with a capital of $500,000.

THE BRUSH DOUBLE CARBON DECISION.

In our last issue we briefly mentioned the decision of Judge Gresham at Indianapolis, on Dec. 24th, in the case of the Brush Electric Company *vs.* the Fort Wayne Electric Light Company, *et al.* Owing to the great importance of the decision and the questions involved therein, we publish the document in full, as follows:

THE BRUSH ELECTRIC COMPANY *vs.* THE FORT WAYNE ELECTRIC LIGHT COMPANY, *et al.*
NO. 8,250. CHANCERY.

Gresham, J.:

This suit is brought for an alleged infringement of Letters Patent No. 219,208, granted to Charles F. Brush, Sept. 2, 1879, for improvement in double-carbon electric lamps of the arc type. Brush assigned the patent to complainant before suit was brought.

When two ordinary, pointed carbon sticks are in contact in an electric current the circuit is closed, and the current freely passes through the carbons without the production of any appreciable amount of heat or light at the point of contact. If, however, while the electric current is passing through them, the carbons are slightly separated, the current will continue to flow in crossing or leaping the small space between the separated carbon points, and intense heat and light will be produced. This is known as the electric arc lamp, and the one generally used for illuminating large buildings and halls, and for lighting streets. The incandescent electric light is produced by causing a current of electricity to pass through a filament in a glass bulb from which the air has been exhausted. In its passage the current encounters great resistance and as a consequence it is heated to a degree producing a bright, white light throughout its entire length. This light is well adapted to use indoors.

As early as 1810 Sir Humphrey Davy, with a battery of 2,000 cells, succeeded in producing an arc light between two horizontal charcoal pencils, insulated, except a small portion at their ends, but owing to the rapid combustion of the soft charcoal points and the great cost of the battery, and the short duration of the light, it was of no practical or commercial value. But little progress was made in the improvement of this arc light or lamp until 1844, when Foucault substituted pencils made of a hard gas carbon for the charcoal pencils of Davy, and thereby for the first time produced a persistent, but short-lived, electric arc light. By a clockwork mechanism Foucault fed the carbon pencils toward each other so as to imperfectly regulate their burning away and maintain the arc. The voltaic battery did not generate electricity on a sufficiently large scale, the light was expensive and it did not go into general use.

Later the dynamo electric machine was developed, in which a powerful current of electricity was produced by revolving coils of wire in a field of magnetic force furnished by powerful permanent magnets, after which the arc electric light was successfully used in light-houses in England, and later (1867) in France. But, up to this time, no means has been devised for producing an adequate current of electricity for illumination at a practicable cost, and it was not until the time of the Gramme dynamo electric machine in 1872 that electricity was produced in a manner and of sufficient strength to render electric lighting practical and useful. This machine was afterward improved in details of construction. In this state of the art, Brush entered the field of invention, and on May 7, 1878, obtained Patent No. 203,412 for his arc lamp, which was superior to any lamp that had preceded it. This lamp, however, was not capable of burning continuously more than eight or ten hours, and when used for all-night lighting it was necessary to extinguish the light and renew the carbons; and in order to obviate the defect Brush invented the lamp in suit. The invention and the means by which it is carried out are thus described in this specification:

"My invention relates to electric lamps or light regulators, and it consists, first, in a lamp having two or more sets of carbons adapted, by any suitable means, to burn successively—that is, one set after

another; second, in a lamp having two or more sets of carbons, each set adapted to move independently in burning and feeding; third, in a lamp having two or more sets of carbons adapted each to have independent movements, and each operated and influenced by the same electric current; fourth, in a lamp having two or more sets of carbons, said carbons by any suitable means being adapted to be separated dissimultaneously, whereby the voltaic arc between but a single set of carbons is produced; fifth, in the combination, with one of the carbons or carbon holders of a lamp employing two or more sets of carbons, as above mentioned, of a suitable collar, tube or extended support, within or upon which the carbon or carbon holder to which it is applied shall rest and be supported.

"I desire to state at the outstart that my invention is not limited in its application to any specific form of lamp. It may be used in any form of voltaic-arc light-regulator, and would need but a mere modification in mechanical form to be adaptable to an indefinite variety of the present forms of electric lamps.

"My invention comprehends broadly any lamp or light-regulator where more than one set of carbons are employed wherein—say in a lamp having two sets of carbons—one set of carbons will separate before the other. For the purpose merely of showing and explaining the principles of operation and use of my invention, I shall describe it, in the form shown in the drawings as applied to an electric lamp of the general type shown in the United States Letters Patent No. 203,411, granted to me May 7, 1878, re-issued May 20, 1879, and numbered 8,718. The leading feature of this type of regulator is that the carbon holder has a rod or tube which slides through or past a friction clutch, which clutch is operated upon to grasp and move said carbon rod or holder, and thus to separate the carbons and produce the voltaic arc light; and I shall refer to such a lamp in my following description:

"*A* represents one set of carbons, A^1 another set, each carbon having an independent holder $B\,B^1$. The carbon holders $B\,B^1$ may either be in the form of a rod or tube, and each of them is made to pass through a clamping and lifting device $C\,C^1$ respectively. These clamps and lifters $C\,C^1$, are shown in the present instance in the shape of rings surrounding their respective carbon holders $B\,B^1$. This form, while I have found it for general purposes the best, is not necessarily the only form of clamp that may be used in carrying out my present invention. Each ring clamp $C\,C^1$ is adapted to be lifted from a single point, thus tilting it and causing it to grasp and lift its inclosed carbon holder. This tilting and lifting movement is imparted to the clamps $C\,C^1$ by any suitable lifter *D*, and this lifter may have its movement imparted either by magnetic attraction due to the current operating the lamp, or by the expansive action of heat upon any suitable apparatus connected with the lamp, said heat generated by the electric current operating the lamp.

"I do not in any degree limit myself to any specific method or mechanism for lifting, moving or separating the carbon points or their holders, so long as the peculiar functions and results hereinafter to be specified shall be accomplished. The lifter D^1, in the present instance, is so formed that when it is raised it shall not operate upon the clamps $C\,C^1$ simultaneously, but shall lift first one and then the other (preferably the clamp *C* first and C^1 second, for reasons which shall hereinafter appear). This function or dissimultaneous action upon the carbons or their holders, whereby one set of carbons shall be separated in advance of the other, constitutes the principal and most important feature of my present invention. In the lamp shown in the drawings the lifter *D* is actuated and controlled through the agency of magnetic attraction due to the influence of the current operating the lamp, and this is accomplished as follows: One, two, or more spools of hollow helices *E* of insulated wire are placed in the circuit, within whose cavities freely move cores E^1. The electric current passing through the helices *E* operates to strongly draw up within their cavities their respective cores E^1, in the same manner as specified in my former patent above referred to. The cores E^1 are rigidly attached to a common bar, E^2, and the upward and downward movement of this bar, due to the varying attractions of the helices *E*, is imparted by a suitable link and lever connection, E^3 *E* to the lifter *D*. By this connection the lifter will have an up and down movement in exact concert with the cores E^1; and it is apparent that this connection between magnet and lifter may be indefinitely varied without any departure from my invention; and therefore, while preferring for many purposes the construction just specified, I do not propose to limit myself to its use.

"The lifter *D* may be so constructed and applied as to separate the carbons *A* and A^1 successively or dissimultaneously by being so balanced that any difference, however slight, between the weights of the carbon $A\,A^1$, or their holders $B\,B^1$, shall result in one being lifted and separated before the other.

"In order properly to balance the attractive force of the magnets, a coil spring *F*, or its equivalent, may be employed, substantially as shown; and to insure a steady motion to the magnets and to the carbon points $A\,A^1$, a dash pot *G*, or its equivalent, should be employed, as this prevents any too sudden, abrupt or excessive movement of parts.

"$H\,H^1$ are metallic cables, through which the current is conducted from above the clamps $C\,C^1$ to the carbons $A\,A^1$. By this provision is not only insured a good connection between the upper carbon point and the mechanism above it, but another important advantage is obtained, and that is the prevention of sparks due to any interruption of the current between the carbon holder $B\,B^1$ and its clamp or bearings. This spark, if occurring too frequently, is liable to burn and roughen the rods $B\,B^2$ or their bearings or clamps, and thereby render their operation uncertain, because it is important that a free movement to any degree, however minute, may be allowed the carbon holder. These cables $H\,H^1$, while operating as just specified, are sufficiently flexible and yielding not to interfere with any movement of their respective carbons or carbon holders.

"The operation of my device, as thus far specified, is as follows: When the current is not passing through the lamp, the positive and negative carbons of each set $A\,A^1$ are in actual contact. When, now, a current is passed through the lamp, the magnetic attraction of the helices *E* will operate to raise the lifter *D*. This lifter, operating upon the clamps *C* and C^1, tilts them and causes them to clamp and lift the carbon holders $B\,B^1$, and thus separate the carbons and produce the voltaic arc light; but it will be especially noticed that the lifting and separation of these carbons is not simultaneous. One pair is separated before the other, it matters not how little nor how short a time before. This separation breaks the circuit at that point, and the entire current is now passing through the unseparated pair of carbons A^1; and now and then the lifter, continuing to rise, separates these points, the voltaic arc will be established between them and the light thus produced.

"It will be apparent by the foregoing that it is impossible that both pairs of carbons $A\,A^1$ should burn at once, for any inequality of weight or balance between them would result in one pair being separated before the other, and the voltaic arc would appear between the last separated pair. This function, so far as I am aware, has never been accomplished by any previous invention, and by thus being able to burn independently and one at a time two or more carbons in a single lamp, it is evident that a light may be constantly maintained for a prolonged period without replacing the carbons or other manual interference. In the form of the lamp shown, I can, with twelve-inch carbons, maintain a steady and reliable light without any manual interference whatever for a period varying from fourteen to twenty hours.

"It is for some reasons desirable that one set of carbons—say the set A^1—should be consumed before the other set commences to burn, although it is not essential, in carrying out my invention, that the carbons should be consumed in this manner, inasmuch as, if desirable, they may be arranged to burn alternately instead of successively. It is apparent, however, if one set of carbons can be made to entirely consume before another set begins to burn, that there will be less interruption of the light than if the different pairs were allowed to consume in frequent alternation. I have therefore shown, in the present invention, one method of securing a consumption of one set of carbons before another shall begin to burn. This I accomplish through any suitable support *K*, and in such a construction of the lifter *D* that it shall be positive in its function of separating one set of carbons before the other; or in case where more than two sets of carbons are employed, to separate said sets successively.

"In the lamp as shown in the drawings the support *K* is in the form of a tube surrounding the carbon holder *B*, and this support *K* is made of such a length that when the carbons A^1 shall have been sufficiently consumed a head upon the carbon holder *B* will rest upon the top or the support *K*, whereby the weight of the carbon holder *B* and its support *K* shall at all times and under any circumstances be supported by the lifter *D*.

"Besides the carbon holder *B*, with its carbon, and the support *K*, the lifter *D* (when the lamp is in operation) should also be made to carry the carbon holder B^1 and its carbon.

"The lamp is primarily adjusted so that the magnets through the lifter *D* shall always carry a definite load; to wit (in the lamp shown) the carbon holders *B* and B^1, and support *K*. The desirability of this construction and arrangement may be explained as follows: Supposing, as is designed in the present instance, the carbons *A* are first consumed. During this time, of course, the magnets are lifting both carbon holders $B\,B^1$. Now, when the carbons *A* are consumed, if no provision is made to the contrary, the carbon holder *B* would not be lifted during the consumption of the carbons A^1, and this diminishment of the weight carried by the magnets would be liable to materially disturb the adjustment of the lamp and impair its operation accordingly. To obviate this difficulty I have provided the support *K*, by which provision the magnets shall be made to carry both carbon holders $B\,B^1$ and the support *K*. The difference in weight, owing to the consumption of the carbons, is a practically unimportant matter, and does not materially interfere with the operation of the lamp.

"In the case of a lamp where the carbon holders $B\,B^1$ are very light, and where the weight of one might be relieved from the magnet (or other moving agent) without material disturbance, the support *K* might be dispensed with. Said support *K* might also be omitted, if desired, in a lamp where the lifter is actuated through the agency of the expansion of the metal-wire or bar by the action of heat generated by the current operating the lamp, inasmuch as the force due to said expansion being practically irresistible, it would not be so necessary to obtain a balance between various parts, as is the case with a lamp as shown in the drawings.

"Thus far I have mentioned but two ways of imparting dissimultaneous motion to the carbons of an electric lamp, viz., through magnetic attraction and through the expansive action of heat. This function of my device may be accomplished by clockwork or equivalent mechanical contrivance, and in this respect, as before stated, I do limit my invention.

"$L\,L^1$ are metallic hoods or protectors for inclosing and shielding the upper projecting ends of the carbon holders $B\,B^1$.

"In the form of lamp shown in the drawing, I obtain very satisfactory results by constructing the helices *E* according to letters-patent No. 212,183, granted to me Feb. 11, 1879. In each helix *E* two independent wires surround the lifting magnets E^1, one of fine and one of coarse wire, and each placed in the general circuit operating the lamp. These two wires (the fine and the coarse) are constructed and connected in such a manner as to carry current in opposite directions around the inclosed core, thus exerting a neutralizing influence upon each

Continued on Page 9.

INCREASING THE EFFICIENCY OF THE QUADRUPLEX.

THE F. W. JONES ARRANGEMENT.

In late years, much time and thought has been given by electricians to increasing the efficiency of the quadruplex, and several devices have been evolved. They all have more or less merit, and accomplish their object to a considerable degree under trying conditions. The Jones quadruplex, herewith described and illustrated, embodies the most important and valuable improvements in this line. It is in many mechanical respects radically different from the quadruplex owned and operated by the Western Union Telegraph Company.

D, D^1, D^2, D^3 represent four compound short wound dynamos. Two of these dynamos are of low potential (one plus and one minus) and two are of high potential (one plus and one minus), and they are connected to a new style of pole-changer, marked *P C*, through a four button switch *S W*.

P C makes four contacts, 1 and 3, when it opens, and 2 and 4 when it closes. Contacts 1 and 2 are adjustable springs and continually preserving, as the end *S* of the lever of *P C* switch and *N* is for the purpose of reducing the potential of the dynamos when it is desired to work a line circuit of shorter length than is designed for the normal potential of the machine. Thus from the same dynamos several quadruplex circuits of varying lengths or resistances may be worked, provided the normal potentials of the machine are adapted to the circuit of highest resistance. The diminution caused to the incoming current by the insertion of *R* is counterbalanced on the relays largely by the greater quantity of the incoming current that will go to earth via the artificial circuit, thus traversing two sets of relay convolutions.

P C and *S T* are shown in an open position, and their manipulation sends the currents to line in the following order:

Both open	100	—
S T open, *P C* closed	100	+
P C open, *S T* closed	300	—
Both closed	300	+

I C is not affected by outgoing currents but is energized by the incoming current, particularly by the increased current designed to operate relay *N*. The third or secondary coil of *I C* connected to magnet M^2 has evoked in it an induced current which energizes M^2 just at the instant of reversal of the main current and thus a holding force is applied to the armature lever of *N*, completely bridging over the moment of no magnetism. The transmitter *S T* has its spring and battery contacts independent of its lever, thus permitting it to emit a clear sound on its down stroke and also reduces the jarring at contact point. *S W* is for the purpose of removing the dynamo currents from *P C* so that the latter may be adjusted without inconvenience. *x*, x^1, x^2, x^3 are four equal resistances about 2½ ohms per volt for the highest potential. The relay *N* is adjusted first by bringing the armature of M^2 in a closed position very near the cores, but not near enough to touch. Magnets *M* and M^1 are adjusted to suit the strength of the received currents.

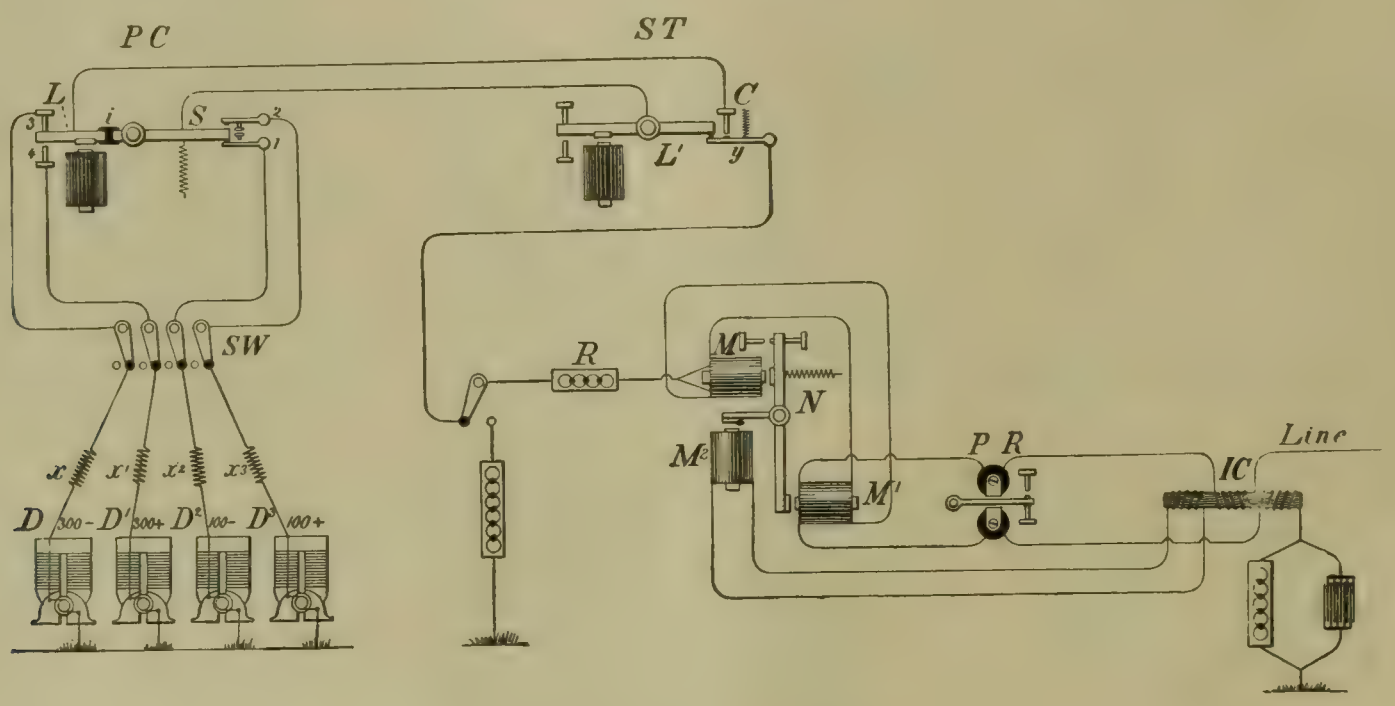


DIAGRAM OF JONES QUADRUPLEX.

The resistance *R* between the three point moves up and down. The contacts 3 and 4 are fixed, and a space occurs when the end *L* of *P C* moves from one to the other. The ends of lever *L* and *S* are insulated by *i* from one another. It will be seen that the dynamos are connected as follows: one hundred minus to contact 1, one hundred plus to contact 2, three hundred minus to contact 3, three hundred plus to contact 4. Two wires lead from *P C* to an improved form of single transmitter *S T*. One wire connects *L* with contact point *C*, the other wire connects *S* with the lever L. The spring *y* of *S T* connects through a three point switch, and a regulating resistance *R* with the dividing point of the Jones Quadruplex relay *N*. *P R* is an ordinary polarized relay, and *I C* is an induction coil having three windings of one hundred ohms each. Two of these windings are included in the main and artificial circuits in the usual differential manner. The third winding is connected with the third electro magnet, marked M_2, of the relay *N*. The electro magnet *M* and M_1 are in series differentially in the line and artificial circuits, the total resistance of both magnets in either circuit being about 200 ohms. The polar relay *P R* has the usual resistance of 400 ohms in each winding.

THE STORAGE BATTERY.—A storage battery does not store electricity any more than the spring of a clock can be said to store time or sound; it stores energy. The energy of an electric current is used to produce a decomposition of metal of such a nature as will independently produce a current on the removal of the original current. The cells or accumulators are two plates of metal immersed in a liquid acid which is called the electrolyte, and which cannot act on the plates until after an electric current has passed through it, which effects its decomposition in depositing its positive and negative constituents on the plates. On the cessation of the current the cells are discharged by a connection outside the liquid, in the opposite direction. Plates of compressed litharge have been recently used, and many experiments are being made in the hope of obtaining such results as will avoid the necessity of using a dynamo. Electric meters are those in which a portion of the current passes through a solution of a metallic salt, and the strength is determined by the amount of electrolytic decomposition it effects. There is also an electro-thermal meter to measure the heat caused by a certain resistance, or by the amount of liquid evaporated by the heat generated by the current; and an electro-magnetic meter, in which the current is measured by the magnetic effects it produces upon a needle by deflecting it.

The Pueblo, Col., Rapid Transit Company has been organized with a capital stock of $250,000 to construct and operate a system of electric railways in that city and the suburban towns. The necessary franchises have been secured.

The proposition of the Electric Traction and Manufacturing Company to equip the Crescent City railway of New Orleans with electric motors has been accepted. The cars on this road are now hauled by mules.

The Board of Improvement of St. Louis gave a hearing to George F. Durant for a consideration, in detail, of the Bell Telephone Company's pending conduit ordinance, which was referred to the board by the council committee on public improvements for the purpose of being perfected. Mr. Durant stated to the committee that the Bell Company's new building, at the southeast corner of Tenth and Olive streets, will be built with special reference to the use of a conduit system in the central part of the city.

The latest illness of the Czar is said to have been brought on by excitement occasioned by the sudden extinction of the electric lights in the Imperial Palace. There are evidently more things than the play with which to "catch the conscience of the King."

Messrs. Chas. A. Schieren & Co., the well-known manufacturers of electric leather belting, of New York, Boston, Philadelphia and Chicago, have been awarded a medal by the American Institute for the superiority of their leather belting.

ELECTRIC EXECUTIONS CONSTITUTIONAL.

The General Term of the Fifth Department, at Rochester, on December 30th, handed down a decision in the case of Kemmler, the murderer condemned to death under the new law providing for the execution of criminals by electricity, which the court holds to be constitutional. Judge Dwight wrote the opinion, in the course of which he says :

"A writ of habeas corpus was sued out alleging that Kemmler was sentenced to undergo a 'cruel and unusual punishment' contrary to the Constitution of the State of New York and of the United States. An offer was made to prove that the punishment as prescribed by the statute was cruel and unusual. A referee was appointed to take and report such proofs as should be offered by either party on the question proposed. The order below dismissed the writ and remanded the prisoner to the custody of the agent and warden of the State prison. An appeal from that order brings the case into this court, and presents a question very novel in its character, and in the manner of its presentation. The attempt is to enforce the provision of the Constitution against cruel and unusual punishments based upon evidence intended to show the character of the penalty prescribed thereby.

"The constitutional provision here invoked originated in the well-known bill of rights of England. That celebrated enactment was the first fruit of the great revolution of 1688."

Judge Dwight then gives a review of the way in which the clause originated, and continues : "It seems very clear that no provision of the English bill of rights was intended to operate as a restriction upon the power of the legislative branch of the English Government. The act was chiefly a protest against the acts of tyranny and oppression on the part of the crown. In regard to the similar provision in the Constitution of the United States, it is in the first place to be observed that it has no application to any department of the Government of the States, but is a restriction upon the Federal Government only. There is even some doubt if it is intended as a restriction upon the power of Congress in regard to punishment for crime.

"With regard to the provision in the Constitution of this State the case is different. It must have been intended as a restriction upon the legislative authority. We have no doubt that if the Legislature of this State should undertake to prescribe for any offence against its laws the punishment of burning at the stake, breaking at the wheel, etc., it would be the duty of the courts to pronounce upon such attempt the condemnation of the Constitution.

"The question is now to be answered whether the legislative act here assailed is subject to the same condemnation. Certainly it is not so on its face, for, although the mode of death described is conceded to be unusual, there is no common knowledge or consent that it is cruel. It is a question of fact whether an electrical current of sufficient intensity and skilfully applied will produce death without unnecessary suffering. Is this a question open to the investigation of the court when called upon to decide the validity of the law in question? Or must it be presumed to have been determined by the Legislature in favor of the mode of punishment prescribed? For the first time in the history of jurisprudence has a court been called upon to enter upon such an investigation."

The judge suggests that it could safely be presumed that the Legislature had sufficiently investigated the nature of punishment before passing the law, and reviews the work of the committee which investigated the methods of capital punishment. After reviewing the experiments made upon animals by electricity, and accidental deaths of men through the same instrumentality, the judge concludes : "The light of the scientific evidence in this case is sufficient, as we think, to remove every reasonable doubt that the passage of a current of electricity of a certain well-determined intensity through the vital parts of the body under chosen conditions of contact and resistance, must result in instant death. If the question were of the advisability in the change of the mode of inflicting death by capital punishment, the discussion might be prolonged. As we are confined to the question of constitutionality, we deem further discussion unnecessary. The order dismissing the writ of habeas corpus and remanding the prisoner must be affirmed."

W. Bourke Cockran, who made the argument against electrical execution before the referee, last October, said :

"This decision has the effect of keeping Kemmler in jail to await sentence, but before the District Attorney can get in a motion to have a date set for his execution I shall enter a notice of appeal, which will be equivalent to a stay of proceedings until the appeal has been heard and a decision rendered. I think I can arrange to make an argument some time in January. This will doubtless delay the execution of other prisoners now under sentence of death, although I have no connection whatever with any case but Kemmler's.

SAFE LIGHTS FOR NEW YORK.

Mr. George Westinghouse, the head of the Westinghouse Electric Company, announces that his company is about ready to supply the metropolis with a new system of arc lighting. Discussing the plan he says :

"The entire suppression of the overhead electric light service in New York City has been followed by a general demand for the restoration of the arc light. Merchants, as well as private individuals, are complaining of the darkness which has prevailed for some time, and the public cry is now for an underground system of wiring which insures such safety that no danger need be feared from contact with any lamp or wire above ground. I think our company has solved the problem of perfect safety in the most complete manner. We have worked for the last two weeks on two large machines, which will be taken to New York almost immediately, for the purpose of demonstrating the practical nature of the new system, which we claim will revolutionize the present methods of street lighting.

"In this system of supply mains the electric current will be unbroken underground, and the current for the operation of each lamp will be an induced one just sufficient for the work. Perfect harmlessness to any person coming into contact with either a lamp or its feed wires is assured. Electrical connection between the underground mains and the feed wires of each lamp does really not exist, and in consequence of the absolute separation of the two circuits perfect safety is certain.

"The lamp used in connection with this system is also an entirely new one. I feel sure that the results which we have obtained by our experiments will eventuate in a remodeling of the entire New York City arc-light system, and I expect our company to receive the contract for apparatus for nearly five thousand arc lights."

The ordinance granting the Quincy, Ill., Horse Railway and Carrying Company the right to change its motive power and to occupy certain additional streets was passed at a recent meeting of the council. Electricity is to be adopted as a motive power.

The South Covington and Cincinnati Street Railroad Company has presented an ordinance to the Board of Public Affairs for an electric street railroad to Covington along the line of the present street railroad, crossing the Suspension Bridge.

ELECTRICAL PROGRESS.

The great advance in the application of electricity for the purpose of light and power during the present year will certainly exceed that of all previous time. A glance at the columns of any of the weekly electrical journals of any date during the present year will show that hundreds of arc, and thousands of incandescent lamps, and miles of electric railway have been contracted for during the previous week.

Electric motors for both constant potential and constant current systems have been manufactured at a rate of upwards of 250 per week, and their rating will exceed 700 horse-power. In spite of this great output of electrical apparatus, every portion of it finds an immediate sale, and, in fact, nearly all of the factories are behind in their orders to such an extent that it is nearly impossible to fill orders under sixty days' time. That the arc light is the most popular system for street lighting is shown by the fact that many small towns with a population not exceeding 1,000 have contracted for the arc light, and many such towns are even now lighted in this manner.

The series system of incandescent lighting, which gives cheap distribution over extended areas, and can be easily and cheaply extended at any time, is being adopted by villages, and is hailed as a blessing by the older people, whose eyesight is growing dim as age advances.

The incandescent lamp in the home of people of very moderate circumstances is a fact of today, and the price at which it is furnished is found to be within their means. This is another triumph in the field of electric lighting, for the incandescent light can now be introduced into places where gas will never be able to compete. The flexibility and simplicity of the series incandescent system will make it the poor man's friend, for in any place where underground wiring is not compulsory, the incandescent lamp can be furnished at a less cost than would be charged for the same amount of light from gas. Electric railways are so rapidly multiplying in the United States, that reliable data is old and comparatively worthless by the time it is compiled.

Motors have been introduced for all conceivable purposes to which power can be applied, and small industries run by electrical power have started up in many places where steam-power could not have been utilized. Motors of all the different designs that have been proven of value find a ready sale. and the factories engaged in their manufacture are, in many cases, being enlarged. The storage battery is being extensively applied to the many purposes for which it is applicable.—*Stationary Engineer.*

AMERICA LEADS GERMANY IN ELECTRICAL INVENTIONS.

BERLIN, Jan. 3—With regard to the proposed World's Electrical Exposition to be opened in Frankfort in June next, and to be continued for five months, Herr Siemens, Germany's foremost electrician, warns his fellow-countrymen that Germany cannot now compete with America in the number of new electrical inventions, and advises that the exhibition be postponed eighteen months until the disparity becomes less startling.

The electric light system, as used in the Jamestown, N. Y., Worsted Mills, is giving great satisfaction. Two Edison dynamos, with a capacity of 1,100 incandescent lamps, of which about 900 are now in use, constitute the equipment of the big plant.

The Marble City Electric Light Company of Rutland, Vt., is rapidly pushing forward operations for the introduction of its new system of lighting.

THE EMPLOYMENT OF ELECTRIC MOTORS. *

Now that electric motors have become a commercial article, and are practically reliable, it is certainly rather strange that in this country, at least, these machines have not come into greater favor than is at present the case, more especially as they could be advantageously employed in many branches of trade. This is all the more surprising when the great developments in the other branches of electrical engineering are taken into consideration, thus leaving, as it were, electric motors almost entirely out in the cold. If a correct and thoroughly reliable return were made of the number of electric motors in use in the United Kingdom, it would doubtless be found that there are scarcely more than fifty at present employed, if, indeed, the figure is so high. In order to illustrate our argument, or rather to bring more prominently forward the purport of this article, namely, that electric motors can be profitably employed in the industries of this country, it may be well if we briefly refer to a few cases where these appliances are used.

The first installation in the United Kingdom, on a practical scale, was, we believe, put up in 1882 at the Trafalgar collieries in the Forest of Dean. The motors in this case are of the Elwell-Parker type, and are used for driving pumps. Three motors are in use—the first having been installed in 1882, the second in 1886, and the third in 1887, the results obtained being very satisfactory. Another example is at the Normanton collieries of Messrs. Locke & Co., whose installation is now so well known. Immisch motors are employed both for driving pumping machinery and for hauling purposes. The useful effect of the pumping plant was over 40 per cent. during twelve months' working. At the Allerton-Main collieries, near Leeds, several pumps are driven by motors, the current for the latter being obtained from storage batteries charged at the surface and taken down the pit. A small electric plant for pumping water into a reservoir is in use at the Kingscavil quarry, Linlithgow, Scotland. In this instance, also, excellent results have been obtained. Turning to the continent, we find several instances of the employment of electric motors. At the new Stassfurt salt mines in Germany a Siemens motor is used for driving a winding drum, the efficiency in this case being 40 per cent., and at the Salzberg works similar results have been obtained. Several instances in Switzerland might be cited, but the mention of the transmission plant between Kriegstetten and Solothurn will no doubt be sufficient. In the United States there are many instances on record of motors being used for driving winding drums, ore-crushing stamps, coal-cutting machinery, etc. In the Kimberley mines in South Africa there are several motors at work, and the mines are lighted electrically. Quite recently the Forbes Reef Gold Mining Company, of the Transvaal, South Africa, ordered some electric plant, including four long-distance transmission motors, as already announced in this journal.

There is not the slightest doubt that with the erection of central electric light stations electrical energy will be supplied, not only for lighting, but also for power purposes. In this country the credit for having brought electric motors into practical application must be given mainly to Mr. Immisch, who has devoted considerable attention to the subject. The result of his labors is to be found in the fact that Immisch motors are now in use, as previously mentioned, in English collieries; they are employed for driving the electric launches on the Thames and in a few electric dog carts. Messrs. Paris and Scott, of Norwich, and Mr. Reckenzaun have also done a great deal to popularize electric motors by showing how they can be successfully and advantageously used in small industries. Other names might be mentioned, but the gentlemen cited have probably done the best part of the work. At the recent Birmingham Exhibition many examples were shown of the simple manner in which motors can be operated for driving various kinds of machinery and tools, and at the forthcoming Edinburgh Exhibition a similar display will be made. Now, there is no reason why electric motors should not come into general favor. In the iron and steel and engineering trades they could be profitably used for working shears, hammers, lathes, rolling-mill machinery, etc.; in the coal trade, for winding, hauling, pumping, etc.; in the textile trade, for driving looms; and in various other trades for driving small machinery and tools. We must, however, not omit to mention the great field open for the employment of motors for traction purposes. There are already a few electric tramcars running in London and in one or two provincial towns, but this branch will soon be greatly developed, more especially as no less than 24 applications for electric traction powers have been made to the Board of Trade, and which will come on for consideration in the ensuing session of Parliament. Very little has been done, except by Mr. Ward, in order to introduce electric omnibuses, and electric traction in this country is, as yet, but little more than an experiment. Considerable development in this direction will take place during the next three or four years, especially when the central stations have got in full working order. It would be well for manufacturers of motors to bring their machines more prominently before the notice of both great and small industrial concerns in order that the power business may not be behind that of electric lighting.

* *London Electrical Review.*

MR. EDISON WANTS TO WORK.

THE GREAT INVENTOR HAS NOT TIME FOR CALLERS AT HIS LABORATORY.

All sorts of people go to Thomas A. Edison's Llewellyn Park laboratory to see the great inventor. Many of the callers could transact their business just as well with a subordinate, and many more have no reason for calling on Mr. Edison, except their curiosity. So numerous have been the triflers that this notice has been conspicuously posted:

> Mr. Edison is compelled to deny himself to visitors, as they have been so numerous lately he has been unable to give proper attention to his experiments.

But even after that placard was displayed there were bold callers who insisted that, if they couldn't see Edison himself, they must see the laboratory. Now, if there is any business which is guarded from prying eyes at present it is that of electricity, and, to put it bluntly, visitors are not at all welcome at any great electrical plant. At Edison's the following is stuck up at the several entrances in big, black type:

> No permit will be issued to any one under any circumstances to go through this laboratory.

The *Elektrotechnische Echo* is responsible for the following explanation of why oaks are more frequently struck by lightning than beech trees. The leaves of the beech tree are, it seems, covered with a fine down, which is a better conductor of electricity than the smooth leaves of the oak. According to the same journal, experiments with discharges from influence machines tend to confirm this theory.

The Guardian Assurance Company of England have just sent out to their policy-holders a special notice with reference to electrical lighting, with regard to which the directors some time ago brought out a set of rules to be observed in the installation of electric lighting with buildings. The notice concludes as follows:—"When properly installed, the electric light is regarded by this company as the safest method of lighting."

Peru, Ill., is to have an electric road.

PRODUCTION OF MOTIVE POWER FROM ELECTRICITY.

Mr. Jablochkoff, says the London *Electrical Review*, recently read an interesting paper before the Société des Ingénieurs Civils on the subject of the production of motive power from electricity. Mr. Jablochkoff has long been an advocate of galvanic electricity, and although chemical reactions were the first means of obtaining electricity, he does not consider it a retrograde movement to return to this mode of production, but, on the contrary, as a step in advance. He considers that the production of electricity from motive power has been a palliative; a happy one, but only a palliative. The lecturer went on to say that the real production of electricity has its source in chemical means. In dynamo machines the initial power is due to the combustion of fuel, which is a chemical combination, but the utilization of which, in a good engine, does not exceed 10 per cent. Whereas only 10 per cent. of the theoretical efficiency is obtained in the shape of power, as much as 90 and even 100 per cent. electrical calories can be obtained under favorable conditions in electro-chemical combinations. It is true that, in the latter case, the fuel used, which are metals such as zinc, sodium, cast-iron, are dearer than the fuel consumed in steam engines, but the efficiency is at once 90 per cent., which affords a large compensation for the discrepancy. If, for instance, we consider the case of cast-iron, a useful horse-power hour will consume 750 grammes, and the said consumption may be brought down to 500 and even 400 grammes. As cast-iron costs 40 francs per ton, the expenditure per horse-power hour will amount to 3 centimes (a little over a farthing). If to this is added the cost of the sulphuric or hydrochloric acid necessary to oxidize the metal, or about 1 kilogramme of acid per kilogramme of cast-iron, the cost of the useful horse-power hour amounts to 9 to 12 centimes, which cost is about equal to that of the production of electricity by means of dynamos driven by engines of 15 to 25 horse-power.

Moreover, when powerful engines are used for the production of electricity, shafting and belting have to be used, and the stoppage of a number of dynamos does not result in a corresponding reduction of the motive power expended. When electricity is used as motive power, there is scarcely, according to the lecturer, any advantage in substituting the power obtained from dynamos to that deriving directly from the steam engine; but the same does not apply in the case of the current being produced by chemical means; this he attempts to demonstrate experimentally, when the figures he uses give rise to objections.

The upshot of Mr. Jablochkoff's lecture is the utilization of local currents and polarization in batteries instead of their elimination. To this effect he uses a three-electrode battery, one being a metal capable of being consumed, the other an unoxidizable metal, such as platinum, and the third a porous carbon. On closing the circuit of the two-metal electrodes a powerful polarization is obtained which soon stops the chemical action. When the couple thus formed, and the third electrode are joined, a powerful current will be developed, so that the two first electrodes act as an accumulator, and the three together as a battery. When the battery is at rest it stores electrical energy, and the battery does not consume in open circuit.

Statistics show that by the use of the electric light in the central post-office in London there is a gain, in point of health, of two days per annum per employé as compared with gas.

The Denver, Col., Tramway Company last week secured an injunction restraining the city authorities from interfering with its construction of an electric road.

An extension of the Seattle, Wash., Elec Railway and Power Company's lines along shore of Lake Union is under consideration.

The electrical cars on the road between Oma and South Omaha were started on the 17th inst.

Continued from Page 5

other, whereby a governing function is secured, for a better description and understanding of which reference is made to said patent No 212,183.

"The poles of the lamp shown in the drawings are constructed in the form of suspending hoops or loops, from which the lamp is suspended, and the corresponding hoops or loops, with which they engage in the ceiling (or other locality where the lamps are used), are the positive and negative poles of the current-generating apparatus. Thus, by the simple act of suspension, the lamp is placed in circuit.

"I will now specify a construction whereby the protecting globe surrounding the light can be raised and lowered for convenience in renewing carbons and handling the lamp. This I accomplish by making the platform or gallery *O*, upon which the globe rests, vertically adjustable upon a rod O^1, attached to the lamp frame in any convenient manner. A set-screw should be provided, whereby the globe can be adjusted to any desired position. By this arrangement the work of renewing carbons and the reliable adjustment of the globe in relation to the voltaic arc are materially assisted.

"In order to accommodate long sticks of carbon, the platform or gallery *O* should be perforated to allow passage down through it of said carbon sticks. I prefer making the platform or gallery *O* of metal, and of such shape as that globules of molten copper from the coverings of the carbon, in dropping away, shall not escape to do damage.

"It will be particularly observed that in the form of dash pot employed the cylinder is the movable and the piston or plunger the stationary element. This construction implies more than a mere reversal of the usual make and operation of the dash pot, for by making the cylinder the movable element the general construction of a lamp can very often be materially simplified, as in the present instance. This form of dash pot is designed to be employed in connection with any of the moving parts of the mechanism of an electric lamp, where it is desired to retard a downward movement."

The lamp covered by patent No. 203,411 is referred to only for the purpose of illustrating the operation of the invention in suit, and the complainant's right to the relief prayed for does not depend upon the validity of that patent. The lower carbon of this lamp is held in a fixed position, and its upper carbon is carried by a sliding rod which passes through a ring clamp just large enough to permit it to slide freely through when the clamp lies flat on the floor of the regulator case, but which binds upon the rod when it is lifted by one edge. The lifter, which is upon the edge of the clamp, is attached to a soft iron core, which plays inside a wire helix, through which the current producing the light circulates. The attracting strength of this coil is proportionate to the strength of the current flowing through it. When there is no current flowing through the lamp the coil has no attraction at all, and the core consequently rests at the lowest limit and the ring clamp lies flat on its floor. In that situation the carbon rod slips freely through the clamp, and the upper carbon rests in contact with the lower one.

Upon the establishment of the current through the lamp it passes through the carbons with little resistance, because they are in actual contact. The circuit is, therefore, a strong one and energizes the coil strongly, and it in turn attracts the core strongly and pulls it downward. This movement being communicated to the lifter it, in turn, first lifts the ring clamp by one edge, which causes it to impinge closely upon the rod and then lifts the rod and carbon and so separates the carbon points. This establishes the arc. But the arc introduces a resistance to the current which diminishes its strength, the resistance increasing as the arc grows longer. Hence, as the arc lengthens by the consumption of the carbons and the increase of the space between them, the current grows weaker, and the attracting power of the coil diminishes until it lets the core move downward sufficiently to release the grasp of the clamp on the rod, so that it slips downward. As the upper carbon approaches the lower and so shortens the arc and diminishes its resistance, the current's strength increases, the coil again pulls the core upward and so tightens the clamp upon the rod and thus holds the upper carbon suspended at its normal distance from the lower. This process goes on until the carbons are consumed.

It will be observed from the description of the lamp in suit that when the current is first passed through it, the current divides at the lamp and passes through both pairs of carbons and instantly energizing the solenoids, draws upwardly the cores, and through the bar E^2, link E^3 lever *E* and lifter *D*, separates the pairs of carbons A^1. The separation of this pair of carbons does not operate to break the circuit and form an arc between them, but simply diverts the entire current through the remaining and unseparated pair of carbons *A*. The lifter *D*, continuing to rise, next separates the carbons *A*, thereby interrupting the circuit and establishing the arc between the last separated pair of carbons *A*. After the arc has been established between one pair, the carbons of the remaining pair are held separated by the ring clamp, their initial separation being such that the idle pair will be retained in their separated relation, while the regulator automatically moves and adjusts the burning pair, to separate or approximate them, as the conditions may require to regulate the length of the arc, and also to automatically feed them to maintain the arc.

When the burning pair of carbons has been consumed, the effective pull of the solenoids is diminished to such an extent that the carbons of the idle pair are brought into contact, which causes the entire circuit to be instantly diverted through them, the effect of which is to strengthen the solenoids and separate the carbons and automatically establish the arc between them.

The separation of the two pairs of carbons, so that the arc is established between one pair, and maintained between the carbons of that pair until they have been consumed, and then automatically established between the carbons of the other pair and maintained between them until they have been consumed is a dissimultaneous and successive arc-forming separation, and it is this feature which distinguishes the lamp in suit from all prior lamps.

The six claims of the patent which it is alleged are infringed read:

1. In an electric lamp two or more pairs or sets of carbons, "in combination with mechanism constructed to separate said pairs dissimultaneously or successively, substantially as and for the purpose specified.

2. In an electric lamp, two or more pairs or sets of carbons in combination with mechanism constructed to separate said pairs dissimultaneously or successively and establish the electric light between the members of but one pair (to-wit, the pair last separated), while the member of the remaining pair or pairs are maintained in a separated relation, substantially as shown.

3. In an electric lamp having more than one pair or set of carbons, the combination, with said carbon sets or pairs, of mechanism constructed to impart to them independent and dissimultaneously separating and feeding movements, whereby the electric light will be established between the members of but one of said pairs or sets at a time, while the members of the remaining pair or pairs are maintained in a separate relation substantially as shown.

4. In a single electric lamp, two or more pairs or sets of carbons, all placed in circuit, so that when their members are in contact the current may pass freely through all said pairs alike, in combination with mechanism constructed to separate said pairs dissimultaneously or successively, substantially as and for the purpose shown.

(*To be Continued.*)

Electric light wires are being put underground in Detroit.

THE ROSEBRUGH TELEPHONE DUPLEX.—Dr. Abner M. Rosebrugh, and his son, Mr. P. R. Rosebrugh, of Toronto, Canada, have recently obtained a patent in this country for a duplex telephone system. During their investigations they discovered that when electrical impulses of equal strength are generated simultaneously and in opposite directions in a metallic circuit grounded at both ends, the currents so generated may be made to continue in the metallic circuit without affecting, or being affected by the two ground wires. They also discovered, after much experimenting, that this can be accomplished in several ways—as, for instance, first, by using a transmitter with a doubly-wound secondary coil, one coil for each branch of the metallic circuit; secondly, by using a transmitter with two induction coils, the primaries being connected either in series or in multiple arc. By the application of these principles it is made possible for two telephone subscribers, or a telephone subscriber and a telephone operator at each end of a metallic circuit to communicate with each other simultaneously. Messrs. Rosebrugh use a cable with two insulated wires connected at the terminals in such a manner as to entirely neutralize the inductive effects.

A very useful electrical invention, tending to lessen the possibility of accidents in factories, is now being extensively adopted in Leeds, Eng. The breaking of a small pane of glass, which is adjusted against the wall of every room in the mill, will at once stop the engine, an electrical current being established between the room and the engineer's room, connecting with the engine's throttle valve, shutting off the steam in an instant. By this means the engine was stopped at the mill in New Wortly in a few seconds when a girl had gotten her clothes entangled in an upright shaft, and she was not hurt.

Watch springs, piano strings and similar articles are being successfully tempered by electricity. The steel is wound on a spool, placed in an oil bath and by the electric current kept at the exact degree of redness necessary for the temper required.

The rapidity with which our Western towns develop is one of the wonders of the age. The city of Grafton, North Dakota, which is only 8 years old, has 300 electric lights on its streets.

Cincinnati, Ohio, is to be lighted by the Brush system.

Electric lights have been adopted to such an extent in the cities and towns of Guatemala, that the importation of mineral oils has largely fallen off. At the capital the use of oil has diminished one-half.

The Storage Battery Motor Company has been incorporated in Chicago with a capital of $2,000,000. The company will manufacture and sell storage batteries, motors and street railway equipment.

The Edison light plant at Calgary, N. W. T., is being enlarged under the supervision of Mr. J. C. Wilson, superintendent of construction of the Edison Light Company of Canada.

The street railway companies of Springfield and Lowell, Mass., have obtained permission to use the single trolley system for over-head conductors.

Pueblo, Colorado, is to have an electric street railway. A company was recently organized with a capital of $500,000.

The San Francisco Electric Light and Power Company has been incorporated with $1,000,000 capital stock.

The Bell Telephone Company report an output of 32,000 instruments during the past year.

The aggregate candle-power of the electric lights used at the Paris Exposition was 273,812.

MODEL WIRED BUILDING.

Heretofore competition decided the character of wire to be used in buildings. Now the very best insulated wiring material is called for in all specifications, and many contracts have been fulfilled regardless of expense, which are models of perfect insulation.

A representative of this paper a few days ago visited the new building of the Union Trust Company for the purpose of inspecting the wiring for the lights, which method is attracting so much attention and favorable comment. This building, which is now rapidly approaching completion, is on Broadway, near the corner of Wall street. and the contract for wiring the same is one of the largest and most complete ever given out. Properly speaking. the building is not yet being wired, nor will not be until it is about ready for occupancy, but what amounts to practically the same thing, it is being conduited. The method employed of conduiting this immense twelve-story building is one so perfect in every way that a description of it at this time will be of exceeding interest. The system used is that of the Interior Electrical Conduit Company, of which a general description was given in our last issue, and the work is being done under the personal supervision of Mr. C. H. Du Bois. Mr. Du Bois has been engaged in electrical contract work for the past 25 years, and there is probably not another person in the United States so well qualified to undertake such a task as this. He is a practical electrician, and perfectly understands the requirements of a perfect system of wiring.

While our representative was watching the workmen on the conduits, Mr. Du Bois came in, and kindly consented to give us all the facts he could in answer to our inquiries in reference to the work.

The building is to be lighted by about 2,000 lamps. which are very liberally distributed throughout every floor. We noticed in many small sized rooms provision for six or more lights. There are to be 1,100 outlets, and the central hanging lamps are to be controlled by a switch in a convenient place on the wall. Besides the main cut-out on each floor. which controls all the lights on the floor, each room has a cut-out.

"This is a very valuable improvement in wiring," said Mr. Du Bois. "It is very convenient to be able to cut off any lamp, room or floor at will."

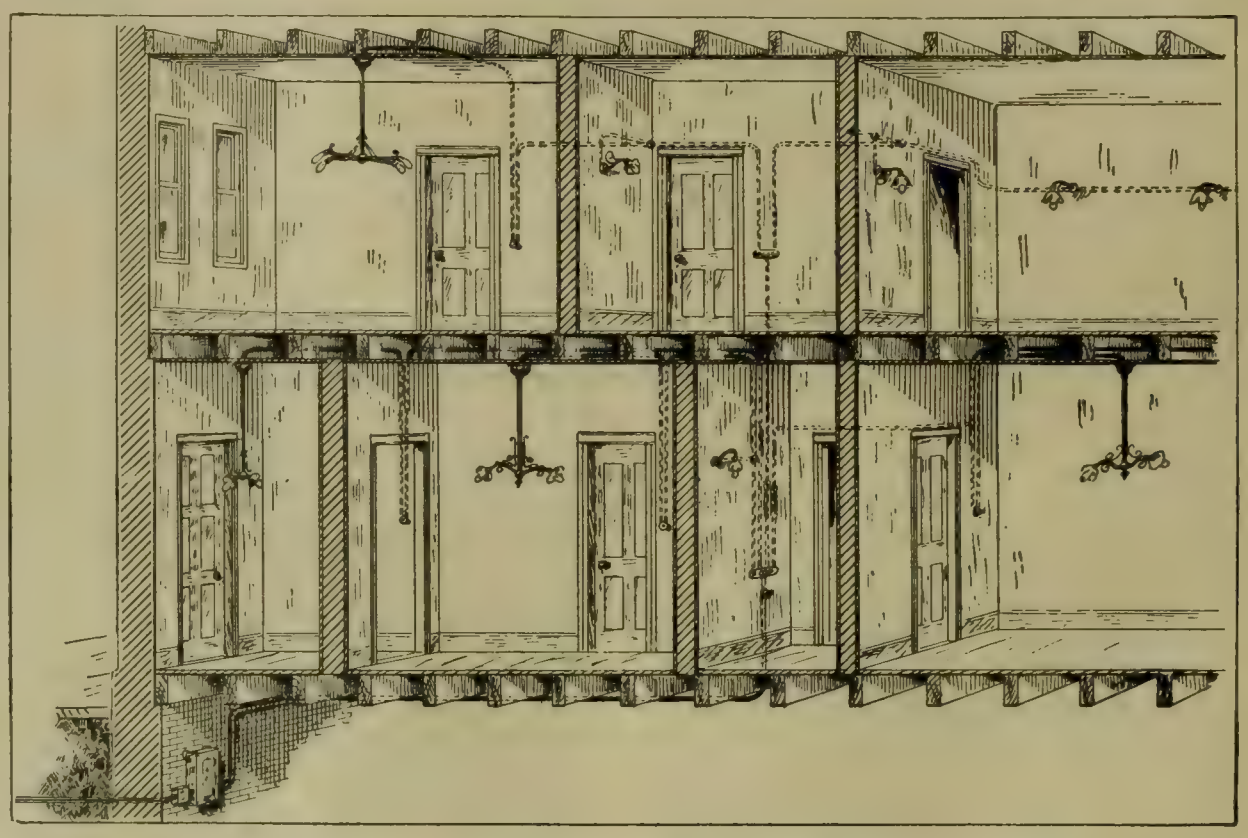
The conduits, as was explained in our last issue, are tubes made of paper prepared in such a manner as to render them extremely tough, waterproof and heat-proof. Of these qualities we shall speak later. The tubes are sufficiently flexible to yield to any inequality on the surface on which they are to be laid. They are, without question, practically indestructible, and when a building is tubed in this manner, it is tubed for the lifetime of the structure.

"The great point in favor of this method of wiring a building," continued Mr. Du Bois, "is the ease with which the wires can be reached in case of trouble with them. We do not claim to be able to prevent possible wire trouble, such as crossing, etc.; what we do claim. however, is that in case a wire becomes defective in any way our system admits of the utmost ease of its removal and the substitution of a good wire, with as great ease, and this without marring the plastering or any part of the building."

"You know," continued Mr. Du Bois, "that under the old method of wiring, in case it is necessary to remove a defective wire, the plastering must inevitably suffer. This is absolutely overcome by our system."

"How about the heat-resisting qualities of your conduits, Mr. Du Bois," inquired the reporter; "supposing a couple of wires within your tubing should become crossed, and burned out, would not the intense heat be likely to damage the conduit?"

"To answer that question best," said Mr. Du Bois, "I will relate to you what took place during the tests of the fire-proof qualities of our tubing, which were made some time ago. The Board of Fire Underwriters, and others interested were present. Two wires were placed in some of our tubing, and connected with a dynamo. The current used was intense; so much so that the wires were soon completely burned up. After the current was turned off, my son, who was present, blew into one end of the tube and a cloud of dust and ashes came out at the other, showing that the wires had been literally cremated. During the passage of the current I placed my hand on the outside of the tube, and felt only a slight warmth, that was all. Yet the heat developed within was sufficient to completely burn the wires up. The tubing was afterwards examined, and the interior was found to be uninjured in any way; it was just as smooth and bright as it was before the tests. These tests prove beyond question the impossibil ty of a fire starting in this way, which, of course, is a matter of great concern these days. And in this connection," he continued. "I want to say that the idea of your paper in getting the opinions of electricians on this very important question, and others of like nature, is one of the best things that was ever projected. It is a very timely topic, and I think that your work will result in a healthy condition of electric lighting hereafter, and a restoration of public confidence."



STREET AND INTERIOR OFFICE CONNECTIONS OF INTERIOR ELECTRICAL CONDUIT.

In answer to inquiries regarding the moist proof and waterproof qualities of the conduits, Mr. Du Bois said they had received many practical tests, and they proved their superiority over everything else that had ever been used. "That fact." said he, "that there is nothing metallic in their composition is, I believe, the reason that no condensation takes place inside of the tubes, and the compound with which they are thoroughly impregnated, renders them waterproof.

As an instance of their being waterproof and moist proof Mr. Du Bois cited a case where these qualities were severely tested. "At Mr. Rockefeller's place at Tarrytown," said he, "which is wired by our sytem, a conduit was laid underground between the engine-house and barn. After the trench had been filled in the rains caused the earth to sink, making a depression along the line of the conduit. Water collected in this trench and consequently kept the earth around the conduit in a very moist condition. I tested the conduit by blowing in at one end. When this was done a cloud of powdered soap-stone came out of the other, showing that there could not possibly be any dampness within the conduit, or else the powdered soap-stone would have come out in the shape of mud."

At this point it may be explained that powdered soap-stone is put into the tubes in order to facilitate the drawing through of the wires, etc.

In further conversation, Mr. Du Bois stated that the merits of the system consisted of its safety, accessibility to the tubes and durability. Furthermore, this system of wiring is more economical and convenient than any of the old methods. A building tubed in this manner need never be disfigured when wires are to be re-run or increased in number, and the tubing cannot possibly get out of order in any way. Hence its economy.

"Our usual method of laying the conduits," continued Mr. Du Bois, "is to fasten them to the laths or bricks of the walls, ceilings or floors in the case of new buildings, before the plaster is put on. When the plaster is applied the tubes are buried therein and out of sight. The ends of the tubes come out of the wall at the points where connections are to be made with lamps or cut-outs, and the wires are afterwards pulled through by means of a "fishing wire." The advantages secured by this will be readily apprehended. By the old methods of wiring, the insulated wires, if buried in the plaster, are in immediate contact with it, and there is no protection to the insulation. Decomposition takes place, as a result, and sooner or later the insulation is destroyed and, of course, the wires become useless. There is no way, in a case of this sort, to replace the defective wires with good ones without taking up the plaster and making life miserable to the tenants. Our system obviates all of this."

In answer to an inquiry as to what kind of wire would be used for the lights, Mr. Du Bois replied that it was not definitely settled yet, but that probably duplex flexible wire would be used.

A very good plan of protecting the conduits containing the wires connecting with the mains is adopted. These are laid under the surface of the tiles in wooden trenches and then pitch is poured over them, forming a conglomerate mass of pitch

and conduits By this means absolute protection from moisture and mechanical injury are secured at points where wires would ordinarily be exposed to danger of disturbance.

It is Mr. DuBois' opinion that this job of wiring will be the most complete and perfect ever accomplished in all his experience. He wired the Mills Building, on Broad street, while being erected, some years ago, and since his connection with the Interior Electrical Conduit Company has wired the elegant residence of Mr. Rockefeller, at Tarrytown; the residence of J. Pierpont Morgan, the new telephone building in 38th street, and many other private residences and business buildings, all of which work is giving the utmost satisfaction.

Mr. Du Bois has at different times been connected with the Holmes Burglar Alarm, the American District Telegraph, Edison's and the Electric Enterprise Company, mainly in construction work. He represented the Bell Telephone interests in Mexico for over a year. But judging from his earnestness of manner in connection with his present duties he evidently finds more satisfaction in the work than in all his other experiences, probably from the fact that he is working in the interest of something that has genuine and enduring merit.

ELECTRICAL PATENTS GRANTED DEC. 24, 1889.

417,742. Electric cam; Henry S. Prentiss, New York, N. Y.

417,747. Device for suspending electrical conductors; Sidney H. Short, Cleveland, O.

417,753. Time distributer for electric clocks; Louis H. Spellier, Philadelphia, Pa., assignor to the Spellier Electric Time Company, same place.

417,758. Automatic circuit closer; John Von der Kammer, New York, N. Y., assignor of one-half to James Ward Packard, same place.

417,787. Incandescent lamp socket; James W. Packard, New York, N. Y., assignor to the Westinghouse Electric Company, Pittsburgh, Pa.

417,788. Incandescent lamp socket; James W. Packard, New York, N. Y., assignor to the Westinghouse Electric Company, Pittsburgh, Pa.

417,789. Incandescent electric lamp; James W. Packard, New York, N. Y., assignor to the Westinghouse Electric Company, Pittsburgh, Pa.

417,794. Armature for electric machines; Albert Schm d, Allegheny, and Nikola Tesla, Pittsburgh, assignor to the Westinghouse Electric Company, Pittsburgh, Pa.

417,814. Galvanic battery; Patrick B. Delany, New York, N. Y.

417,842. Device for an electric car-signal; John P. Runkel, Milwaukee, Wis.

417,910. Electric heating apparatus for electric railways; Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company, of America, same place.

417,923. Electro-therapeutic apparatus; Frederick J. Kneuper, New York, N. Y., assignor to Emilie Louise Kneuper and Chas. G. Willing, same place.

417,926. Electric circuit controller; Frederick A. Lane, New Haven, Conn., assignor of one-half to Frank E. Morgan, same place.

417,927. Automatic electric clock-winding device; Frederick A. Lane, New Haven, Conn., assignor of one-half to Frank E. Morgan, same place.

417,928 Electric winding clock; Frederick A. Lane, New Haven, Conn., assignor of one-half to Frank E. Morgan, same place.

417,937. Motor-truck; Edgar Peckham, New York, N. Y.

417,974. Electric railway contact; Francis Blackwell, New York, N. Y.

417,992. Underground electric conduit; Dell, St. Louis, Mo.

418,069. Electrical toy; Henry G. Rogers, Washington, D. C.

418,070. Electrical toy; Henry G. Rogers and Andrew M. Coyle, Washington, D. C.

418,120. Magneto-electric machine; Webster Gillette, New York, N. Y., assignor to C. F. Gillette, same place.

418,125. Electric synchronizing device for clock pendulums; James Hamblet, Brooklyn, N. Y.

418,138. Metallurgical filter; John S. McArthur, Pollokshields, County of Renfrew, Scotland.

418,140. Electrode for secondary batteries; Harry G. Osburn, Chicago, Ill.

C. B. James, of 98 Lake Street, Chicago, dealer in fine tools for accurate measurement, has just issued the advance sheets of his catalogue for 1890. The catalogue is fully illustrated and contains much valuable information in the way of tables, etc. Wire gauges and other tools used by electrical people are here found, and users of such would do well to communicate with Mr. James.

Mr. Eugene T. Lynch, Jr., of 120 Broadway, this city, has secured the contract to establish a light station in Hampton, Va. In addition to Hampton, Elizabeth City and several adjacent institutions will be lighted from this station. Fifty 2,000 c. p. arc lights and 8,100 16 c. p. incandescent lamps will be used, and the plant complete will be one of the finest in the South.

PUBLIC OPINION.

PUBLISHED SIMULTANEOUSLY IN WASHINGTON AND NEW YORK.

WASHINGTON, D. C., November 1, 1889.

The following of interest to you appears in this week's *Public Opinion*:

ECONOMIC VALUE OF ELECTRICITY.

Mr. A. R. Foote's book on the Economic Value of Electric Light and Power is of more than ordinary interest to the public at the present time, when there is so much doubt expressed in various quarters as to the danger invested in the wires which contain the electricity used for lighting our cities and for a motive power. The subject is treated, as the title indicates, from an economic point of view, and it is well worth careful study. The book is full of statistics and arguments favoring the general adoption of electricity for lighting and as a motive power; and the statements are very clear, comprehensive, and conclusive. The author says: "To speak of the dangers of the electric service is a misnomer," and he gives extracts from the reports of the fire departments in several large cities, showing that a large percentage of the fires is caused directly by oil. Selections from papers written by insurance experts are quoted, proving that electricity, when properly handled, is the force most easily controlled and least hazardous, and that electric lighting is the best and safest form of artificial illumination. The testimony of eminent physicians, showing the hygienic advantages of electric light in our public theaters and halls, is also given. Much of the mystery connected with electricity to the average person is caused by ignorance, or a very slight knowledge of what is in reality the greatest force which man has ever made his servant. Mr. Foote treats the subject in an intensely practical manner, and uses language which is intelligible to the general reader. He defends in a most able way a subject which has been so misrepresented by ignorant or unscrupulous writers, and throws much light upon a force which is but little understood by the masses as yet. The author has brought together recent facts and testimonies, and has presented to the public a most useful and convenient volume on a subject with which we ought to be far more familiar.

Yours, very truly,

THE PUBLIC OPINION CO.

THE WORLD'S TELEGRAPH-TELEPHONE LINES.

The total length of the telegraph lines of the world amounts to 557,064 miles. Europe, 216,490; America, 163,642; Asia, 46,800; Australia, 24,204, and Africa, 12,060 miles. There have to be added 950 submarine cables, 774 of which are laid in European seas, and have a total length of 3,200 miles, while the remaining 176, with a length of cable of 85,850 miles, belong to companies. The service of these lines is carried out by 160,000 offices.

Telephonic statistics are as follows: The United States, 739 exchanges and 158,712 subscribers; Germany, 164 exchanges and 31,325 subscribers; England, 122 exchanges and 20,420 subscribers; Sweden, 137 exchanges and 12,864 subscribers; France, 28 exchanges and 9,847 subscribers; Switzerland, 71 exchanges and 7,626 subscribers; Russia, 36 exchanges and 7,589 subscribers; Italy, 28 exchanges and 6,183 subscribers; Belgium, 4,674 subscribers; Austro-Hungary, 4,200 subscribers; Norway, 21 exchanges and 3,930 subscribers; Holland, 9 exchanges and 2,876 subscribers; Spain, 2,218 subscribers; Denmark, 1,837 subscribers; Portugal, 2 exchanges and 890 subscribers. The town with the largest number of subscribers is Berlin, having upward of 10,000, and followed by New York, 6,900; Paris, with over 5,000, and London about that amount.—*London Standard.*

The Westinghouse Electric Company has received orders for three incandescent electric light plants from San Salvador, South America. These are regarded as a result of the visit of the Pan-American congressional delegates.

The New Bedford, Mass., Gas Light Company is now putting into its electric lighting station two 50-arc-light dynamos of the Waterhouse patent, intended to supply power for arc lights for stores and commercial use, and each dynamo has a capacity of 500 incandescent lights.

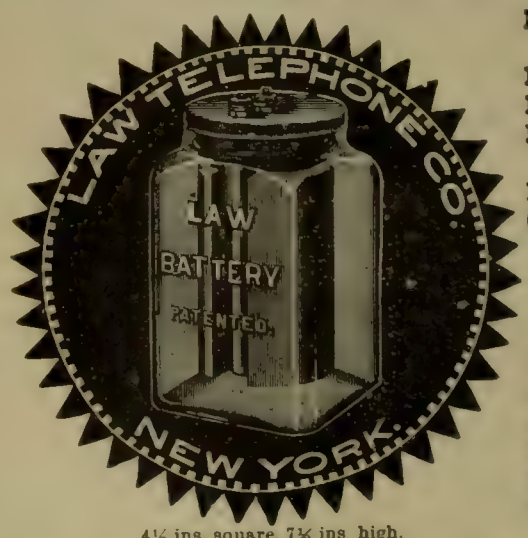
Savannah, Ga., will abandon the tower system of electric lighting and substitute the ordinary method. One hundred arc lights are to be added to the present number.

The Double Cylinder Law Battery

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Pure Sal Ammoniac.
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CHAS. A. STRELINGER & CO., Detroit, Mich., for Detroit.

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The reaction in public sentiment in favor of the resumption of electric lighting is becoming more and more pronounced, and the question now is, "what can be done to relieve the embarrassment?" Everybody's hands seem to be tied, and nothing tangible is promised. There is no doubt of the possibility of making overhead wires safe if constructed properly and intelligently. The many replies we have received to our circular in reference to the question of making electric light wires safe, are almost unanimous on that point, and we commend these articles to the careful consideration of the Board of Electrical Control and other municipal officers interested. The companies, no doubt, are ready and willing to go ahead and restore the lights when permitted. We do not see, however, how any permanent settlement of the differences can be effected until the persons representing the city in electrical operations are electricians not only in name but in fact. Politicians can no more be entrusted to deal with the scientific questions that naturally arise in connection with electric lighting than a pig could govern a State, and the sooner a board of practical electricians is substituted for the present "wire pulling" ring, the sooner shall we have electric lights back again. All agree now that there is greater danger to our citizens without the lights than there was with them, and New York to-day stands in the anomalous position of being the only city in the United States without electric street lights. The change from gas to electricity, although very marked, is as nothing compared with the change from electricity to gas. It reminds one of the traditional Egyptian darkness. There is one thing certain, however, in the present chaotic state of affairs, the absence of the electric light has created a very strong and general sentiment in its favor, and when it is restored as a street illuminant it will be heartily welcomed. The work of destruction of the wires is about complete. Nothing is left, and what the next step will be no one can prophesy. The junk dealers have taken advantage of the situation, and profited greatly as a result. One of the men who had a contract to destroy the lines is a junk dealer by trade. It looks as though politics was the heart and soul of the shameful crusade against the wires.

Mr. C. J. Kintner, the well-known electrical expert, supplements his views on the question of making electric light currents safe, which were published in the issue of January 4, with a letter giving some additional and valuable information on the subject. Mr. Kintner describes the system of concentric conductors used in London, which has proved to be efficient in the safe transference of high potential currents, and believes that if a line carrying 10,000 volts can be operated with safety in London, there is no reason why electric lighting cannot be conducted with safety in this country. He also makes prominent the fact that the electric light service in London is in the hands of competent electricians, and is subject to rigorous laws.

Mr. Kintner advances a novel theory as to the cause of the subway explosions which occur occasionally in this city. In his opinion leaky gas mains are not the cause of these upheavals; they are chargeable to self-generated gases in badly engineered conduits. These dangerous gases are evolved by the galvanic action between the lead, iron and other dissimilar metals used in the construction of subway lines.

MEETING OF THE ELECTRICAL BOARD.—The first meeting of the Board of Electrical Control since last October was held in the mayor's office, January 9th. Their report of recent operations says the rules and regulations of the Board are universally violated, that "dead" poles and wires make up from thirty to fifty per cent. of all those existing, and charges the electric light companies with utter recklessness and carelessness in throwing the burden of removing unused lines upon the city. The report dwells at some length upon the æsthetic features of the situation. The Board objects to many of the poles because they are crooked and unpainted. Mr. Henry S. Kearney, the engineer of the Board, submitted his report. He says the condition of the subways was satisfactory in the main. The mayor announced it as his opinion that the work on the Third and Eighth avenue subways was done in a very loose and careless manner, and did not believe it was done under proper regulations. He did not agree with the report. The report, however, was adopted, Mayor Grant being in the minority.

CABLE EARNINGS.—The gross earnings of the Commercial Cable Company for the quarter ending December 31, partly estimated, were $495.189, and net $320,187. The statement for the year shows gross earnings of $1,789,387, and net $1,089,379. Interest charges for the year were $140,256, being six per cent. upon $2,337,600 of debenture bonds, and sinking fund requirements were $200,000, a total of $340,256, leaving $749,123, or more than eleven per cent. applicable to the stock. An Atlantic cable company which can show earnings equal to eleven per cent. with the present sharp competition, must be pretty well managed.

THE DULUTH ELECTRIC LIGHT COMPANY.—The Duluth Electric Light and Power Company of Duluth, Minn., has had a year of unprecedented prosperity. Two 750 sixteen c. p. incandescent dynamos of the Westinghouse alternating current system have been added to its plant, and its motive power has been greatly increased. It is behind in its orders for wiring of buildings, etc., and the demand for help far exceeds the supply.

GREAT ELECTRICAL INVENTIONS.—Among the great successful inventions in the practical application of electricity, the United States may claim the telegraph, the telephone, the incandescent light, and unquestionably the microphone. The latter was invented by Hughes in England, but he lived the greater part of his life in the United States, where he obtained his education which led him to the invention. To France belongs the invention of the accumulator and Gramme ring; Italy, the battery and Pacinotti ring; England, the self-exciting dynamo; Germany, the drum armature; Russia, the commercial arc lamp.

CENSUS OF ELECTRICAL INDUSTRIES.—Mr. Allen R. Foote, special agent electrical industry, census office, Washington, is sending to "all persons interested in the electrical industry" a circular and a "preliminary schedule," the latter containing questions on subjects relating to the character of business, officers, etc, which are to be answered and returned to Mr. Foote. If any person or company fails to receive a schedule Mr. Foote would be glad to be apprised of the fact so that he may forward the same. His address is that at the head of this paragraph.

A TELEPHONE COMPANY IN COURT.—The People's Telephone Company of Philadelphia is before the New Jersey Court of Chancery on a complaint of certain stockholders. They aver that the annual meeting of the company in August last was packed in the interest of certain parties and that there was an over-issue of 500,000 shares of stock. An injunction was granted restraining the board of directors elected at the annual meeting from transacting any business until an investigation can be made.

ELECTRIC LIGHTING IN HAVANA.—The electric lighting plant of the Spanish American Gas Light and Power Company in Havana, Cuba, now comprises three 1,500 light Westinghouse alternating machines, and six 50-light Thomson-Houston arc machines.

It is interesting to note the high degree of efficiency attained in the operation of the Cincinnati Inclined Plane Electric Railway. Every part of the equipment is of the best material, and represents the latest improvements in electric railway machinery. The results show that it is economical in electric railway management as well as in everything else to be thorough and use only first-class material.

The Westinghouse Electric Company has secured a contract for a plant of 6000 incandescent and 200 arc lights, to be located in Willamette, California. This is the largest light contract let on the Pacific coast, and one of the largest in the United States.

A chair of electrical engineering has been established in the Western University at Pittsburgh. Prof. C. V. Kerr, a graduate of Stevens Institute and of the Western University, will be instructor.

Some Chicago merchants have established an electric light plant of their own for the purpose of illuminating the fronts of their stores, as well as the interior.

The White Plains, N. Y., Gas and Electric Light Company will increase its capital to $150,000 in order to extend its plant.

J. H. Herrick has been elected President of the Sprague Electric Railway and Motor Co., *vice* E. H. Johnson resigned.

The Fremont, Ohio, Gas Company has been absorbed by the Electric Light Company at a cost of $75,000.

The new electric railway in Covington, Ky., is to be opened on March 15th.

Seymour, Ind., is to be illuminated by electricity.

PROF. GEORGE FORBES, F. R. S. OF LONDON, ENGLAND.

Prof. George Forbes, F. R. S., of London, a member of the Royal Society of Electrical Engineers, is staying at the Windsor Hotel, in this city. He has inspected all the principal electric lighting stations in Europe and has made the subject of electric lighting a study for years.

In reference to the agitation over electric lighting in this city, Prof. Forbes expressed himself as follows:

"What has most impressed me in my various visits to this country, especially in New York, is the very temporary manner in which circuits have been constructed and the great risks run by the corporations who started the lighting for the sake of a temporary profit; whereas in Europe those who have initiated electric lighting from central stations, especially with high pressure, have foreseen the absolute necessity of adopting every precaution against fire and life risks in the interests of electric lighting generally. This period of bad work in New York has seemed to me and other electricians abroad to be followed by a period of incompetent supervision by the Board of Electrical Control, and finally to be followed by panicky legislation on the part of civic authorities, which is telling disastrously against the progress of electric lighting in all parts of the world. In London and in England generally the principal control has been handed over by Act of Parliament to the Board of Trade, which is a Government department. When applications for powers to light a district have been applied for, the Board of Trade on several occasions has appointed a commissioner to hold inquiry and to hear evidence as to the conditions under which such power should be granted The Board of Trade has also on special questions, such as the conditions under which overhead wiring shall be allowed, consulted with the Council of the Institution of Electrical Engineers and thus obtained the best possible technical advice as to rules and regulations. Further, in every case where the Board of Trade has made regulations it has also regulated penalties, and otherwise given power by which its regulations are certain to be enforced. As far as I have been able to see, in all these points the action of the Board of Trade differs very much from the action of your Board of Electrical Control.

"The Board of Trade has a permanent electrical expert whose duty it is to give them advice and see that their regulations are carried out. Their technical adviser is Major Cardew, who is a skilled electrician, and who is always anxious to call in the assistance of men of technical experience, as represented by the Council of the Institution of Electrical Engineers. Electric-light currents have been distributed in London by means of overhead wires in the past, but in the future everything will be put underground. I may say that our overhead work has always been done by the electric-light companies with great judgment and foresight, and with a view to their permanent rather than their temporary interest. The overhead work has been done in an admirable manner, with the best insulation and with perfect mechanical construction; and even with a pressure of 2,500 volts alternating current no damage to the wires has occurred and no deaths from the high-tension currents. Both the public and the electric-light companies feel that for permanent work the conductors must go underground: this substitution is going on gradually, and before many years have elapsed will be completed. All the permanent new work is now being put underground.

"We have been operating high-tension currents in London for some years without any deaths, and this is simply due to the fact that proper care was taken in the construction of the lines. I believe that the application of similar methods in New York city would result in the same degree of safety.

"I know of cases where underground distribution has been in use in Europe for about six years with perfect success. The Grosvenor-Gallery station which uses the alternating currents of 2,500 volts, has had many miles of conduit at work for several years. In Milan, also, similar currents have been used underground for several years, and in many other places which might be mentioned. For that matter in most continental towns the electric light wires are placed under ground.

"It is not only demonstrated by theory, but by practice as well, that currents can be operated successfully and safely underground. The best evidence of this is perhaps to be got from the action of the London companies. Take, for example, the London Electric Supply Company, which has invested something like £250,000 in overhead conductors and which is now going to the expense of putting the whole of these underground; and the Metropolitan Electric Supply Company, which is using a large portion of its capital of £500,000 in putting its mains totally underground.

"European electricians do not agree with the statement made by the great American electrician, Thomas A. Edison, that putting the high-tension wires of this city underground would increase the danger. If he made such a statement I think it must have been a hasty and hardly sufficiently considered statement, because in his conversation recently with electricians in Europe I think he must have realized the general impression that the danger from electric shocks is thus almost entirely prevented.

"The subways in this city, I have observed, are constructed either of wrought or cast iron pipe laid in cement, or cement-lined pipe laid in cement. I consider that this is one of the most convenient and satisfactory means of laying the conductors, provided always that the insulation of these conductors is of the best possible description. The drawing-in system, involving the use of wrought-iron pipe from two to six inches in diameter, has been extensively used in London, and alternating currents of 2,500 volts have been conducted through them with entire success. We have had no experience with cement-lined pipes in England, but we would certainly prefer them to the ordinary iron pipe.

"I may say that the present tendency in incandescent lighting in England is almost entirely in favor of the alternating current system. I think that nine-tenths of the capital which is now being expended in electric lighting in London is for central stations on the alternating current system. There are districts, however, where the continuous current at low pressure can be worked economically; such as the St. James district, which includes all the clubs—highly concentrated districts where the lights are applied up to late hours of the night. This is one of the special cases where that system can be used economically.

"I consider both systems absolutely safe as regards electric shocks if the insulation is properly attended to, and if the total system is under proper supervision and regulations. The risk of fire would also be trifling if these conditions could always be fulfilled. As a matter of fact, however, fire risks are greater where large quantities of electricity are introduced into houses than when a high pressure is adopted; and I also consider that the separation of the mains in the streets from the wiring in the houses by means of the alternating-current converter is a great security, when proper steps are taken to insulate the high pressure current of the streets from the houses."

CAN ELECTRIC CURRENTS BE MADE SAFE?

WHAT PROMINENT ELECTRICIANS HAVE TO SAY ON THE SUBJECT.

The following replies in answer to our circular on the above named subject have been received since the discussion in our last and previous issues:

THOMAS D. LOCKWOOD,

ELECTRICAL EXPERT, AMERICAN BELL TELEPHONE CO., BOSTON, MASS.

Question 1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer.—I think they can *generally*, yet no matter how carefully they are constructed and maintained contingencies will rise which cannot be foreseen, just as in the operation of railways or any other business.

Question 2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer.—Yes several, if pains are taken, to look out for wear and tear; by daily and even more frequent testing, and by prompt removal of defective wire.

Question 3.—Is there, in your opinion, any reliable method of laying electric light wires under ground? If yes, please state.

Answer.—Not by any but the common sense method. Knowing what is to be done it can be done. I am quite certain that a proper conduit can be made for electric light wires alone which can be made quite safe.

Question 4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer.—No. Danger will always exist where *any* of the forces of nature are employed. It can however, be much minimized by proper care.

Question 5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer.—It cannot at all; but it can be cut down very materially by the best work, the best men and the best materials. By good construction, constant watchfulness, and careful maintenance.

Question 6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer.—A cut-out inside operated from the outside Wires run on non-combustible bases, and fuses at all necessary points with a receptacle to catch molten metal.

The subject is one which cannot properly be discussed by a few answers to questions. In the first place I think and have always thought it wrong to place so many arc lamps on a circuit as to require the driving of a current of from 8 to 16 ampères at a pressure of from 2000 to 3000 volts.

But since this is done, the proper thing to be done is obviously to use proper insulation. This everyone knows that but few electric light companies have done. They have used the non-insulating covering known as underwriters, well knowing it to be no insulator at all; and while good articles could be purchased if customers were willing to pay the price.

The substance of the whole matter is that electric lighting will always be liable to cause accident, exactly as is gas, steam, fire or any other force which man has made subservient; but that this liability can be reduced to a very low point, if the business is properly run, few lamps on a circuit, proper insulation used; and if care, the care necessary in dealing with a possible dangerous force, be taken by management and men to make construction good, keep repairs well up; to take down immediately all bad work; and to be personally careful in handling all parts of a circuit.

The force of an electric light company ought to have as strict discipline as an army—and notices ought always to be put up warning the public to let things alone.

And if judgment, and the proper amount of money be laid out, this safety can be secured just as well under ground as overhead.

It is too costly? it won't pay? Then the business should be discontinued. No man has a right when engaged in a business which under certain conditions is hazardous to himself and others, to neglect the conditions of safety because they are costly.

Mr. Chas. Cuttriss, electrician of the Commercial Cable Company, was presented by his colleagues with a very pretty silver match box for X'mas.

A San Francisco family used a phonograph to cheer the mother's illness and also to preserve the tones of her voice after death.

ELECTRICAL EXPERT KINTNER DISCUSSES THE ELECTRIC LIGHT QUESTION.

NEW YORK, January 8th, 1890.

To the Editor of "THE ELECTRIC AGE."

Sir:—Touching the question of proper insulation and the construction of systems of electrical conductors for electric lighting, I think very much valuable information might be obtained from our slow-going English cousins, who, if they have not made rapid strides in the introduction of electric lighting plants, have, at least, been very certain of their ground, in so far as they have substituted this modern innovation for older and alleged safer systems of illumination.

During all of the discussion which has taken place within the past year in America, very little seems to have been said by electricians of the progress in this direction abroad. In the great city of London I am advised that accidents from electricity are very, very rare, and that the statutes governing the distribution of electrical currents are based upon practical common sense ideas, while those who have to do with the construction and the management of electrical systems are, in every instance, as they should be, expert electricians who put into practice engineering ideas only in this very important art. The greatest care is observed in locating electric light conductors on poles entirely apart from similar means of support for telephone and telegraph wires. The insulation is of the most perfect nature, and every detail of construction, looking to the safety of the public, is most rigorously carried out. To what extent these important features are followed in this country, and particularly in New York City, it is obviously useless for me to say, and until the entire control of this important industry which is a specialty in itself, be placed in the hands of specialists who have knowledge enough to dictate proper laws, and power to have the same passed, and always rigorously executed at the hands of subordinates who are educated experts, we can hope for no safety in the use of electricity by systems of distribution.

The system of concentric conductors, to which I referred in my answer to your inquiries, has been in use in London, between Deptford and Charing Cross, for almost a year, and the arrangement is as follows:

First. A central copper split tube constitutes one main conductor, which carries the entire primary current over a distance of eight miles. This copper conductor is surrounded by what is known as the "Ferranti Compound," an insulating material which is found to answer the purpose, and tested at a million volts; outside of the compound is placed a metallic shield, acting in the nature of an armor, which in turn is connected to the earth through an outside surrounding iron tube, the latter being connected to one pole of one or more alternating current generators, the other pole of which is connected directly to the interior copper tube.

This enormous conductor carries at present, as I am advised, a primary current for 250,000 lamps, at an electro-motive force of 10,000 volts. At intermediate stations converters are used, converting, first, to 2,500 volts, and finally, secondary converters converting to 100 volts to the consumption circuits. These consumption circuits supply directly the 250,000 lamps, and have capacity for 1,000,000 lamps.

With the subordinate system of concentric tubing conductors of the same nature running into the houses, to the chandeliers and the lamps, there is no possibility of dangerous shocks, and with the proper system of cut-outs in the man holes adjacent to the main conductor, there is not the slightest possibility of high-tension currents entering the houses. The outer concentric conductor acts as a protector both against moisture and dangerous shocks, and there is not the slightest question but that, with such a system, absolute security can be maintained. There is no danger of crosses between telephone, telegraph, or other wires and high-tension conductors, said conductors being always of the potential of the earth, and the inner or return conductors being absolutely inaccessible.

In response to the replies which some of your correspondents have made, to the effect that there is now no means of avoiding the danger of high-tension alternating currents, I have simply to say, that the best proof that it can be done lies in the fact that it is being done, and successfully.

The hearty endorsement as to the safety, economy and practicability of this system by such eminent authority as Sir William Thomson, (and it has his endorsement), ought to quiet forever the baneful effects of the opinion of alleged electricians who make a specialty of dog killing with a special kind of apparatus for the sole purpose of belittling that apparatus in the eyes of the public.

Mayor Grant deserves very great credit for the vigor he has displayed in attempting to undo much that has been wrongly done by a stubborn, ill-advised predecessor, who seemed not to know what to do, and rarely willing to accept suggestions of those who knew the real needs of the issue.

In the heat of all this discussion Mayor Grant would do well to take into his confidence some practical electrical engineer known to be retained by none of the companies, and thoroughly conversant with this type of engineering abroad, where much more care and attention has been given the matter than here.

In the great bustle of Americans to make money, I am sorry to say, in many matters where life and property are concerned, self-gain is often made precedent to security. In Europe there is much more stability in this respect and rigorous laws for the protection of life and property are made and vigorously executed.

The present system of conduits used in the subways, made of iron and filled with lead-covered cables, has been well proven to be practically worthless in London, it being a matter of common knowledge there that the galvanic action between the lead and iron will soon destroy the iron, and yet the electrical experts who have this matter in charge here seem never to have realized it.

It is also a fact demonstrable that gases generated by the galvanic action between the lead, iron, and other dissimilar metals used, are often deadly and explosive, and the gas companies are accredited with leaky mains, and the electric light companies with leaky circuits, whereas the total trouble is due, as before, to self-generated gases in badly engineered conduits.

There are other very important matters, not enumerated here, that time and experience have developed abroad, which should be discussed and settled by properly trained experts.

These few suggestions are thrown out in support of my proposed settlement of the difficult problem.

Let us hope the time is ripe for a discontinuance of this interminable suicidal jangle between the leading electric corporations as to which has the better system. There is room enough for all. Both of the great incandescent systems are practicable, and each has its especial advantages under especial conditions; there is no gainsaying that fact. Both are dangerous under conditions predicated by the enemy; both equally safe under conditions based upon careful and considerate construction; either will "kill dogs" in the hands of a paid Guy Fawkes, masquerading under cover of humanity to fellow man.

Is it not time, then, to bury the hatchet in the interest of a common cause, and to exert our total energies in elevating rather than belittling the greatest of modern arts?

Yours truly,

C. J. KINTNER, C.E.

Our English friends are looking forward to the time when the Bell patents shall expire. They are proposing to establish co operative telephone companies when this event shall come to pass, and are figuring on the possibilities of large profits on a small capital.

The alarm-clock of the future will have an Edison phonograph arrangement that will exclaim "Get up!" in stentorian tones.

ELECTRICAL PATENTS ISSUED DECEMBER 31, 1889.

418,198 Method of making collars or axles by electricity; Hermann Lemp and Elihu Thomson, Lynn, Mass.

418,227 Electric exercising machine; Edward W. Robinson, Boston, Mass., assignor to the Electric Exercising Machine Co., Nashua, N. H.

418,248 Electro magnetic motor; Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place

418,249 Lightning arrester; Elihu Thomson, Lynn, Mass.

418,258 Electric railway signal; Edgar C. Wiley, Independence, Va.

418,270 Combined gas and electric light fixture; David J. Braun, Chicago, Ill., assignor to the David J. Braun, Mfg. Co., same place.

418,284 Quadruplex telegraphy; Clarence L. Healy. Brooklyn, N. Y.

418,301 Armature for dynamos; James J. Wood, Brooklyn, N. Y.

418,302 Automatic regulator for dynamo electric machines; James J. Wood, Brooklyn, N. Y.

418,303 Current-regulator for dynamo electric machines; James J. Wood, Brooklyn, N.Y.

418,322 Electric signal system for letter boxes; Geo. L. B. Rounseville, Chicago, Ill.

418,369 Screw-cleat for electric wires; Geo. E. Huff, Hartford, Conn.

418,373 Electric railway; Hosea W. Libbey, Boston, Mass.

418,402 Electric brake mechanism for cars; Wm H. Darling, New York, N. Y., assignor of two-thirds to Leo Bock, Jr., and Gardner P. Harrington, both of same place.

418,426 Incandescent electric lamp socket; Frank Thone, Oskaloosa, Iowa.

418,443 Mechanical telegraph instrument; Jesse H. Bunnell, New York, N. Y.

418,444 Electric arc lamp; Jesse H. Bunnell, New York, N. Y.

418,472 Electric meter; Chas. A. Pratt, Toledo, Ohio.

418,473 Electric light carbon; Llewellyn Saunderson, Kingstown, County of Dublin, Ireland.

418,483 Secondary battery; Albert E. Woolf, New York, N. Y., assignor to Beuno Loewy, same place.

418,484 Perforating machine; Frank Anderson, Peekskill, N. Y.

418,510 Method of finding the positions of distant objects; Bradley A. Fiske, U. S. Navy.

418,551 Apparatus for the manufacture of gas by electricity; Martin C. Burt, Lake View, Ill.

418,559 Electric meter; Alphonse J. Frazer, Paris, France.

418,602 Governor for steam engines; Louis Bell and William H. P. Creighton, Lafayette, Ind.

418,612 Ocean motor; Isaac St. C. Goldman, Los Angeles, assignor of part to Henry Timken and R. B. Davy, San Diego, Cal.

418,636 Electric light fixture; Geo. C. Baillard, New York, N. Y., assignor to J. H. Bunnell & Co., same place.

418,652 Generation and distribution of electric currents; Francis J. Patten, New York, N. Y.

418,653 System of electrical distribution; Francis J. Patten, New York, N. Y.

418,654 Electric motor; Francis J. Patten, New York, N. Y.

418,655 Distribution of electric currents; Francis J. Patten, New York, N. Y.

418,659 Dynamo electric generator; William Stanley, Jr., Great Barrington, Mass.

418,664 Electro magnetic type setting machine; William Dreyer, Frankfort-on-the-Main, Prussia, Germany.

The Ball Company is about to establish an electric light plant in Montgomery, Ala.

A MODEL ELECTRIC RAILWAY.

The Cincinnati Inclined Plane Electric Railway is, on account of its efficiency, attracting a good deal of attention among electric railway managers and other interested parties. The road runs from the Post Office to the Zoological Gardens, six miles from the city, and was equipped by the Sprague Electric Railway and Motor Company of New York.

From the Post Office terminus the cars run to an inclined plane, up which they are taken on an elevator. Upon leaving the elevator, electrical connection is again restored, and remains unbroken to the end of the line.

The accompanying view represents one of the cars rounding a corner on this road, and is from a photograph. The view is taken at the junction of Locust and Mason streets, and gives a very good idea of the style of overhead wiring and throughout the line. All the poles are of iron and are of neat and tasteful design, and the construction and line work throughout, while showing evidence of durability and strength, is yet unobtrusive and by no means unsightly.



A MODEL ELECTRIC RAILWAY.

The motors used on the line are of the Sprague improved type, using two motors to each car, and all the latest improvements and devices used by the Sprague Co. upon their motor equipments are in use here. The management of the company report that they have never had either a field or an armature burn out since they have had the road in operation

The care of these motors and car equipments does not require more attention than two hours' care from one man, whose duty it is simply to look over each equipment and clean commutators, gears, and other wearing parts.

The dynamos are of the standard Edison type for railway power circuits, and it is interesting to note that they have been in operation for seven weeks without re-oiling.

The self-oiling bearings upon these dynamos are of the well-known ring pattern, in which the oil is distributed over the interior of the bearings automatically by the revolution of the shaft, and after performing its duty of lubrication is returned to the reservoir where it has opportunity to cool and settle. The two pints of oil which were placed in the dynamo bearings at the starting of the road have not been added to, and the dynamos have since run without any attention whatever.

Although the grades upon this line are very heavy, reaching in some cases as high as 12½ per cent., the average amount of coal consumed per day is 3½ tons of nut and slack for 17 cars, or an average of only about 1-5 of a ton per day per car. The steam power required at the power station for the operation of these 17 cars is supplied by one 150 h. p. engine.

INSULATION POSSIBLE. — Mr. Frank Kitton, chief operator of the Western Union Telegraph Company, read a timely and interesting paper before the Buffalo Electrical Society, January 6th, on the subject of insulated electric wires, in which he described the result of a series of tests applied by himself to some of the wires at present employed for electric lighting and other purposes. After descanting upon the desirability of raising the electrical standard of insulation to the highest possible point where high pressure or dangerous currents were employed, and of the necessity of using none but waterproof and weatherproof covering under all such conditions, Mr. Kitton went on to show that the comprehensive claims made on the part of manufacturers and other interested parties were not in many instances borne out by test or experience. He had subjected a number of samples of wire to tests which were by no means severe, but had discovered a lack of the qualities claimed for them, and really requisite in the interest of life and property, that was simply amazing. There were on the contrary other samples which had been put to the severest possible test for a long period without in any material way affecting the high insulating properties of the covering. The latter samples were usually the more expensive, and probably for this reason were not so much in use as the less costly but more dangerously insulated specimens. Some of the latter he had known to show up remarkably well in the absence of moisture, but in less than a minute after their immersion in water, the insulation began to fall rapidly and at the end of a few hours the covering instead of insulating the current actually conducted it. Mr. Kitton contended that it was not difficult to provide an insulated wire that would be impervious to moisture, nor to insulate aerial lines in a manner to make them reasonably durable and safe, and if the proper way was only set about to attain these ends their accomplishment would be certain.

RULES FOR WIRING BUILDINGS IN BOSTON.—The Boston Fire Underwriters Union and New England Insurance Exchange, has issued a supplemental circular giving the rules and requirements for interior and concealed electric light installation. Arc light wires, inside must not be concealed, and they must be rigidly kept apart at least one foot, unless an *approved, moisture proof, non-conducting, non-inflammable tubing* is used. Incandescent wires laid in plaster, cement or other similar finish will not be approved, no matter what insulating covering is used. The use of such tubing, as above described is recommended. Wires of whatever insulation must not in any case be taped, or otherwise fastened to gas-piping. The wring of any building must be so calculated that there will be no loss greater than three per cent. for the total number of lamps to be used, when supplied from central stations, or eight per cent of an isolated plant. Private dwellings are exempt from this rule. All switches must be made of non-combustible material, and the running of wires for electric gas lighting on the same fixtures with electric lighting will not be approved.

ELECTRIC WAGONS.—A system of electric propulsion on common roads has been invented and patented by two citizens of Hill City, Dak. The wires conveying the current are overhead, and trolleys are attached to the conveyance, which may be turned to one side or the other to avoid collision with other vehicles.

An unique and enjoyable occasion on the evening of December 28th was the "warming of the new shop of the Gilliland Electric Company" at Adrian, Mich. The company celebrated the holiday season, and the opening of the new shop building by giving a ball to its employees and friends. The buildings were brilliantly lighted from top to bottom with the incandescent lamps installed some time since. Nearly 300 guests were present, including a number from other cities. Several phonographs were placed in the supper room for the entertainment of the guests. The local papers mention it as one of the most pleasant affairs of the season.

Victor Poissant, a young electrician of Omaha, has a very ingenious way of killing rats. The prying rodent is caught in an ordinary oval trap, the bottom of which is covered with tin. Mr. Poissant has a small dynamo, of his own manufacture. One wire, connecting with the dynamo, is fastened to the tin lining of the trap, and another is thrust into the prisoner's cell. The well known propensity of a caged rat to do battle asserts itself, and he seizes the wire between his teeth. In so doing he makes the mistake of his life. The circuit is complete, his jaws close on the wire with a death grip, and he passes into a state of eternal desuetude.

Although the electric light is gradually taking the place of illuminating gas, the latter article is evidently going to meet with an extensive sale in another direction, on account of its considerable evolution of heat. In comparison with the electric light, it is this property which is, apart from minor brightness, considered as its principal deficiency. Already gas is being extensively used for the purpose of heating and cooking in New York and Brooklyn.

Philadelphia, Pa., is discussing the subject of putting in a municipal electric lighting plant, and doing away with gas. It is estimated that the plant would cost $300,000, and that $90,000 per year would be required to run it.

THE BROWN & SHARPE MANUFACTURING CO'S SCREW MACHINES.

A pamphlet on screw machines has just been issued by the Brown & Sharpe Manufacturing Co. of Providence, R. I. The term "screw machines" is, however, a rather narrow one, and not comprehensive enough in its application in this case. The fact is, the machine, although primarily designed for the making of screws, is equally well adapted to making a large variety of pieces from iron or steel bars, and in finishing castings or forgings, which may be held in a chuck while subjected to a number of operations.

The pamphlet is liberally illustrated, and the great variety of work possible on this machine makes it especially adapted to electrical work The manufactures of this company are well and favorably known in the electrical trade, and the business is very extensive. Their plant is a large one, as may be seen by the accompanying cut.



THE BROWN & SHARPE SCREW MACHINE FACTORY.

A Decision Reversed.—The Illinois Appellate Court handed down a decision on the 2nd inst., reversing the decision of the Circuit Court in the case of the Great Western Telegraph Company against W. H. Bush. The latter was one of the numerous stockholders of the company who have been sued on their subscriptions to the capital stock. The Supreme Court held that the new subscribers, of whom Bush was one, were the bona fide stock-holders. The Court sustained the Circuit Court in the case of Eugene C. Bates against the same corporation.

The electric light is to supersede gas in Rome. The motive power will be derived from the waterfalls of Tivoli, and the station for the distribution of power will be near Porta Pia. Rome does not in this case lose in pic turesqueness what it gains in modernization, for the few electric lights already established —as, for instance, on the Quirinal Hill and in the Piazza Colonna—lend a singularly new and beautiful aspect to the Eternal City as seen in the evening from the neighboring hills of Frascati and the other "Castelli." The spectacle of Rome with its mighty overhanging cupola, illuminated by the electric light, across the wide Campagna, will be remarkable

It is reported that the various electric light companies in this city who have suffered from the wholesale destruction of wires, will sue the city for three millions of dollars It will be an interesting fight, and public sentiment is undoubtedly on the side of the companies.

The Empress Frederick has given orders to have her castle at Cromburg put in telephonic connection with the opera house at Frankfort, so that she may hear the music in her own home.

The Thomson-Houston Electric Company are 70¢ car motors behind their orders, notwithstanding the fact that the capacity of their factory has been quadrupled during the past year.

The Brush Plant at Rochester.—The Brush Electric Light plant at Rochester, N. Y., is unique and interesting, in that it is one of the largest stations in the United States operated by water power. The station is situated at the lower falls of the Genesee river. Fifteen turbines under 88½ feet head supply the power for driving the dynamos. The company is at present operating 29 dynamos supplying 1604 lamps of both classes, and 400 motors. It has 330 miles of wire, all overhead. The company supplies current for a large number of motors used in various establishments throughout the city. When the plant was established in 1881 a 50-horse power engine was used, now the plant has a capacity of 3000 horse power.

Among those who have worked out the problem of procuring aluminium by electrolysis M. Minet is one of the most successful. The electrolyte used by him is a mixture of from 30 to 40 per cent. of cryolite with from 60 to 70 per cent. of common salt.

The Connecticut Electric Light Association was organized in New Haven, December 23rd. This is the third State to organize. There is no doubt that these associations will result in great benefits to its members in many ways. The following officers were elected: James English, president; J. A. Hadley, 1st vice-president; J. P. Stowe, 2nd vice-president; John C. English, treasurer; A. M. Young, secretary. Executive committee: James English, New Haven, Conn.; J. A. Hadley, Meriden, Conn.; J. A Stowe, Middletown, Conn.; John C. English, Bridgeport, Conn.; A. M. Young, Waterbury, Conn.; L. S. Beardsley, Naugatuck, Conn.; F. F. Fusenich, Torrington, Conn. Massachusetts and Maryland (including the District of Columbia) were the first and second States respectively to organize.

The Wisconsin Electric Club was recently organized in Milwaukee Frequent meetings of the club will be held for the reading of papers and general discussion, and occasional lectures will also be given upon interesting electrical subjects. The club now numbers eighty members, mostly men of prominence in connection with the telephone, electric lighting, electric street cars and similar commercial interests.

The Postal Telegraph company forwarded a message, addressed Liverpool, Eng., at 8.45 Friday morning, delivered it, obtained the answer in Liverpool and received the answer in Sioux City at 9.16, having consumed thirty one minutes in the sending of the message, its delivery, the receiving of the answer and its transmission back to Sioux City, crossing the ocean twice.—Sioux City *Globe*.

The Erie Railroad is about to extend the automatic signal block system, already in operation between Jersey City and Turner's, to Port Jervis. Orders have been given for the building of the eight new signal towers required for the extension.

Messrs. Chas. A. Schieren & Co. report aggregate sales of 386½ feet of double belting during the week ending Dec. 28, last.

MAYOR GRANT'S REPORT ON THE WIRE SITUATION.

In the annual report of Mayor Hugh Grant to the Board of Aldermen, he refers to the electric wire question as follows:

For many years our thoroughfares have been obstructed and disfigured by unsightly poles and dangerous electrical wires. Laws have been enacted providing for the burial of electrical conductors, but, until recently, no apparent effort had been made to enforce them. In the early part of the present year energetic and decisive measures were taken to abate this nuisance. From some of the leading thoroughfares these obstructions have been entirely removed, and it is the firm purpose of the local authorities to prosecute this reform to a speedy completion. By the close of next summer it is confidently believed that every pole will be removed from the streets, and that every electrical wire will be operated underground in properly constructed subways.

The public authorities have recently felt compelled to remove from the streets wires which were believed to be dangerous to human life. By this action some portions of the city were deprived of the use of electric lights. The interruption of this service will, however, be but a temporary one. Already subways have been constructed in some of the leading thoroughfares, and it is hoped that sufficient will be constructed during the coming year to accommodate the entire electrical industry in the city.

Since the first of January, 1889, the Bureau of Encumbrances has removed 2,905 poles, and about 14,500,000 lineal feet of electrical wires.

By the provisions of law now in force the official existence of the Board of Electrical Control will terminate during this year, and its powers and duties will become vested in the Commissioners of the Sinking Fund. The duties of any Board charged with the supervision of electrical conductors must necessarily be onerous and difficult. They should be discharged by officers who possess some knowledge of electrical science. A Board of Electrical Control, composed, at least to some extent, of electrical experts, would be a great assistance to the local authorities in dealing with those branches of industry which are compelled to maintain electrical wires in the streets.

An Electric Railway for Sale.—It is said that the Fulton Street line of electric railway in this city is in the market for sale, but that there is no anxiety to acquire the property on account of the fact that under the terms of the charter thirty-five per cent. of the gross receipts are to be turned over to the city treasury. This line has never been put into operation, although the conduits and rails have been in position for months.

Tailor Work by Electricity.—An enterprising Minneapolis tailoring firm has made electricity their servant in many novel ways in connection with their business Besides lighting their establishment with electricity, they use the power in operating shears and warming the pressing irons. They find their enterprise rewarded by a saving in labor, time and money.

The remark "how simple it is, and it is a wonder nobody ever thought of it before," is often heard, but was never more applicable than to the idea of Superintendent Temple, of the Salem, Mass., Electric Light Company. He proposes to give a distinguishing mark to all "live" wires on each cross arm to which they are attached. This will in a great measure help to lessen the danger to linemen when working on the poles.

There are about 400 miles of electric railway in operation in the United States.

THE INVESTIGATION OF THE ELECTRICAL INDUSTRY FOR THE ELEVENTH CENSUS.

By Allen R. Foote.

1. The investigation of the Electrical Industry, to be reported in the Eleventh Census, offers an opportunity of great value to ascertain the true importance that the practical application of electric energy has acquired in industrial and social development. This opportunity should be made use of to the fullest extent possible. In all departments of endeavor an exact knowledge of existing and antecedent conditions is the necessary base from which to direct future action. Laws and actions based on assumptions, instead of ascertained facts, are the pitfalls of civilization. Whose action is not in accord with fact, though it be unknown to him, must pay the penalty of ignorance through the loss caused by his inevitable error. A business policy guided by ascertained facts cannot fail.

2. Some managers of electric lighting and power stations have intimated to me that there are certain features of their business concerning which they do not desire to answer inquiries. They have acknowledged at the same time, however, that information regarding those very points, if given by other companies, would be more valuable to them than any other data that can be obtained

So strong is the repugnance of some persons to the invasion of what they consider their private affairs, that sworn agents of the Census frequently find it difficult to obtain the information to which they are legally entitled. I believe the policy of secretiveness on the part of any individual to be a mistaken one, adopted either under a misapprehension of the facts or an ignorant view of his own interests. It may be stated as a fact that no person will be benefited more by the publication of an absolutely truthful statement, showing the operation of every company in the United States engaged in his line of business, than that person who doggedly refuses to answer inquiries, or retards the publication of the information to be collected by dilatory compliance with the requests sent him. A just punishment for his illogical selfishness would be to make his self-imposed isolation still more impenetrable, by debarring him from receiving any benefit whatever from the information given and work done by others. Such a person should be compelled to live where there are no mails, newspapers, railroads, telegraphs or telephones.

3. Information given to an agent of the census, cannot be used to the injury of the giver. The interest of the government can be served only by protecting the interest of the individual. Every agent is sworn to secrecy and is under as strict supervision as are the National Bank Examiners. Every publication of the information obtained is absolutely impersonal, so that it cannot possibly be traced to any individual or company unless it should happen that but one person or company is employed in the occupation described. While these regulations offer protection to the individual, they at the same time offer him, in full and equal exchange for the information he can give, all the information obtained from every person in his line of business The exchange is a thousand for one—a consideration worth an hundred times more to any other person or company than the cost of the effort they are required to make to obtain it.

4. In no department can the benefits that a citizen may derive from well organized and intelligently directed governmental action be better exemplified than by the operations of the census office. The main features of the industrial information wanted are plain statements of facts, which any well regulated business concern can furnish easily and promptly, from the accounts kept by themselves for their own advisement. To provide for the lack of uniformity in accounts and to inform all persons interested as to what inquiries they will be expected to answer, schedules are furnished months in advance of the date on which the information is wanted. This enables each concern so to keep account of the items that, on the day from which the information must bear date, an accountant can easily fill up the entire schedule and mail it to the Census Office. The advantages to be gained by individuals and companies in doing this, are a most generous return for so simple and easy an undertaking on their part.

5. The magnificent exhibition of co-operation with the government, that would be shown by simultaneously mailing a properly filled schedule to the Census Office on the same day by every company or person interested in the Electrical Industry, would mark the advance line of progress in census taking. Those who are placing this great agent of power, electricity, at the service of every citizen and municipality, by doing so will but sustain their well merited title of "Lightning Engineers." Really it is but a simple thing to do. It only requires that each one shall demonstrate himself to be the peer of the sun in his ability to do things on time. All things done require time for their doing. It requires no more effort to do a thing at a proper time than to do it at any other time. Who so orders the doing of them that each is done when required, liberates himself from the law of necessity and makes himself master of circumstances. All that is required in this case is that each company shall designate an officer or employee as the person who will furnish the information desired by the Census Office, and hold him responsible for having it ready on the mailing date.

6. The lack of information that may be obtained through the Census report has been felt so keenly that no less than ten individual attempts by as many central station companies to gain some part of it, have come under my observation during the year 1889. These attempts have been expensive to their originators, and troublesome to those to whom they have made their appeals. Worse than this, they have been unsatisfactory, because too limited in the scope of their inquiries; and dangerous, because they have not covered all the factors necessary to a correct statement. Public or private action based on insufficient data can but be ill-advised and disappointing. Such disadvantages may now be overcome with the greatest ease, to the injury of none and the advantage of all, if each person in interest will promptly and fully supply his own quota of Census data.

7. It is not the business of the Census Office to report or to prove the correctness of theories. It is its business to report facts. No person should be so eager to know facts as the man with a theory. If the facts are with him, he will be enormously benefited by their helpfulness If they are against him, a knowledge of them may save all disastrous loss. No man ever attained a success by remaining ignorant of the facts pertaining to his occupation. The electrical industry is so young, it is almost too soon to attempt to separate the experimental from the practical. No feature of the wonderful progress made, which may now be recorded, is removed from its experimental stage by so much as a single decade. In view of this, it will be well to take notice of every experiment that is now being practically tested. Such a record will possess great interest for those who may be privileged to compare the results of the eleventh with those of the twelfth census. The experiments of to-day will furnish the best landmark for the progress to be recorded in 1900.

8. The report of the investigation with which I am intrusted will be the first official chapter in the history of the practical application of electricity to the uses of light and power. I do not assume the ability to write a report that shall be perfectly satisfactory to the 65,000,000 critics in the United States, not to mention those in foreign countries, to whom my work must be submitted. What I shall do is to give every person who may criticise me adversely, *after* my report has been published, a good opportunity to place himself on record by making suggestions to me while the work is in condition to be benefited by them. No more time will be required to write a suggestion before, than to write a criticism after the work is finished, *but much greater genius.*

The wisdom of foresight is far more rare and valuable than the wisdom of hindsight. To look ahead to an objective point, and form plans which, if followed, will make one sure of getting there, is a work of immeasurably greater value than to look backward and tell how present conditions came to be so. The historian of events, real or imaginary, can never be a leader. Who declines to suggest, deprives himself of the right to criticise. Through the courtesy of the electrical press, I urge every one interested in the electrical industry, each from his own point of view, to suggest to me every item of information that, in his opinion, should find a place in my report, together with his idea as to how it may be most easily and correctly obtained.

9. In my opinion the facts to be reported form two distinct classes:

First. Facts of the present value, the full benefit from which will be realized at the time of publication

Second. Facts having a future value, the full benefit from which will be realized ten years hence, when comparisons are made between the results shown by the eleventh and twelfth censuses.

10. There are a multitude of facts of very great value to those directly interested in the industry that have no value to the general public, except in an indirect manner. The collection of such facts will be admitted by the voluntary co-operation of those to be benefited in supplying them. I shall be greatly disappointed if there is any failure in this regard, especially since Hon. Robert P. Porter, Superintendent of Census, has invited such co-operation in the following terms:

"It is the purpose of this office, without seeking data which may be irrelevant or unimportant, to make the statistics of this industry complete and accurate, so that its real condition and true importance may be known and understood by the general public. It is confidently believed that those who are to derive the chief benefit from the result of the industry, viz: manufacturers and central station companies engaged in the distribution of electric currents for the commercial uses of light and power, will lend their cordial aid to render that result full and reliable. A formal response to the questions of the schedule is all that can be insisted upon, but the superintendent solicits beyond this, the hearty co-operation of everyone interested in respect to furnishing information promptly and accurately, in the procurement of additional facts, and in the suggestion of pertinent and useful lines of investigation, Without such co-operation; intelligently supplied, the inquiry must of necessity be limited in its value.

"The census of 1880 makes no mention of the industry of generating and distributing from central stations, electric currents for the uses of light and power. The investigation of this industry for the eleventh census will be the first official census report made on the subject in this or any other country. For this reason it is particularly desirable and essential that the investigation shall not only present a record of the industry as it exists to-day, but that it shall so classify and arrange the information as to render it serviceable as a basis for present action and of comparison for all

future reports. In view of these facts, the importance and value of such an investigation and the official publication of its results should in itself be sufficient to secure from every person addressed, a special effort to answer fully and promptly every inquiry. The exhibition of the birth of an industry and its growth, to the magnitude of an interest second to none in importance within the short space of a single decade, is a marvelous record of progress. In no other industry and in no other country has such a record ever been made."

THE WESTERN UNION ST. LOUIS OFFICE BURNED.—The building of the Western Union Telegraph Company in St. Louis was destroyed by fire on the morning of Jan. 8th. The fire was started in the basement by a wire coming into contact with an electric light wire, and in a very short time the entire building was a mass of flame. Fortunately there were few persons around at the time, owing to the early hour at which the fire occurred and all these escaped uninjured. All communication with the office by wire was of course completely severed, and for the present the business is being handled at East St. Louis. In the same building were the offices of *The Associated Press* and a few business concerns, all of which were completely destroyed. The total loss amounts to $100,000 of which $50,000 falls on the Western Union. The sleet storm of the day previous had coated the wires so heavily with ice as to cause them to sag and break. One of these wires became crossed with a light wire and caused the fire. The building was an old one and was situated on the corner of Third and Olive Streets.

Prof Sheldon, in suggesting some points for an electric blowpipe, states that the pole of a powerful magnet strongly attracts or repels the electric arc, which may by this means be driven out sidewise into a point very similar to the point of flame projected from an ordinary blowpipe; at the end of this point the heat is intense, being sufficient to melt large copper wire constantly and to fuse any of the metals. It would serve admirably for welding, and a slight alteration would fit any arc lamp to perform the double function of lighting and welding.

It is shown by Prof. Hughes that a stranded iron wire cable has less self-induction than one of the same mass of metal formed into a solid wire; the explanation of this being that the circular field of magnetic force round the axis, which exists inside the wire as well as outside, is not so strong in the interior of the stranded iron cable as it is in the interior of the solid iron rod. The stranding reduces the magnetic permeability along lines which are circles described around the axis, and hence reduces the self-induction.

An electric locomotive of somewhat novel design has just been built at the New York Locomotive Works, Rome, N. Y., for W. H. Darling. The storage system is used, the batteries occupying what would be the fire box in an ordinary engine. The reciprocating movement of the pistons is caused by currents in helical coils wound about the cylinder, the construction being founded upon the principle that an iron plunger will be drawn into a coil of wire through which an electric current is passing.

In Cincinnati, last week, the question of ordering electric light wires under ground was referred to a special committee of five from each of the three city boards, to devise ways and means of accomplishing the task.

Russian officials have decided that the telephone is "dangerous to the State." In Warsaw orders have been given that telephones be removed from all restaurants, coffee houses and liquor saloons. Similar orders have been issued in all other large Polish towns.

THE COST OF ELECTRIC PLANTS.

Mr. O. P. Loomis, an electric expert of this city, was interviewed the other day by a reporter for a daily paper on the subject of cost of electric light plants. Mr. Loomis said the cost is "not so much as is supposed by people unfamiliar with such matters. The companies generally charge so much a lamp for the electrical outfit. Thus we will suppose that a shop or an office building wanted to put in a system of 300 lamps. That would require to start with an engine of 30-horse power, for the calculation is that 1-horse power will run 10 ordinary lamps. The best dynamos run 11 lamps per horse-power. A good engine will cost, say, $750 set up. Then the dynamo, the wires, the switches and the lamps must be provided by the company owning the system decided on. These will cost about $10 a lamp for 300 lamps if for an office building or a hotel, but for a factory not over $8 The difference is in the finish of the brass work, the trouble in running wires to the places where wanted, etc. In a hotel much care must be taken in such matters. In a factory we have no hard-finished walls to take care of. A little over $3,000 would pay for a factory plant of 300 lamps No account is made of the boiler, because in all buildings where such plants are wanted there is commonly a surplus of boiler capacity on hand.

"The lamps cost 80 cents each, and are warranted for 600 hours. If a good system is adopted there is no occasion to hire an expert to care for the plant. An engineer fit to trust with a steam-engine is capable of caring for the plant. The dynamo lasts a lifetime, so do the wires, and an intelligent boy screws on a new lamp when the old one wears out.

"The running expense of the system depends on the cost of coal. It takes about five pounds of coal per horse-power, per hour, in an ordinary building. If a good condensing engine is put in then the consumption of coal is reduced below that. A ton and three-quarters of coal should run 300 lamps twenty-four hours.

"If smaller plants are wanted, say, twenty-five or fifty lamps, it costs from $12.50 to $13 per lamp for the electrical plant all in and ready to set going. In spite of what has been said about fires, the electrical plants are much safer than oil or candles or gas. The insulation does not wear out when properly put up, because there is nothing to wear it out, if exposed to chafing, as it would be if the wire hung where it could swing against a post or a wall, the rubber will wear off. That is the fault of the man who puts up the wires."

A novelty is announced in the shape of a "recording and alarm" compass which, it is declared, will greatly increase the safety of vessels. The apparatus is said to be composed of a binnacle and recording and alarm instruments connected by electric wires. The principle, in brief, is to sound an alarm whenever the course is not kept.

The transmission of electricity by insulated wires was shown by Watson in 1747; telegraphy was invented by Morse in 1837; the first Atlantic cable was laid in 1857, and the quadruplex system, by which four messages may be sent over the same wire at the same time, was first used in 1877.

The novel sight of two Edison phonographs in charge of half a dozen men coming out of Grace Church, New York, attracted considerable attention January 2nd. The machines had been placed in the belfry the evening previous, and the New Year's chimes recorded. A cylinder, containing one of the pieces played, is to be placed in a cedar box and preserved in the church. The records of the tunes are very loud and accurate, and will be heard at phonograph entertainments this winter.

KANSAS CITY'S ELECTRIC LIGHT COMPANIES.—The Kansas City Electric Light Company is the oldest organization of the kind in the city, having been organized in 1881. It is the licensee of the Thomson-Houston system of lighting by electricity. The capital stock is $450,000. It has a plant with a capacity for 930 arc lamps, 700 of which are in use, and 1,500 incandescent lamps, employing both continuous and alternating circuits. Ten engines are required, and they are of the Corliss, Ide and Armington-Sims make; seven boilers, three of which are Babcock & Wilcox and four common tubular boilers. The power employed aggregates 1,200 horse power. During the past year, $77,676 have been expended in real estate, additional power plant and street system. A building has been purchased and remodeled and a large amount expended in lines, poles and lamps. The works are on Eighth and Santa Fé streets

The Edison Electric Light and Power Company was organized in 1888. The company has a capital of $100,000, with an investment of nearly one fourth more. This company is the licensee of the Edison system and its plant has an aggregate capacity of 6,000 lamps, 4,000 of which are now in use. Three New York safety engines and three Babcock & Wilcox boilers are used. They serve electrical currents for power purposes as well as light. Some of their wires are under ground and some over head. The company's central station plant has been erected and fitted up during the past year at a cost of $125,000.

The American Electric Light Company's plant is located at Twentieth and Central streets. It has three boilers and three engines. They use the Ball and American arc light dynamos, supplying 250 arc lights; the Heisler incandescent system, one dynamo, furnishing 300 incandescent lights. The company's service has more than doubled during 1889, and $7,000 has been expended during the year in building, new machinery and other improvements.

The Interstate Electric Company has increased its capacity during the past year from 2,500 incandescent lights to 10,000 and its horse-power from 100 to 500. It is the only company using storage batteries. There are four battery stations in the city. During the year Paul W. Bossart has retired from the management and has been succeeded by T. F. Clohesy. Mr. Clohesy has gone to New York to purchase more machinery. The office has been removed from the Keith & Perry Building to 222 West Fifth street. Kansas City will continue the Western headquarters for the company.

The Sperry Associate Electric Company was organized in 1886. It has a capital stock of $30,000 with nearly double that amount invested. It has an arc light plant of 300-lamp capacity and has recently started a new Westinghouse plant with a capacity of 3,000 lamps, at a cost of $30,000.

On the Boulevard des Capucines, in Paris, it was noticed recently that horses manifested considerable uneasiness on passing over a particular portion of the roadway. The electric light company was communicated with, and on the roadway being dug up it was found that the lead cover of the branch conductor to the street lamp was in contact with one of the bare main conductors, and as the neutral wire was faulty in several places a circuit was completed through earth between the lead cover and the neutral wire. The iron hoofs of the horses made excellent contact with the damp wood of the roadway, and the unfortunate animals consequently became a shunt on this leakage circuit and received smart shocks.

The trestle carrying a trolley on one of the Boston roads, a few days since, fell with a crash on a passing car, greatly frightening the passengers.

J. H. BUNNELL & CO.'S NEW QUARTERS.

Messrs. J. H. Bunnell & Co. have removed from their old stand, at the corner of Liberty and Church streets, to more spacious and convenient quarters at 76 Cortlandt street, corner of Washington. A very handsome building has recently been erected on this corner, and the above named firm occupies the ground floor. The interior is fitted up with a view to convenience and to show to the best advantage the great variety of electrical apparatus manufactured by this firm. There is nothing in the electrical line that cannot be found here, and the superior workmanship for which the firm is justly celebrated is displayed to the very best advantage. The location is a very convenient one, being within one block of the Pennsylvania Railroad ferry, North River, and handy to all other railroad ferries, and the general business centre of the city.



J. H. BUNNELL & CO.'S NEW QUARTERS.

The St. Paul, Minn., city council has adopted a motion providing that no wires should be strung hereafter, except under the direction of the city engineer.

A. M. Pennock has accepted a position with the Western Union at Richmond, Va.

A decision was rendered by Justice Poche, of the Louisiana Supreme Court, at New Orleans last month, in the case of the New Orleans Gaslight Company, *vs.* The City of New Orleans. The suit involved a contract with the Louisiana Electric Light Company for lighting the city, and the decision of the lower court in favor of the company was affirmed. In his opinion, the court says that the plaintiff brings suit in the capacity as a taxpayer for the purpose of setting aside a contract made between the city and the Louisiana Electric Light Company in May, 1887, to light the city by electricity for five years, beginning January 1, 1888. The grounds of attack to be considered on appeal are as follows: That the contract is null and void, because it violates the prohibition contained in section 2448 of the Revised Statutes, which provides "that police juries of the several and the constituted authorities of incorporated towns and cities in this State shall not hereafter have power to contract any debt or pecuniary liability, without fully providing in the ordinance creating the debt, the means of paying the principal and interest of the debt as contracted. That the city has no power in law to enter into such a contract." The defense is practically a general denial, and the judgment on appeal rejected plaintiff's demand. The court holds that "in the absence of a special statutory limitation or restriction, the power given to the city of New Orleans to make contracts for lighting its streets, landings, etc., is sufficient to authorize a contract for more than one year for such commodity."

THE PULSION TELEPHONE.—A curious scene was enacted recently at a place called Child's Hill, on the Midland Railway, near London, England. What took place there, as vouched for by *Engineering*, was as follows: A party of gentlemen alighted from the train and ascended the embankment. Here one of them reached up to a wire stretched along the telegraph poles, and, placing the crown of his hat flat against it, he commenced a conversation with some unseen correspondent. The answers to his questions and remarks came back quite audibly to the group gathered around him, while those who felt sceptical as to the reality of what was being enacted before them, removed to a distance, and, pressing the wire against their ears and cheekbones, heard the return messages for themselves. After some desultory conversation, the unknown speaker was asked to give a good shout, and in reply he jodelled with such vigor that a boy plodding his way along the cutting, at the opposite side of both up and down lines, looked up with amazement. He was at least eighty or one hundred feet distance, and yet he evidently heard the yell transmitted along the wire and received into the crown of an ordinary silk hat. It was quite impossible that he should have caught the original sound, for it was uttered in a cabin more than a mile away. Those who were on the embankment knew that it was transmitted by means of a new mechanical telephone. The instrument is the invention of Mr. Lemuel Mellett of Newton, Mass., and already several hundred instruments are at work in Boston and elsewhere. The receiver, which also acts as a transmitter, consists of a wooden case, divided into two parts by a metallic diaphragm held by a clip ring and screws. In the centre of the diaphragm is a hole through which there passes the line wire, having at its end a button to take the pull. So far there is no special novelty to distinguish the telephone from the old pill-box and string. The new feature consists in a set of resonators placed over the diaphragm to re-enforce its vibrations. These resonators are spiral springs of various lengths, and made from wire of different gauges. One set of springs is festooned between the screws which hold the diaphragm, while others are held at one end only, and project upwards and inwards within the case. These resonators are chosen experimentally of such dimensions that each will be set into vibration by some one or more of the tones which are usually found in the human voice.

The conversion of electrical energy into mechanical work dates back much further than is generally supposed, the first practical electric motor having been made by Jacobi in 1834. Motors, however, remained mere philosophical toys until 1870, when the Gramme dynamo was introduced. To M. Gramme, therefore, is due the credit of enabling the transmission of power by electricity to become a commercial possibility. During the next ten years electric motors received considerable attention, and by 1880 they had become greatly improved under the master hands of the late Sir William Siemens and others. For several years past motors of all sizes have been in use, for various purposes. At the present time the efficiency of conversion obtained, closely approaches the theoretical limit, some motors returning from eighty-five to ninety-four per cent. of the electrical energy supplied. This rapid progress is certainly due to the high order of genius brought to bear upon the matter by men of science, and to the mechanical ability of engineers, rather than to the simplicity of the subject.—*London Times.*

THE BRUSH DOUBLE CARBON DECISION.

(Continued from last issue.)

5. In an electric lamp, wherein more than one set or pair of carbons are employed, the lifter *D* or its equivalent, moved by any suitable means, and constructed to act upon said carbons or carbon holders dissimultaneously, or successively and substantially, as and for the purpose shown.

6. In an electric lamp wherein more than one pair or set of carbons are employed, a clamp *C* or its equivalent, for each said pair or set, said clamp *C* adapted to grasp and move said carbons or carbon holders dissimultaneously or successively, substantially as and for the purpose shown."

It is admitted by the defendants' counsel that the patent in suit describes a new and useful mechanism for which Brush was entitled to a patent; but it is urged that the first, second, third and fourth claims are for functions or results without regard to mechanism and are, therefore, void.

The claims are not open to this objection. The specification describes mechanism whereby a result may be accomplished, and the claims are not for mere functions, nor fairly construed, can it be said that they cover other equivalent means employed to perform the same functions. The first claim, construed in connection with the means described in the specification, is for an arc lamp in which two or more pairs of carbons are used, the adjustable carbons of each pair being independently regulated by one and the same mechanism, and in which there is a dissimultaneous or successive separation of the pairs, so effected as to secure the continuous burning of one pair prior to the establishment of the arc between the other pair. Thus construed the invention claimed is limited to the particular means described in the specification and their substantial equivalents.

The second, third and fourth claims also refer to the particular mechanisms described in the specification for the accomplishment of results covered by these claims. They are for combinations of specific mechanisms and their substantial equivalents, and not for results irrespective of means for their accomplishment.

It is true that in the specification Brush declared, "I do not in any degree limit myself to any specific method of mechanism for lifting, moving or separating the carbon points, or their holders, so long as the particular functions and results hereinafter to be specified shall be accomplished."

He did not say, however, that he claimed all mechanisms irrespective of their construction and modes of operation. By this language he simply notified the public that he did not restrict himself to the particular lamp described in the patent, but that his invention embraced *that* and all other lamps operated substantially the same way by equivalent mechanism.

It is urged that the fifth claim covers the lifter simply and that the sixth claim covers nothing but the clamps, and being only for detached parts of the lamp, incapable of separately performing the function ascribed to them, and these claims are void.

The fifth claim is for a combination of which the lifter *D* is an element, and thus construed, the claim is for a novel and useful invention.

The sixth claim is not for the two clamps aside from other connected mechanism. It is for the two clamps in combination with the mechanism described in the patent for actuating the clamps and causing them to grasp and move the carbons dissimultaneously, substantially as and for the purpose described in the specification.

Patent No. 147,827, issued to Matthias Day, Jr., Feb. 24, 1874, is relied on as an anticipation of the first, second and fourth claims of the patent in suit. This defense is based upon a construction of these claims that gives no effect to their concluding restrictive language, which construction, we have seen, is not authorized. The patent in suit describes mechanism which designedly and positively effects a dissimultaneous separation of the carbons, and Professor Barker, the defendants' expert, testified that the Day lamp was not so constructed, and did not so operate. It is true that the Day patent describes a lamp which contains two or more pairs of carbons, but not such a double carbon lamp as Brush invented. In the Day lamp each carbon is split or divided vertically for a slight distance from the outer end, but so rigidly connected at the clamp extremity as to act solely as a pair of separate carbons, and not as "two or more independent pairs or sets of carbons."

Owing to the constant and frequent shifting of the arc from one pair of carbons to the other in this lamp, it produced an irregular and unsatisfactory light. It was unlike the Brush lamp both in construction and mode of operation.

The answer also denies infringement, but that defense, like the last one, is based on the theory that the claims are not at all limited by their concluding language. It is plain from the evidence that the defendants' lamp was designedly constructed so as to insure the dissimultaneous separation of the two pairs of carbons for the purpose of forming the arc between one pair only of the carbons, and that both lamps operate identically the same way and for the same purpose. The patent describes a ring clamp and the defendants use a hinged clamp; but there is not the slightest functional difference between them. Both operate by grasping and holding with varying pressure the smooth rod which carries the carbons, thus allowing the rod to slide so as to secure a continuous feed by inappreciable degrees, while under other conditions, the cord is allowed to slip suddenly by gravity. The ring clamp was old, and Brush simply employed it as suitable for his purpose in combination with other elements with which it co-acts, and the substitution of the hinged clamp, without any change in the mode of operation or function, did not change the combination.

In the Brush lamp the clamps rest on a flat floor, and the arms of the lifter are of unequal length, so that when the lifter is raised one clamp is tilted in advance of the other, and the carbons are separated dissimultaneously. In the defendants' lamp the same result is accomplished by supporting the clamps in different planes, and employing a lifter with arms of the same length, so that in the operation of the lifter it will tilt one clamp in advance of the other. Brush did not claim that there was invention in the lifter and clamps disconnected with other parts in the operation of the lamp, and the defendants cannot escape infringement by showing that they used a lifter and clamps not identical in construction with the lifter and clamps described in the patent. It is admitted that if the claims are construed as embracing the mechanism described in the specification the defendants use a lamp covered by the patent in suit, and that renders a further description of defendants' lamp unnecessary.

It is finally contended that, while the patent describes particular mechanism by which the functions stated in the claims can be performed, the patentee expressly declared in his specification that he did not limit himself to this mechanism, or its equivalent, but claimed that his invention comprehended all means capable of accomplishing the results stated, and that having thus claimed more than he was entitled to, the complainant cannot recover until he disclaims everything in the specification except the specific mechanism.

An application for letters patent is accompanied by a specification giving a full general description of the alleged invention, and this is followed by what is known and well understood in the courts, as well as the Patent Office, as a "claim." What the patentee invents and describes in his specification, but fails to embrace in his claim, he abandons to the public, unless by timely application he obtains a reissue for it, and if in the descriptive part of his invention he inadvertently, or otherwise, includes as a part of his invention that which is old, but does not claim it, his claim is not thereby invalidated. Such part of the specification is surplusage. It is only when the claim following the specification is too broad, in the sense of embracing something as new which is not new, that the patentee is required by Section 4,922 to disclaim. He is not required to disclaim anything in the specification not covered by his claim. The word "specification" is obviously used in the first clause of Section 4,922 as synonymous with "claim." I am aware of no decision, holding that a patentee is required to disclaim anything in the descriptive part of his invention which is not fairly embraced within his claim.

In Railroad Company *vs.* Mellem, 104 U. S. 118, the court said: "In view, therefore of the statute, the practice of the Patent Office and the decisions of this court, we think that the scope of letters patent should be limited to the invention covered by the claim, and that though the claim may be illustrated, it cannot be enlarged by the language used in other parts of the specification. We are, therefore, justified in looking to the 'claim' with which the specification of the appellee's invention concludes to determine what is covered by this letters patent."

It is not material for the purpose of this suit whether Brush was a pioneer, or a mere improver. It is sufficient that he described and illustrated in the patent in suit a specific mechanism, or double-carbon lamp, adapted to burn its carbons independently and successively; that he was the first to accomplish this result, and that the claims are for mechanism substantially as described in the patent in combination with two or more pairs of carbons or sets of carbons for producing the result specified. We have already stated that what is claimed is not functions and results, but mechanism for producing functions and results.

A decree will be entered in accordance with the prayer of the bill. M. D. Leggett & L. L. Leggett, H. A. Seymour, for complainant; R. S. Taylor, for defendant.

THE NEW HAMPSHIRE ELECTRIC LIGHT ASSOCIATION.

THE FIFTH STATE ORGANIZED.

The Central Station Companies of New Hampshire held a meeting to organize a State Association, at Manchester, Thursday January 9th.

The response to the call for the meeting was almost unanimous. Nearly every company in the State was represented either in person or by letter. A careful estimate showed that over eighty per cent of the capital employed in Central Station lighting in the State was represented in person. The desirability of organizing a State Association was fully discussed and the proposal to organize at once was cordially endorsed.

The organization was effected by the adoption of by-laws and the election of the following officers: president, Alonzo Elliott, Manchester; vice-president, F. W. Eastabrook, Nashua; secretary and treasurer, Edgar Woodman, Concord. Executive committee, Alonzo Elliott, Manchester; F. W. Eastabrook, Nashua; H. W. Burgett, Dover.

After the adjournment of the meeting, President Elliott's invitation to partake of a dinner was accepted.

Hammerfest, Norway, is to have an electric light plant. This is the most northerly town on the globe.

It is said that upwards of $600,000,000 of capital is invested in the electrical industries in the United States.

MODEL ELECTRIC ELEVATOR INSTALLATION.

We present herewith a view of a recent hydraulic elevator installation made at the building of the United Security Trust & Safe Deposit Co. of Philadelphia by the Otis Elevator Co. of Yonkers, N. Y., and Chadbourne, Hazleton & Co. of Philadelphia, agents in Pennsylvania for the Sprague Electric Railway & Motor Co. of New York.

One of the first things which strikes an observer is the minimum of space required for every part of this installation. The pump was manufactured by the Otis Elevator Co. especially for this plant, and the arrangement for reduction of speed between the armature shaft and pump is made in the compact manner shown in the illustration. The motor operates the pump against a pressure in the tank, there being no overflow, and when the maximum pressure is reached, the motor runs empty, automatically cutting down the amount of electric current taken from the line so that only sufficient current is used to supply the energy to keep the motor in operation.

WESTINGHOUSE COMPANY'S SALES.—During the first three weeks of December last the Westinghouse Electric Company, of Pittsburgh, secured contracts for alternating current apparatus, to be used at the following places: Salem, O., 750 lights; Louisville, Ky., 759 lights; Greenfield, Mass., 750 lights; Denison, O., 500 lights; St. Louis, Mo., 2,500 lights; Hamilton, Ont., 1,500 lights; Denver, Col., 3,000 lights; Pittsburgh Kan., 750 lights; Pueblo, Col., 750 lights; McKinney, Tex., 500 lights; Portland, Ore., 6 000 lights; Lynchburgh, Va., 750 lights; Dansville, N. Y., 500 lights; Batavia, N. Y., 750 lights; Pittsburgh, Pa, 3,000 lights; Oldtown, Me., 750 lights. Arc light machines of a capacity of 250 lamps were sold as follows: Pittsburgh, Kan., 50; Portland, Ore, 100; New Bedford, Mass., 100.

"Whipple's National Electrical Directory and Electric Reports" is the title of a book just issued by Fred Whipple, of Detroit. This Directory will no doubt meet with a hearty welcome among electricians. It contains a list of all the associations in every branch of electricity, and clubs in the United States, including the names of the members of each. Every branch of electrical industry is very completely listed, and the book will be invaluable to persons who have occasion to learn the names of those engaged in any particular branch of electricity.

Three 7 000-pound dynamos are being turned out by the Eddy Company at Windsor, Conn. They will be of 45-horse power each, and are to be used for the deposition of copper.

The Commercial Cable Company paid their usual quarterly dividend of one and a half per cent. on the 2d Jan. last.

One of the special features of this hoist is the compactness of the casting, which was made expressly for this plant. It is in one piece, consequently greater rigidity is secured.

Before the installation of the electric motor at this place, a gas engine was used to supply the necessary power, but gas never proved satisfactory in this capacity, and the Sprague motor was substituted. This motor is now giving perfect satisfaction and the plant is one of the finest in Philadelphia. Our view is made from a photograph, and shows all the details of this installation.

The Citizens' Electric Street Railway, of Decatur, Ill., changed from horse to electric power last August, and has since been in successful operation. The road is five miles in length. The over-head wire system is used, and since the change travel has increased 100 per cent.

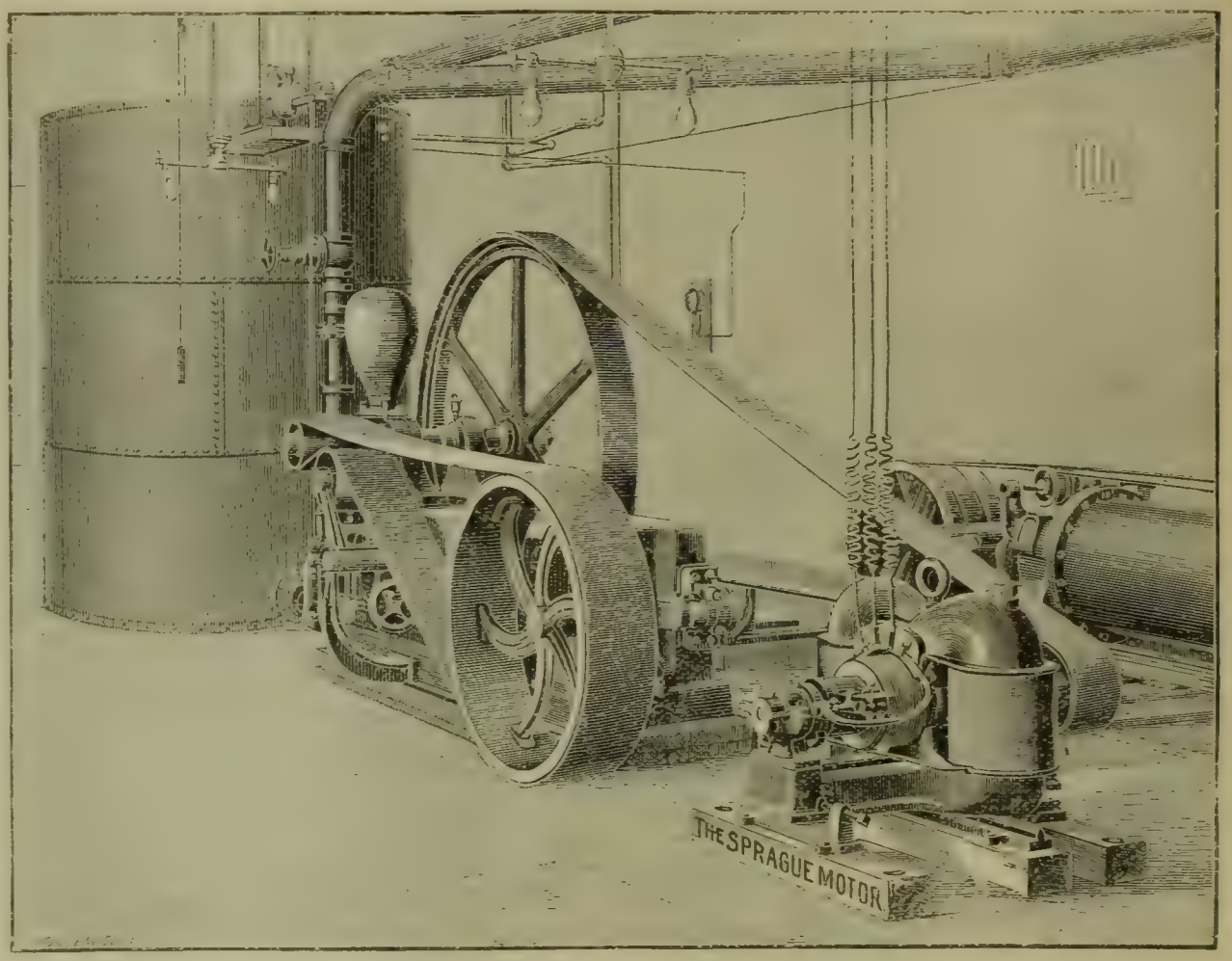
The power plant for the Fostoria, O., electric light company has been completed.

A most ingenious electric cash register has been brought out. When the cash drawer is pushed in after the requisite amount is deposited it must be wholly shut and locked; otherwise a bell will ring until this is done. Besides the drawer cannot be pulled out after attempting to close it until it is fully closed and locked; thus carelessness in closing the drawer is at once detected. At the close of business the door in front of the register is dropped, and on the dials is noted the total cash of the day in dollars, dimes and cents, so that the total amount of the day's business can be seen at a glance.

The opacity of steam issuing from a nozzle is greatly increased by bringing electrified points near it, and its color is changed to orange brown.

The Electric Light Company at Salem, Mass., has provided a library of works upon electricity for the benefit of its employees.

Pittsburgh Chronicle: An electric piano has been invented, and now its makers will try to introduce it into our ohms.



THE SPRAGUE MOTOR FOR ELEVATOR INSTALLATION.

BUILDING WIRING.

The acme of perfection in incandescent wiring is the system used in the new Metropolitan Telephone Building, in 38th St., between Sixth Ave. and Broadway, being that of the Interior Electrical Conduit Co. It was the writer's pleasure to visit that building a short time ago. On going into the cellar, the first thing out of the ordinary run of wiring that was noticed, was three neat black tubes about an inch in diameter coming in from the street service. These ran into a junction box about ten feet from the building line. At this point the system divides, running on either side of the building, extending along the ceiling to a distance of half the depth of the cellar, at which point they run into another junction box dividing again, one half returning half way to the front of the building, the other running to an equal distance back. At these points the tubes elbow upwards, running up the side of the building to the fourth floor—the centre of distribution; at which point they run into a junction box placed in the centre of the crib, which runs from the cellar to the seventh story. Each floor has four cut-out junction boxes, one on each crib or vertical main, and each junction box has four divisional circuits of ⅜-inch tube. The tubes run to three outlets each, coming out with an elbow and also returning with one, running to the next outlet. The building is wired throughout with flexible wire and cable. All feeders and vertical mains are single conductors run in one inch tubing. The divisional circuits are single tubes containing flexible twin conductors, and in no case exceed eight ampères. One of the principle features of this system is that the building was conduited throughout while in course of construction, and the conductors were inserted after the building was completed, thus showing that the wire can be withdrawn and replaced at will.

One of the treasures of the Edison phonograph works at Orange is a cylinder that was impressed with the voice of the late John McCullough, the actor, who died in a madhouse. The impression was taken while he was in confinement. Rambling passages from the plays in which he acted were recited in a voice of wonderful power and pathos, but at the end of each passage the actor would stop and say, in a voice to chill the blood, "But now I'm mad—ha, ha, ha, ha, ha, ha, ha—ah-h-h h." The end of the laugh was all but indescribable, for he drew in his breath with a sound that was partly a shriek and partly a gasp. If there is ever a voice heard from the tomb it is when this cylinder is put in the phonograph.

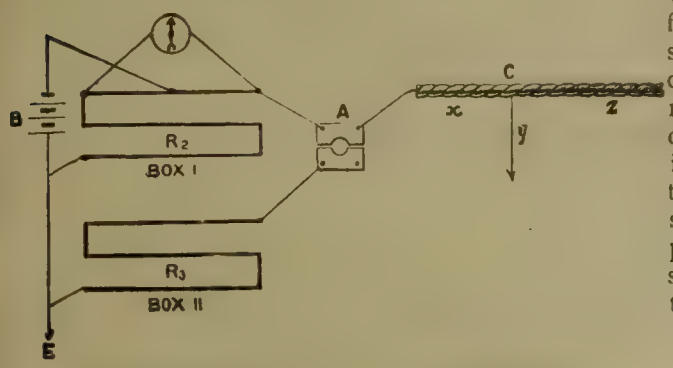
The trouble between Mayor Hart, of Boston, and the electric light companies has been compromised. Pending the signing of contracts for lighting the city at cheaper rates, the Mayor has agreed to let the Boston Electric Light Company, which supplies the bulk of the light, continue its service at the old figure, 65 cents per lamp a night. Some of the smaller companies meanwhile will extend their plants until they have circuits enough to light the city. When this is accomplished, contracts will be signed for 40 cents a lamp.

Mr. Edison is adding to his laboratory a collection of minerals.

THE BLAVIER METHOD OF LOCALIZING FAULTS IN SUBMARINE CABLES.

In a communication to the London *Electrical Review*, respecting the Blavier method of localizing faults in submarine cables, Mr. P. Chr. Dresing, of Copenhagen, says:

It is well-known that the Blavier method of testing suffers from the disadvantage of exposing the fault to a higher potential when the distant end of the cable is insulated than when it is earthed. The consequence is that the current through the fault to earth is of different strength in the two cases, and that the resistance of the fault which is a function of the current must vary between the two measurements This difficulty can partly be overcome by using a smaller electro-motive force when the cable is freed than when it is put to earth, and the ratio between the two battery powers can be found approximately by calculation. But there are other sources of disturbance produced by the earthing of the cable, such as the shunt circuit formed by the length beyond the fault, and as these errors cannot be compensated for, it is only in some few cases that a localization by Blavier's formula can be relied upon. Refuge is then, as a rule, taken to the so-called "overlap methods" of testing from *both ends* of the cable, viz, localization by the two measurements with the distant ends insulated, or by the two measurements with the distant ends earthed. Both these, but especially the latter, have been developed into tests of great practical merit and accuracy by Messrs. A. E. Kennelly and J. Anderson.



THE BLAVIER METHOD OF LOCALIZING FAULTS.

There are, however, cases when, if possible, it is desirable to localize a fault by *measurements from one end only*, and to be enabled to do this with as much accuracy as possible, it occured to Mr. Jordan, one of the acting electricians of the Great Northern Telegraph Company in the Far East, that the following modification of the ordinary Blavier method might be made, in order to remove some of its disadvantages as mentioned above.

The diagram shows Mr. Jordan's arrangement. Box I. is an ordinary Wheatstone bridge with resistance coils, and Box II. an ordinary resistance box from 1 to 10,000 ohms. G is a Thomson's reflecting galvanometer. A is a commutator, and to the same and the bridge is connected a cable, in which there is a fault, y, with the lengths, x and z, on either side thereof.

The *modus operandi* is as follows: First, the resistance is measured in the usual manner with the other end of the cable earthed and with no plug in A, and balance is obtained by unplugging a resistance, R^2, in Box I.; then

$$R_2 = x + \frac{y\,z}{y+z}.$$

The moment it is observed that the cable is freed at the other end, a plug is inserted in A, R_2 *is left unaltered* and the resistance in Box II. is adjusted until the spot of light again covers zero; then $\frac{R_3(x+y)}{R_3+x+y} = R^2$, from which

$$x+y = \frac{R_3 R_2}{R_3 - R_2}.$$

We know that $x+y = R$, and thus we have the equations requisite, and arrive at the following expression:

$$x = R_2\left(1 - \sqrt{\frac{R - R_2}{R_3 - R_2}}\right).$$

From this it is manifest that when the cable is insulated the current is shunted by the resistance, R_3, in the same way as z is a shunt when the cable is earthed, and the result is that the fault in the two cases is acted upon by currents of more equal strength than in the ordinary Blavier test; and further, that it is possible to take the tests so quickly and nearly instantaneously after each other, by having adjusted the resistances, R_2 and R_3, in accordance with the two conditions, that the resistance of the fault may be assumed to remain approximately constant during both measurements

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ELECTRIC FOG SIGNALS.—The *Herald* of this city describes a fog signaling apparatus lately invented in London, which will be of great value in the saving of life and property at sea. The invention calls into use electricity, which admits of the signals being automatically worked and at the same time records every signal as it is given on a band of graduated paper. The apparatus consists of a single switch which is placed on the vessel's bridge so that the signaling can be controlled by the officer on watch. When it is desired to blow the signal whistle or begin the automatic signaling, whatever its nature may be, the lever is turned to the "under way" notch if the vessel be moving, and the electric current at once begins working the valve of the steam whistle at regular intervals, conforming to what the law specifies. Should the vessel be at anchor the switch is turned to "at anchor," and the bell is rung in the same way. The register consists of the band of paper properly subdivided and moved along by clock-work. A traveling pointer, actuated by an electro-magnet, pricks the paper at every sound of the bell or whistle. The signaling can also be made at will entirely independent of automatic mechanism by simply pressing a button which closes the circuit leading to the bell or whistle.

Perhaps no more significant evidence of the onward march of civilization could be afforded than the lighting by electricity of the palace of the Guikwar of Baroda in India, and that, too, on a scale of unstinting splendor. The interior is lit with 215 16 candle power incandescent lights. The large hall is illuminated with two large 12-light electroliers, made in bronze and lacquered work, while the light is softened and diffused by dioptric shades. Single lights are also pendent from the ends of the columns of the gallery. In the numerous rooms are three and four light electroliers, made in a variety of designs to suit the surroundings.

It is noted in Berlin that Mr. Weems of Baltimore has reproduced Dr. Werner Siemens's idea of long ago of an electric letter post Dr. Siemens proposed that this form of transit of letters should replace the pneumatic tube system now in use in Berlin and Paris, the letters being conveyed on small electrical cars through a tube at a very high rate of speed.

Shelford Bidwell has published a preliminary notice of certain experiments made by him, which apparently show that a piece of iron can be slightly magnetized by allowing a ray of light to fall upon it. Mr. Bidwell does not consider the results entirely free from suspicion, but, if further results confirm the experiment, it is of the highest importance, and will go far to prove that light is an electro-magnetic disturbance—a theory which many other facts apparently tend to confirm.

The case of the Bell Telephone Company against the Arkansas Telephone Company was dismissed at Fort Smith, Ark., recently. The plaintiff is to pay costs.

DENVER'S ELECTRIC LIGHTING.

For a city of its size Denver has, without doubt, the finest plants of electric light machinery in the country, although the light furnished is not always faultless. The Denver Consolidated Electric Company has a capital stock of $1,000,000, and have the largest central station in the country. From the plants of this company are furnished the light for all city purposes, beside the domestic and commercial lighting. There are 216 arc and 930 incandescent lamps now in actual use by the city. There are eight towers, constructed of cast-iron, with six lamps of 3,000-candle power each. These towers are seventy-five feet in height. The incandescent lamps on the corners of all streets are supposed to have a twenty-candle power. In the last year the company's works at Twenty-first and Wewatta streets have been enlarged to twice the original size, while another large stack has been erected. The Brush system is employed for arc lighting entirely, while the Edison municipal system is employed for street lighting. The Westinghouse alternating incandescent is employed for commercial and domestic uses

The arc light room now has a capacity of 1,000 lights of 2,000-candle power each. Of this number 900 are in use. The city lights run on what is known as the moonlight schedule. On Fifteenth, Sixteenth and Seventeenth streets are located 170 arc lights of 2,000-candle power each, hung at the intersections of the streets The Consolidated Company keeps a large force of men, known as "trouble hunters," constantly looking up breaks and other accidents.

The Denver Electric Illuminating Company has been in operation about fourteen months. during which time its works located at Sixth and Lawrence streets, have been more than doubled to meet the enormous demands for light. The company's present building is 171 by 135 feet and two stories high. Its plant consists of nine arc dynamos, two incandescent dynamos and two motor or power dynamos. The Thomson-Houston system is employed throughout.

Over 300 arc lights are in operation at present, and over 800 incandescent lamps have been placed since the installment of the first incandescent dynamo four weeks ago. It has been almost impossible with an extra force of men employed to meet the demand. Over $200,000 was expended last year in permanent improvements and extension of service. This company's lines are now extended over all of East Denver. A contract has been let recently, by the terms of which this company will furnish the town of Highlands with street light throughout its entire limits.

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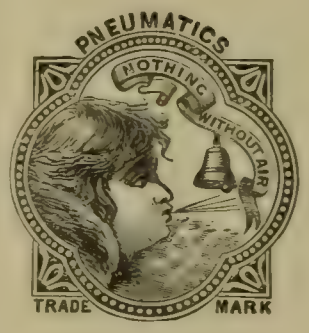
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THE ELECTRIC LIGHT QUESTION.

The Atlantic cable has been brought into use in getting the opinions of prominent electricians on the question of making electric light wires safe to life and property.

Herr von Siemens, the eminent German scientist, was interviewed on the subject, and his views are given elsewhere in this issue.

The subject is one of such manifest importance that prominent scientists and electrical experts, both in this country and Europe, have without hesitation expressed their views, appreciating the predicament in which the people of the American metropolis and other places were placed.

They have all added to the general fund of knowledge on this most important subject, and it is earnestly hoped that when the companies get to work to rebuild their lines they will put them up to stay.

Many ways have been pointed out to make electric lighting safe, and surely something should be done quickly to restore this superior illuminant to our streets.

The sickly gaslight is not in keeping with the times.

No doubt every effort on the part of the electric light companies to resume business will be bitterly opposed by the gas companies. But public sentiment is in favor of electricity as a street light, and gas will have to go.

The companies themselves will necessarily have to take the initiative toward the restoration of order out of the chaos.

The days of the Board of Electrical control are numbered, and it is hoped the authority over electrical affairs will be placed in the hands of rational beings.

The ships of the Russian squadron of the Black Sea and the Baltic Sea are to be lighted by electricity, and 650,000 francs have been appropriated for the purpose.

UNFAIR TESTING.

There is a loose screw somewhere in the matter of testing the insulation of electric light wires. To test it with an electromotive force of 200 volts and then use the wire for a 2000 volt current is an extraordinary way of doing things. A wire intended to convey a current of 2000 volts should be sufficiently well insulated to withstand the great tension as far as possible. The application of such a pressure is enough to destroy any ordinary insulation, and serious leakage is the result. A different method of testing should be adopted. Men go around the streets with a testing outfit with a capacity of 200 volts. With this the wires are tested, and the report goes in that the wires stand the test satisfactorily. On the strength of these reports the full current is turned on, then the trouble begins. Under the increased pressure any undiscovered fault will be aggravated. This is all unfair to light companies and to the public. There is no reason why more care should not be exercised in this important matter.

When submarine cables are tested for insulation they are subjected to a pressure of ten times or more the strength of current intended to be used in practice. A cable that cannot stand such a test is laid aside as faulty. Similar tests should be made with electric light wires. All insulation deteriorates, and it is, of course, more difficult to prevent leakage on a wire carrying a high voltage than on one conveying a low pressure. But all wires should be properly tested, and none should be utilized unless they stand the test. This is a matter of great importance, and the evil complained of should be corrected.

In their haste to provide subways for electric wires the Board of Electrical Control has not forgotten to provide means for clearing the manholes of gas. The method is a novel one to be sure, but it is simple and effective. Its very simplicity shows the great wisdom and forethought of the board. The board provides the closed chamber in which the escaping gas can accumulate and nature or an accident, at the proper time, ignites the explosive compound. The manholes are cleared in an instant, and the heavy cast iron covering and several square yards of paving stones attend the operation. Were it not for this wise provision there is no telling what harm the escaping gas from leaky mains might do!

Congressman Amos Cummings, of this city, is right in giving electricity the credit for being largely instrumental in placing this country where it now is as a wealth-produciug nation. He also believes the fruits of our wonderful prosperity ought to be shared in by the laborer as well as the capitalist, and to this end he introduced into the House, a few days ago, a resolution to the effect that the day should be divided into eight hours for work, eight hours for rest and eight hours for recreation. He believes that a general reduction of the working hours to eight per day would be conducive to the public weal, and contribute to the industrial, commercial, social, and moral advancement of the people.

A few years ago some of the leading photographers in London went to the expense of equipping their establishments with engines and dynamos, so that, by means of the electric light, they might be to some extent independent of the sun in their work. The results were satisfactory though the cost of equipment and maintenance was high. Most of these photographers have discarded their engines and dynamos, though still adhering to the electric light. They find it much less expensive and satisfactory to take their current from the street mains of the different electric light companies, paying only for the quantity consumed.

THE BOARD OF ELECTRICAL CONTROL.

Steps have been taken at Albany to abolish the present Board of Electrical Control, and place its affairs in the hands of a State commission. Senator Roesch introduced a bill in the Senate on the 16th instant with this object in view. The new board is to consist of three non-partisan commissioners, and is to be given powers similar to those of the railroad commission.

No person receiving any emoluments from any electric company can hold office in or under the commission. The main office shall be at Albany, with branches in New York and at such other places as may be necessary. In the words of the bill the commission shall have "general supervision of all the telegraph, telephone, electric light wires, subways, conductor or conduit, associations, companies and corporations, and of all corporations or associations which in any manner utilize the electric fluid for public use or for public commerce * * * and shall examine the same and keep themselves informed as to their condition and the manner in which they are conducted with reference to the security of life, protection of property and accommodation of the public."

The commissioners must investigate the causes of all accidents to life or limb or that damage property. All electric companies are compelled to report to the commissioners any accidents which may occur in the course of their business. In the case of any company violating the laws or otherwise rendering itself amenable to prosecution, the commissioners shall inform the attorney-general, who shall bring action in the usual way. The commissioners are also empowered to make changes on the lines of the companies or in their way of doing business, and they have power to regulate charges after having given a hearing to the companies affected.

It is expected that a strong opposition will be made by the electrical companies.

POLE CHOPPING.—The work of removing wires from the streets in this city continues with renewed vigor. The force of pole-choppers has been enlarged, and the Mayor has mapped out a new and large plan of operations. Telegraph and telephone wires largely constitute the lines to be removed, but no inconvenience to speak of will result from their removal, as most of the wires have been placed in the subways as far as the latter are completed.

ELECTRICAL EXECUTION TABLEAU.—The latest novelty at the Eden Musee in this city is a tableau representing the method of electrical execution as adopted in this State. Dynamo, switches, volt-meter, criminal and executioner are all fashioned in a realistic manner. This tableau is found in the "Chamber of Horrors," where it properly belongs.

The Detroit Electric Light Company has secured a three years contract to light the city. All wires are to be put underground within a half-mile radius of the city hall.

The Brush Company, however, at once took out an injunction against the Detroit Company, on the ground that the latter company's bid was not accompanied by certain papers. It looks as though a prolonged fight would result.

The electrical department of the New Haven Clock Co. has been organized into a separate company, and it is its intention to open an electrical headquarters on Dey street, in the near future.

Superintendent Whitney of the Manchester, N. H. Electric light station has devised an automatic alarm, which rings a little bell when a circuit breaks during the day time.

CAN ELECTRIC CURRENTS BE MADE SAFE?

WHAT PROMINENT ELECTRICIANS HAVE TO SAY ON THE SUBJECT.

Under this heading the New York *World* publishes an interview with Prof. Werner von Siemens, of Berlin, which we give in full :

The one man who has brought electric lighting to the perfection it has obtained in Berlin to-day is Privy-Councillor Werner von Siemens, the famous electrician. The correspondent called to see him at his great factory in the Markgrafenstrasse, where thousands of men are employed in the manufacture of dynamos and various electrical appliances. But I found that he was not expected there, and I went to his house, a spacious mansion in Charlottenburg, about four miles from Berlin. The grounds surrounding the house itself are brilliantly illuminated by electricity. The correspondent was shown into the drawing-room to await his coming. Presently he came in, greeting me cordially. "I am very glad to see you," he said, shaking hands, and immediately afterwards touched a button in the wall, which increased the force of the electric lamps and filled the room with mellow light.

"You are evidently not afraid of electric currents here," he was asked by way of starting the conversation

"No," he said, "not the slightest. To us electricity is an obedient slave, and not the fierce demon which your New York papers seem to represent it."

"Do you think, then, that the dangers we have experienced from electric lighting in America can be obviated?"

"Yes," he said. "By well constructed underground conduits the danger of electric light wires can be totally abolished if low-pressure currents are used, and the dangers resulting from very high pressure can be reduced to a minimum in the same manner. There is no doubt at all that the greatest proportion of such accidents as have happened in New York will cease on the day when the last overhead wire is buried."

"Gas and water pipes," Herr von Siemens continued, "can never act as conductors of dangerous electric currents from the underground wires into dwelling houses. These pipes, if crossed by such a current, would at once divert it into the ground It is just so with lightning-rods, which electricians frequently connect with the water-pipes because they make the easiest and most perfect distributors of electricity, diffusing the current over so wide an area as to make it harmless.

"The insulated wires for street lamps should be placed inside of hollow lamp posts. For interior lighting (houses, stores, etc) no high pressure currents should be used unless the construction is such that every possible danger from contact with conductors and lamps is obviated.

"Electric-light conductors will ever cause a fire unless they are carefully constructed. A well-planned and properly constructed conductor, supplied with the necessary safeguards, is entirely harmless.

"No death caused by contact with electric wires has ever happened here in Berlin. A few accidents by fire have happened in isolated plants, but always because of faulty construction.

"Overhead wires should never have more than 500 volts pressure. Underground conductors, with transformers, no more than 2.000 volts. The transformers and conductors should, however, be tested up to 5,000 volts.

"My system of insulated conductors, protected by lead cover, asphaltum and sheet iron, has proved successful wherever it has been used—in Berlin, Munich, Rome, Milan and other continental cities. Some of these cables have been in use (partly for high-pressure and transformers) for six years, and are apparently good for a long time to come. Their exact duration cannot be fixed. Time only can solve that question.

"This system, or a similar one, will overcome all the difficulties you Americans have to contend with. In conclusion, I will say that high-pressure should never be used, except where, for pecuniary or technical reasons, it is impossible to introduce low pressure."

So much for Prof. Siemens. He said enough to show his conviction that electric-lighting in the streets can be made absolutely safe. Herr Emil Rathenau, who is President of the Berliner Electricitats Werke, which supplies the Berlin public with electric lights, was next called upon. He had been kept thoroughly posted by a correspondent in New York of what had been going on in America, and was quite willing to discuss it.

"I have read," he said, "of the numerous accidents in New York, and, in my opinion, your Mayor did an excellent thing when he ordered the electric wires overhead to be cut. They should all be placed under ground. There is no danger of the currents being carried into the house by gas or water pipes and thus making mischief. It is absurd. I think the trouble has been caused by the carelessness of the companies. They were probably trying to make money too quickly.

"How do you manage to avoid accidents here in Berlin?"

"There are two kinds of accidents which may be caused by electric-light wires. The danger to life is one. That we entirely obviate by using only low pressure no higher than 300 volts, with which we secure an excellent, clear, bright and steady light. Never a complaint is heard. We have 80,000 lamps in operation now here in Berlin, and we expect to have 160,000 within a year. You see we attain excellent results with this low pressure. We use the Edison lamps, but all the arc lamps in Berlin are also fed by our cables. Formerly we used 400 volts for the arc lights, but we find that 300 volts would work as well. A current of that strength is perfectly harmless. You would scarcely feel it. There is absolutely no danger to life. We have 1,500 men in our employ, who all have more or less to do with the wires, but no one in our employ has ever been killed or even injured.

"It is otherwise, however, with the second class of accidents—fires. Low pressure alone will not prevent that danger. But proper construction will. For five years we allowed no one but our own men to put in the plants. With proper care and safeguards there is no danger. Now we allow other contractors to arrange the individual plants, but they must work according to our rules (here Herr Rathenau produced a formidable set of rules, regulating every detail of laying and arranging the wires, insulation, safeguards, etc.) After the work is done it is inspected by one of our experts and only accepted if properly done. Besides all this precaution we have everywhere automatic cut-offs, which at once disconnect the current should any wire become overheated. We allow no single wire to carry more than a fixed pressure. We are responsible for all accidents, but we have none. You Americans are the best mechanics in the world, and if you set to work in earnest to perfect your electric-light system no more accidents will happen. It would be folly to discard electric light merely because you have handled it carelessly and burned your fingers."

"Is the low-pressure light so much more expensive than the high-pressure one?"

"I will answer that question," he said, "by giving you some figures. We charge for each new lamp (connections and all) placed in a building, 20 marks ($5); such a lamp will last forever. Then we charge 5 marks ($1.25) per lamp a year for keeping it in order, and 4 pfennig (1 cent) an hour of actual use for each lamp of sixteen-candle power. At these rates we paid a dividend of 8 per cent. this year, besides adding greatly to our reserve fund. Commencing January we reduced the rate per hour to 3.60 pfennig (9.10 of a cent) and still expect to make money. Surely your New York companies can do better than that, for we have a strong competitor in the gas works, which sells 1,000 cubic feet for 5 marks, a much lower rate than obtains in New York.

"Our rates for street-lighting are somewhat higher. The city pays us 100,000 marks ($25,000) for the 108 lamps in Unter den Linden, and 36,000 marks ($9,000) for the thirty-six lamps in the Leipziger strasse. But then these are lights of intense power, and we had to erect the lamp-posts, make connections and take care of the entire plant. The lights burn every night in the year, moonlight nights not excepted."

It will be seen by the facts given in the above interviews that electric light can be furnished cheaply and without exposing the public or the workmen employed on the wires to any danger. Herr Rathenau also said, in the course of conversation, that his Company owns and runs the electric-light works of Madrid, Antwerp, Eisenach and other cities, and that their experience there was the same as in Berlin—no accidents and no trouble.

GEORGE H. BENJAMIN.

ELECTRICAL EXPERT.

Mr. Benjamin has just returned from abroad. Under this heading he writes : Having recently spent some seven months in Europe, I took occasion to carefully investigate the methods employed for handling high tension currents. As a result of my inquiries I found that the practice of burying the wires was universal in all well-constructed plants, and that up to the present time no difficulty whatever had been experienced in conveying currents of extremely high tension without danger to life or from fire ; and that, on the contrary, experience had shown the practice of burying wires to be much safer than where over-head wires were employed, productive of greater convenience in handling the wires and currents, and economical in course of operation and maintenance.

In discussing the subject with the most prominent electricians of Europe, among whom may be mentioned Sir William Thomson, of England, and Dr. Werner Siemens, of Berlin—the latter being without doubt the most eminent authority on the subject in the world—I found no doubt expressed that any tension of current could be safely carried in conductors, whether placed under ground or over head, if ordinary and sensible precautions were taken in the construction and arrangement of such conductors. The consensus of opinion was to the effect that it was preferable for every reason to place the wires underground.

One large electric-lighting company of London is now transmitting currents throughout the city of London, which currents are alternating in character and of a tension of 10,000 volts, which is some five times greater than the voltage of any alternating current heretofore employed in America.

The system of transmission of electric currents commonly employed in Europe is to convey the currents by conductors covered by one or more sheetings of lead and buried directly in the earth. The cables employed consist usually of two conductors arranged concentrically, so arranged for the purpose of cutting off the inductive influence between the cables and other wires placed contiguous thereto. Burying the cables directly in the earth is considered the best practice, and the objection which has been urged against this practice in this country—to wit, that such cables are destroyed by the corrosive action of the earth, gases, etc.,—has been found by over ten years' practice to be utterly fallacious.

In London the practice has been to lay the cables directly in the earth or in iron boxes situated about twenty inches below the surface of the sidewalk, it being considered preferable to break up the sidewalk than to disturb the surface of the street. In Paris the cables are likewise stretched beneath the sidewalk in a single duct provided for them. The cables commonly employed are known as those of the manufacture of Siemens, of Berlin, and Berthoud & Borel, of Switzerland.

In various continental cities I noted the cables were placed in conduits of Beton, the practice being to stretch the cables on a form and subsequently construct the conduits around the cables by tamping the cement. By this ar-

rangement no gas can find its way around the cables, the danger from explosion of accumulated gas is thus avoided and the cables themselves are protected from mechanical injury.

All those who have had any experience in handling cables have found that they are liable to be seriously injured by being drawn into conduits previously prepared, such as are in use in this city, and it is therefore thought necessary to use extreme care in drawing in the cables, or what is a better practice, make the conduit around the cable.

In case it is necessary to renew a cable for any reason, or to make a connection with the cable, the conduit may be broken and replaced at comparatively small expense.

In house to house lighting, the currents are conveyed from the cables in one of two ways, as desired; either by tapping the cable at the point where the light is to be located, or by tapping the cable at a given point and conveying the current by another cable to, say, the centre of the block of houses, and then distributing the current by overhead wires. By such an arrangement of conductors the danger from interference is practically avoided

Comparing the two systems, namely, that employed in the city of New York and that commonly in use throughout Europe, it is evident that that now in process of construction in this city is more or less defective, but may be made of value when placed under intelligent supervision.

In conclusion, I would say that my experience teaches me that a current of almost any tension, that is to say, not over 15,000 volts, may be transmitted through a proper conductor, placed under ground, without the slightest danger, and in this opinion I am borne out by the facts as above stated. I would further state that I believe, with conductors properly arranged, that any high-tension induction system can be made safer than the direct or continuous system, for the simple reason that when the conductors are properly laid the pressure in the mains has little or nothing to do with the case. In the induction system, alternating currents, the high-tension current in the mains is not conducted into the houses, the system in the houses being absolutely independent, so far as circuit connections are concerned, from the system in the mains; whereas in the continuous system, the current is conducted into the houses, the circuit in the houses being a part of the main circuit. The tension of both systems in the houses is practically the same, whereas, in the continuous system the whole current of the mains may be turned into the houses and produce a result similar to that described in Mr. Edison's recent article as occurring near the corner of William and Wall streets in this city, when the conductors became crossed.

It is perfectly evident to all those who know anything of the subject that no accident to the mains in the alternating system will have any appreciable effect upon the house circuit of the system.

The electric lighting industry of this country has become too great a one to be hampered by any petty restrictions, and if there is to be any discussion of the subject it should be directed as to how the conductors shall be placed, and not as to the pressure conveyed by the conductors.

America, up to the present date, has been in advance of the world in electric lighting, simply because no onerous restrictions have been imposed. It is, of course, proper that rules, and stringent rules, should be enacted governing the employment of electrical apparatus, but those rules should result from careful deliberation and not such as are usually the result of hasty action induced by the clamor of those who have no information in regard to the subject, or an axe to grind. As I have already stated underground electric light wires are perfectly safe if properly laid.

THE BUFFALO EXPRESS.

The *Buffalo Express*, in an editorial discussing the electric light problem, makes use of the following language:

Frank Kitton of the Western Union Telegraph Company, in his paper read before the Buffalo Electrical Society last week, disapproved unwise haste in placing arc wires underground, because their closer proximity to each other in the conduits, and to other underground conductors and enclosed gases, rendered the danger from imperfect insulation greater than when they were strung further apart in the open air. This caution is deserving of consideration for it implies a continuance and increase of one of the overhead dangers when certain of the wires are placed under ground.

Mr. Kitton divided the insulating material at present applied to electric wires into three classes: fireproof, weatherproof, and waterproof. The first, he said, is of little use. The second is not much better. The third had resisted the action of the elements for a long season without in any way losing its insulating qualities. It did not appear from his remarks that any of these insulations could be depended on to resist even ordinary abrasion by slight contact with foreign substances. But Mr. Kitton declared that the most desirable covering would possess the combined qualities of good insulation, resistance to water and to abrasion, no change by exposure, and a reasonable degree of proof against fire. Yet he considered only aerial wires as safe even then. These remarks applied, of course, merely to wires carrying high potential currents.

While recognizing the difficulties in the way of burying arc wires, the *St. Louis Globe-Democrat* believes that "the dangers arising from the difficulty of insulation must be far greater and more imminent while the wires are over head than it would be if they were under ground. The nearness together of large masses of wires under the existing system, together with their exposure to wind, rain, sleet and the other influences which cause them to sag, sway, or break, forms a combination of perils which could not be equaled by any which would arise if the wires were buried." This seems reasonable. And bearing upon this point are the opinions of a number of experts now being published in the New York ELECTRIC AGE. These persons represent various systems of electric lighting and other departments of electric work. The general opinion is that overhead lines can be rendered safe by proper construction and use of suitable insulating material, but that placing the wires under ground by the usual method would increase rather than diminish the dangers. The dangers, however, of underground wires could be overcome by constructing the wire conduits themselves of insulating material.

If the objections of these experts are to be overcome, it is evident that invention must be directed toward an insulated enclosure for wires already insulated. But it will take a great deal more conclusive evidence than any yet offered to convince the public that the buried wires in any case are as dangerous, or in as many ways, as those over head.

W. D. SARGENT.

ELECTRICAL EXPERT, GENERAL MANAGER N. Y. AND N. J. TELEPHONE CO.

Mr. W. D. Sargent, general manager of the New York and New Jersey Telephone Company, says: "I do not feel that I have had sufficient experience with electric light conductors to express any very decided opinions, as desired. I have no doubt however, that all the troubles New York has been afflicted with during the past few years, could have been avoided by the application of a little common sense and scientific electrical engineering."

Many streets in this city still remain in darkness.

INDIA-RUBBER.

The monoply in India-rubber which has been created by the Brazilian Government, for the benefit of a local company, says the London *Electrical Review*, has caused considerable disgust and alarm in commercial circles. The "Companhia Mercantil," as the favored company is called, owes its existence to a certain "Count" Viana. Our neighbors across the Channel have a lively recollection of this M. Viana as the head of a syndicate whose financial operations culminated in bankruptcy, but not until it had raised the price of India-rubber very considerably. Viana since transferred the sphere of his activity to Para, the Province of Brazil, where the best India-rubber comes from, the inhabitants of which, who alone had profited by the rise, received him with open arms and he was dubbed a Count. In those days Brazil groaned under a system of provincial councils, which possessed among their prerogatives the fixing of the duties on exports. The directors as well as many of the shareholders of the Companhia were also members of the local council, and the duty on exports then amounted to 22 per cent. When the Government of Brazil recently changed hands one of its first measures was the suppression of these provincial assemblies and the transfer of their prerogatives to the Governors of each State. The saying about an "ill wind" is peculiarly applicable to the Companhia, since, according to recent despatches, the new Governor of Para has just imposed an additional duty of 20 reis or 0 francs .03 per kilogramme to the 22 per cent. already payable on India-rubber exported, and this for the benefit, not of the province, but of the Companhia Mercantil. This is what has roused the very virtuous and just indignation of dealers in India rubber, not only in Paris, but in London and New York. Its importance may be estimated from the fact that in 1888 the Province in Para alone exported ten millions of kilogrammes of first quality India-rubber, and five millions of the second quality. The Paris Chamber of Commerce has protested vigorously; there have been marchings and countermarchings of ministers and deputies; but protests, as experience has shown, are generally thrown away upon South American republics.

CHURCH LIGHTING BY ELECTRICITY.—The Cathedral of Notre Dame, Montreal, Canada, has now an installation of 400 incandescent and 15 arc lights. The incandescent lights are all in the chancel of the church.

MONOPOLY EXTENSION.—The Eastern Telegraph Company has made an offer to the Sydney government to lay a duplicate cable to New Zealand without subsidy, "provided the government guarantee no other company shall be allowed to enter into competition" with it.

Electricity is being more and more used among the manufacturers of the wood-working class. It is practically the only light in use at the present time in sawmills, sash and door factories, furniture factories, and all the wood-working establishments where a superabundance of inflammable material and more or less dust is unavoidable. Manufacturers recognize that they cannot afford to risk the lighting of their plants with lamps, or even gas, with the danger from fire which these illuminators offer. And as a rule, where motive power is abundant and cheap, electricity, besides offering the best and safest light, is in the long run the cheapest.

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RESIGNATION OF COMMISSIONER GIBBENS.

Subway Commissioner Daniel L. Gibbens surprised his associates of the Board of Electrical Control Monday last by sending his resignation as a commissioner to Gov. Hill. Mr. Gibbens has been very restive in office recently. He and Commissioner Jacob Hess talked the matter over on Sunday, and the latter tried to persuade Mr. Gibbens to reconsider his decision. Mr. Gibbens, however, was determined to withdraw from the Board. Early Monday morning he sent a message over to the rooms of the Subway Board for the stenographer to come at once to his rooms in the Alpine building. When the stenographer got there he dictated this brief letter to Gov. Hill:

I hereby tender my resignation as Commissioner of the Board of Electrical Control, to take effect this date. Respectfully yours,

DANIEL L. GIBBENS.

The Commissioner in a conversation said: "The Subway Board is all right, and can get along without me. My reasons for resigning were purely personal, and they had nothing to do with any controversy with Mayor Grant or any one else. Mayor Grant is a clever man, and will get ahead with the subway bnsiness all right."

The Commissioner said that he was going to attend to his law business and take an American's interest in politics as usual.

Commissioner Hess was chagrined at Mr. Gibbens's resigning while the newspapers were attacking the Board.

"I don't like the idea of any one getting out under fire," he said; "I'm going to stick until the attacks cease."

Mayor Grant said he saw no reason why Mr. Gibbens should resign, and had had no hint that such was his intention. Mr. Gibbens became a member of the Board in October, 1886, succeeding Roswell P. Flower, who resigned. He was appointed by Mayor Grace, Comptroller Loew, and Commissioner Newton.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.—All arrangements have been completed for the Electric Light Convention to be held in Kansas City next month. The railroad arrangements are in keeping with the importance of the Convention, and nothing has been spared to make the trip as comfortable and pleasant as possible for the delegates. The Pennsylvania road will supply a vestibule train, to be known as the "Electric Limited," which will be run through to Kansas City without change. This train will leave New York at 9:30 A. M., Sunday, Feb. 9th, and will arrive at Kansas City the following Tuesday morning early. At Chicago, on Monday, the delegates will be entertained by the Chicago Electric Club, as has already been announced The train will be composed of the latest Pullman vestibule sleeping cars lighted by electricity, a dining car, composite car containing barber shop, bath room, card room, library, writing desk smoking room, etc., and an observation car with a large open room luxuriously furnished, as well as an observation platform. The train will be supplied throughout with fixed and portable electric lamps. Special accommodations will be provided for members accompanied by their wives. The rate of fare going, including sleeping car accommodations, will be $39.75 and inasmuch as it is necessary to guarantee a certain number of people in order to secure this superb train, it is important that those who propose attending the Convention notify, with remittance, as promptly as possible, C. E. Stump, Chairman Transportation Committee, *Times* Building, New York. Extensive preparations have been made to render this one of the most interesting conventions ever held, and it is expected that members will do their utmost to induce as large an attendance as possible.

ANNUAL MEETING OF THE EDISON COMPANY.

On Monday last two events distinguished the affairs of the Edison General Electric Company and the companies now affiliated under its management. One was the annual meeting of the parent company and the other a delightful dinner given to E. H. Johnson, formerly President of the General Company, who has just retired from the Presidency of the Sprague Electric Railway and Motor Company, as was previously announced in this paper, the latter concern having been bought by the Edison Company.

Henry Villard, who succeeded Mr. Johnson as the President of the General Company when all the subordinate companies were consolidated, presided at the annual meeting and read the annaal report. In this the details of the purchase of the Edison Electric Light Company, the Edison Machine Works, the Edison Lamp Company, Bergman & Co., and the Sprague Electric Motor Company were set forth, together with the financial condition of all of them. The old trustees of the parent company, with the exception of a Mr. Marx, who was succeeded by Joseph S. Decker, were all re-elected. They are C. H. Coster, Thomas A. Edison, J. H. Herrick, Samuel Insull, E. H. Johnson, A. Marcus. Carl Schurz, Francis S. Smithers, Henry Villard, and J. Hood Wright. It is expected that they will elect Mr. Villard as President.

The dinner was a private affair, given in a parlor at the Hoffman House by H. McL. Harding and J. L. Barclay. John S. Wise presided, and others present were: Samuel Insull, J. H. Vail, A. S. Beeves, T. C. Martin. Edward Blake, S. Dana Green, Charles Price, Frank Johnson, Henry Hobson and John Muir. They united in their after-dinner speeches in complimenting Mr. Johnson's management of the companies with which he is connected.

REDUCTION IN ALUMINUM.—The great cut in the price of aluminum by the Pittsburgh Reduction Company is considered by leading engineers one of the most important steps recently taken in general metallurgy. Commercially pure aluminum is selling in England at one pound sterling for a pound of aluminum. The Pittsburgh Reduction Company is now having a series of tests made to determine the following points: 1, Specific gravity; 2, the melting point of the metal: 3, the temperature at which the metal becomes pasty: 4, the temperature at which the metal had best be annealed, the best method to anneal the metal, length of time of cooling, etc.; 5, electrical conductivity of the metal; 6, the fixity of the metal—that is, a confirmation of Deville's, Watts' and Fremy's statements, that "Aluminum is absolutely fixed and loses no part of its weight when it is violently heated in a forge fire in a carbon crucible:" 7, thermal conductivity; 8, its specific heat, an experiment as to the action of moist air upon it, as to the action of water upon it, the action of hydrogen sulphide upon it; the action of sulphuric acid, nitric acid, hydrochloric acid, potash, soda and lime, aqua ammonia, and the more common forms of organic acids; 9, the action of common salt water and of sea water upon aluminum.

IS THIS EDISON'S DAUGHTER?—A press despatch from Dresden last Saturday says: "While travelling in an express train from Vienna to Berlin today a lady passenger was taken suddenly ill, and a physician on the train pronounced her ailment small-pox. She was brought to this city and conveyed to the hospital. In answering questions she asserted that she is a daughter of Thomas A. Edison, the American electrician."

ELECTRICITY IN WARFARE.

An interesting and instructive lecture on "Electricity in Modern Warfare" was delivered last Monday evening by Lieut. Bradley A. Fiske, United States Navy, before the Franklin Institute. The lecturer dealt directly with the present condition of the science, the advance it has made in the past five years, and the ways in which it is now actually used Lieut. Fiske pointed out that five years ago the whole science was in a transitory stage; that electricity was just emerging from the laboratory and entering the region of practical life: that only one war ship afloat was lit by electricity, and her plant was so defective and accidents from imperfect insulation so frequent that many people concluded that the only effect of this vessel's electrical equipment was to prove its impracticability. To-day, however, every war ship possessing any pretensions to modern equipment is lighted by electricity.

The lecturer dealt at some length with the various improvements made in electrical devices. He told of submarine mines and the spar torpedo. This last device, he said, was becoming rapidly a thing of the past. In the case of the Lay torpedo, he was of the opinion that little improvement had been made. The Simms-Edison and Halpine-Savage, on the other hand, are much more effective to-day, he thought, than they were a few years ago. He next took up the military telegraph service, balloon observation, and balloon propulsion. Among the more recent applications of electricity to warfare Lieut. Fiske spoke of the hauling of heavy guns by electric motors, electric ammunition hoists, and electric motors as auxiliary engines.

Firing guns by electricity he considered a great advantage over the old system, if for no other reason than that the piece was fired at the instant the button was pressed. This obviated the delay incident to the lanyard and the primer, between the actual pulling of the lanyard and the discharge.

No subject of the evening was of more interest than that which had to do with electric communication between ships at sea. In the development of this practice the lecturer has taken a prominent part. Recently experiments on this subject have been carried on extensively at the Brooklyn Navy Yard. In these experiments a large dynamo was used as a source of power, and in one case the cruiser Atlanta was converted into the largest electric magnet known, being wrapped with heavy wire through which the dynamo current was sent, while the iron tug Nina was made a receiver, she being wrapped with fine wire, having a telephone in circuit.

THE DUTY ON COPPER.—Mr. George M. Phelps, of New York, appeared before the Ways and Means Committee of the House, at Washington, on the 16th inst., in behalf of the National Electric Light Association, and asked the abolition of the duty on copper ingots plates, bars, rods and wires. The association represented about $275,000,000, and was composed of electric light companies throughout the United States, and manufacturers and dealers in electric supplies. The United States not only produces, he said, more copper than it consumes, and therefore exports it, but it possesses the richest and most easily worked mines in the world. American copper mine owners produce copper and can put it on the market at lower cost than the Spaniards or Chilians, and consequently no duty is needed. The duty is of no value to the Treasury, and is not needed for protection, because it is not imported in any considerable quantities, while considerable is exported.

Storage batteries will probably be used to supply the power to drive the cars of the Consolidated Street Railway Company in Toledo, Ohio.

ARC AND INCANDESCENT LAMPS.

The action of an arc lamp depends not only on its own mechanism, but on the working of the dynamo, and on the quality of the carbons. The object of the mechanism of the lamp is to keep the arc as steady as possible. It is easier to maintain a steady light with several lamps in series than it is with them in parallel circuits. It is generally necessary to add resistance in series in the latter case. The arc behaves very much as if it were the seat of a back electro-motive force, but the phenomenon may be explained by supposing the cross section of the arc, or heated air, to vary as the current. This seems to be the most rational explanation, as the arc appears to be larger when the current is increased. If the specific resistance of the heated air remains the same, and the cross section of the conducting part of the same varies as the current, the arc would behave as if it had a constant back electro motive force, and a given electro-motive force, say of 50 volts, would be enough to maintain any current through the arc. The difficulties in running arc lamps in parallel, or multiple arc, is due to the arc behaving as if it had a back electro-motive force, so that a very small difference in the electro motive force on the lamp causes a large difference of current The candle power of an arc lamp depends upon the quality of the carbons. the current and its electromotive force. It is impossible to determine the candle power of a lamp in the absence of any one or more of these factors.

The candle power and life time are the tests to which incandescent lamps are subjected.

In heating a solid body it throws off energy in the form of heat and light At a low temperature heat is the only manifestation, but as the temperature increases the body becomes luminous, that is, it throws out light. At first the light is red in color, and as the temperature increases it becomes yellow, and so on until it gives a complete continuous spectrum. As the temperature increases the light increases faster than the heat radiation, and the yellow, and finally the blue lights increase more rapidly than the red, which is the first light given out. The body finally gives off white light.

When a certain power, say 50 watts. is spent in a lamp carbon, the temperature rises until the emission of energy by radiation, and the loss of conduction is equal to the electromotive force If the carbon is placed in a vacuum, so that the loss by convection or conduction becomes practically nothing, only the radiation need to be taken into account. The smaller the surface of the carbon the higher will be necessary the temperature to radiate a given power. A large surface will radiate all the power at a comparatively low temperature. Surface and temperature, however, are not the only factors. Two bodies of different substance of equal size and at a given temperature would not emit the same quantity of heat per second, or give the same light. They would, however, emit light of the same color. A piece of carbon, for instance, would give more light than a piece of silver, of the same surface, and would also radiate more heat but the ratios of the light to the heat would be the same in each case. The power necessary, therefore. to maintain the two bodies at a given temperature would be in proportion either to the heat radiated or the light emitted.

From these phenomenon is deducted one of the most important laws in the theory of incandescent lamps; namely, that incandescent bodies at the same temperature give light of the same color, and are at the same efficiency. They will give the same number of candles per watt.

As efficiency depends on the temperature, the aim in lamp making is to produce a carbon that will stand as high a temperature as possible without breaking. The emissivity of the carbons used by the different companies is about the same. The light of a given lamp depends upon the surface area and the temperature. Efficiency is not an inherent quality of a lamp. Any lamp may be run at any efficiency under its breaking point. A lamp run at a low temperature, is low in efficiency, and is less likely to break than when run at a high pressure, but it gives less light, and therefore costs more in electrical power.

In installation work what is aimed at is to get as much light as possible from the lamps without breaking them. To get the best results it is necessary that all the lamps should run equally bright, that is to say, at the same efficiency and same temperature. It is also necessary to know which lamps will last longest at a given efficiency. A good lamp on an installation where the electro-motive force varies considerably will not last as long as a bad lamp on a circuit on which the electromotive force is constant. In many cases lamps increase in resistance instead of breaking. Such lamps are practically useless, and might as well be broken. Thus when incandescent lamps run dull with the electro-motive force unchanged, they are really worthless. and it would pay better to replace them with good ones. It happens sometimes that when many lamps are running dull, the electro-motive force is increased to make them brighter. Then the bright lamps break. New lamps put in the place of dull ones will thus be overrun and their lifetime shortened. This results in greater expense and general disorder. Blackened lamps are useless and few people realize what little light such a lamp gives.

Subway Explosion.—On the night of the 15th instant another subway explosion occurred in this city At about 8 o'clock a dull. rumbling noise was heard in the vicinity of Sixth avenue and 17th street, and it was discovered that the accumulated gas in the subway manhole had exploded, tearing up the pavement for several feet around. Simultaneous with this explosion another took place a block away, at the corner of 16th street doing about the same amount of damage to the street.

Reports differ as to the violence of the explosion. One is to the effect that the manhole covers and paving stones were not thrown into the air, while another states that the air was filled with these missiles. Be that as it may. suffice it to say that no one was hurt. although there were many people on the streets at the time. Incident to these explosions the electric lights in the neighborhood, the wires of which run in the subway, acted in a strange manner. Just about the time the explosions occurred some of the lights gave evidence that something was wrong. It is evident that there must have been some connection between the two manifestations of disturbance, but whether the disturbance on the light circuits caused the explosions. or whether the explosions caused the lights to act as they did, has not yet been determined.

New York Subways.—Up to the present time 73 miles of trench have been constructed This provides 1 007 miles of duct. with a capacity for 45,000 miles of telegraph and telephone wires, and 2,000 miles of electric light wires. Commissioner Gilroy said that it had cost the city $46,000 last year to remove poles and wires, and would probably cost two or three times as much this year. All this expense, he argued, should have been borne by the companies, as the law required them to remove their own poles and wires, and he had therefore kept an accurate account of all such expenditures with a view to bringing suit to recover the amount. Commissioner Gibbens doubted whether the city could recover in all cases.

PHILADELPHIA NOTES.

The Bell Telephone Company in this city has a plant worth, at the close of the year 1889, about $610,500, of which, over $140,000 is represented in underground work. Between the receipts and expenses for the year there was a difference of over $200,000, the latter being about $233,000, and the former nearly $435,000, which shows a handsome profit. Over $67,000 was paid in dividends, and with assets of $1,000,000, the company starts the new year with a total surplus of $40,000.

It is said that a gas and electric light fixture company will shortly be organized in Camden with a capital of $500,000, of which enough will be paid to commence operations immediately. The company includes among its incorporators such men as Benjamin Thackara, and it is quite likely that the enterprise will put Philadelphia in the lead in the manufacture and sale of gas, electric and combination fixtures.

There is a possibility that the city of Philadelphia will soon conduct its own electric lighting plant—it having been stated by experts that such an establishment could be constructed at a cost of $300,000, and maintained at a yearly cost of $90,000. This amount, it is said. would supply 1,200 lamps of ordinarily sufficient candle power. In this connection, I might remark that the city will be fortunate, indeed, if they succeed in conducting the electric light system as well as the companies now in the field have done. There have been but one or two deaths caused by electric light wires in this city, and the quality and power of the lights have been fully up to the average. The fact of the Gas Bureau in this city having introduced recently incandescent lights as a means of illumination in their general offices, and the entire success of the same, may signify that the city officials have concluded that they can manufacture better electric lights than they can gas.

The appearance of the Electric Age, with its new dress. and as a weekly publication, was one of the welcome visitors of the new year. Philadelphia having assumed a position in the electrical field which is almost and probably will be. second to none. always welcomes an able advocate of the interests connected therewith.

In consequence of the sudden and lamentable death of Mr. Joseph J. Walton, who was so well known in connection with the establishment of James W. Queen & Co., the labors of his department have devolved upon the Messrs. William and James G. Biddle, the former assuming charge of the electrical, chemical and physical department, while his brother James will attend to the correspondence and advertising branch of this department of the large establishment. I am sure that no more worthy selection could have been made. The death of Mr. Walton was a severe blow to the house, but his successors being thoroughly capable, and, pursuing the path marked out by their predecessor, will undoubtedly bring Queen & Co. to the front rank of electrical, chemical, optical and philosophical houses of America. I must add too, that both of them are gentlemen whom any person could not help deeming it a pleasure to meet.

Underground work is at its height in this city, and the probabilities are that the year 1890 will see, not only all of the electric light, but all of the telegraph and telephone wires as well, under the bosom of mother earth.

—Electro.

The citizens of Rockville, Conn., turned out in large numbers on January 5th, to witness the turning on for the first time in that town of the electric street lights. There are 74 in operation.

THE GERRITT SMITH METHOD OF INCREASING THE EFFICIENCY OF THE QUADRUPLEX.

The weak point in the quadruplex is the well known tendency on the part of the No. 2 relay to "kick" whenever the distant pole-changer reverses the battery current. This is due to the fact that no current flows to line during the momentary short-circuitings of the battery which occur at the points of the pole-changer when the latter is being operated. There are, consequently, periods of no magnetism in the cores of the neutral relay when its armature, instead of remaining closed to correspond with the closing of the No. 2 transmitter at the sending station, flies open under the influence of its adjusting spring, and interferes to a greater or lesser extent with the incoming signals on the No. 2 relay.

This detrimental action becomes more and more pronounced as the length of the wire and its static capacity increases; and without some method of bridging over the intervals of no magnetism, successful quadruplex working on long circuits would be almost, if not quite impracticable.

Devices of various kinds have been in operation for a number of years with more or less successful results, but the introduction of dynamo currents, necessitating the use of pole-changers constructed on the "walking beam" principle, *P C*, aggravated the evil so much, that, to meet the altered conditions, a more effective system of compensation became desirable, if not absolutely necessary.

Mr. Smith attains the desired result by the use of an extra coil upon the neutral relay, and by utilizing the discharge of a condenser to energize the coil whenever these momentary interruptions of current occur.

The manner in which this is effected will be better understood by reference to the diagram. In fig. 2 *D D*¹ are the dynamos which, under the control of the pole-changer *P C*, furnish the currents of required polarity to line. The pole-changer is supposed to be at rest, through the opening of Key *K*, and a positive current is shown as starting from *D* traversing the resistance *r* and the pole-changer points at *x*, and after flowing through the line wire, continuing its course through the line coils *N R* till it reaches *S*. At this point the current divides, a portion going via *R*¹ and battery *B* to ground, the remainder passing by way of the extra coils *E C* into the condenser *C*. The latter thus becomes charged with unlike electricities, which are retained there in accordance with the laws governing the action of the condensers so long as the distant key remains open. When, however, the key is depressed, the lever of *P C* is released from the battery stop at *x*, and its opposite end striking the stop *y*, a reversal is made; but between these operations a short interval of time elapses during which it will be seen there is an entire absence of current to line and consequently a momentary demagnetization of *N R*. It is at this moment that the condenser discharges its accumulated electricities through the supplementary coils, thereby magnetizing the core, and compensating for the interruption of the line current.

The effect, therefore, of this discharge is to minimize or practically eliminate the interval of "no magnetism" in the neutral relay, and hold the armature firmly against its front stop until the succeeding reversal of current reaches *N R* and once again magnetizes it.

It will be noticed that the extra coils and condenser are placed between the main and artificial lines, or, in a position corresponding with that of the galvanometer in the Wheatstone bridge system. It follows, therefore, that when the real and artificial lines are properly balanced, no current from the home battery *B* will flow through the extra coils, nor charge the condenser in the "cross wire," inasmuch as the opposite ends of that wire are at the same electrical pressure or potential, and no current can pass between points where a difference of potential has not been established between them.

R and *R*¹ are adjustable resistance coils of about 600 ohms each, one inserted in the main, and the other in the artificial line. Their primary object is to create the necessary difference of pressure or potential between the opposite plates of the condenser to enable it to receive a charge from the incoming current; or, what may be more easily understood, they are placed there for the purpose of diverting a portion of the incoming current into the extra coils and condenser. The direction of the diverted current through *E C* is such, that it supplements the effect of the current traversing the main line coils upon the core of the relay, and thus intensifies the magnetism and increases the "margin" of the neutral relay.

In this respect considerable improvement has been experienced in the working of most circuits provided with this attachment.

On some lines, however, its beneficial results are frequently neutralized (especially in bad weather) by the introduction of so much additional resistance, which reduces the current strength, and tends to weaken signals not only on the polar, but also on the neutral relay, where the increase of "margin," due to the extra coil, is more than counterbalanced by the loss of current due to the extra resistance.

THE SPRAGUE MOTOR COMPANY BECOMES EDISON PROPERTY.—The Edison Electric Company has bought the Sprague Electric Motor Company. The Edison now acts as a sort of fiscal company, and manages the finances of the various corporations controlled by it.

When the Edison Company was organized last summer, Henry Villard became its president in the place of E. H. Johnson, but the latter still retained the office of president of the Sprague Company, the relations between the two companies being very close. Recently Mr. Johnson resigned from this position. His resignation, however, was not accepted until a few days ago. He still remains a director and started for Chicago on business connected with the company. His successor was Vice-President Herrick, of the Edison Company, but it is probable that when the deal is completed there will be some other changes.

Prof. George W. Plympton, President of the Brooklyn Board of Electrical Subways—a body which expired by limitation on Nov. 1—has submitted to the Mayor his last report in relation to the wires, underground and overhead, in the city. During the eleven months ending on Oct. 31, 1889, the length of conductors underground was increased 839 miles, making a total mileage underground of 3,007, leaving, according to the estimate furnished by Prof. Plympton, 4,500 miles of wire yet to be put under ground. On the elevated railways 768 miles of wire have been strung. These estimates do not take into consideration the electric-light wires, but those exclusively of the telegraph and telephone service. Of the 4,500 miles yet to be placed underground permits have been granted for the laying of conduits capable of carrying 3,500 miles of wire. Telephone wires have been removed from 271 poles which remain standing because they carry the city wires.

President Plympton, in his report of the work executed by the Commissioners, expresses satisfaction at the success attending the Commissioners' efforts, but regrets that the Board had no control of the electric light wires.

The entire operation of producing the smallest-sized wires from rods of one-half inch is done cold. It is alleged that this method obviates the danger of unequal annealing and of burning in the furnaces. In addition to this, the wire, being more flexible and homogeneous than that made by any ordinary method, is capable of sustaining greater longitudinal strain.

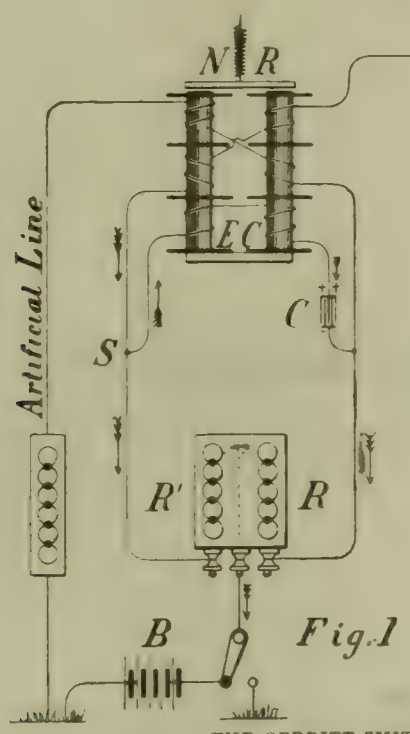


Fig. 1

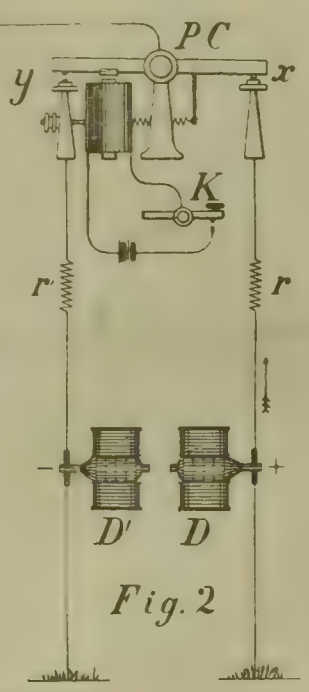


Fig. 2

THE GERRITT SMITH METHOD OF INCREASING THE EEFICIENCY OF THE QUADRUPLEX.

ELECTRIC LIGHTING IN LONDON.

The recently completed plant of the London Supply Company, Deptford Central Station, contains probably the largest dynamos ever constructed. They are of the Ferranti type, and their diameters are 42 feet. The following particulars and illustrations of this immense plant are taken from the *Engineer*. Figure 1 shows the Ferranti dynamos complete. The armature coils are of a flat copper strip built up on a central support of brass, flat brass rods separated by an asbestos and sulphur mixture. These coils are screwed radially into the flange of the big drum, and are surrounded by the double ring of field magnets, which cover the whole of that end of the pulley which has no grooves.

The construction of the works was begun in April, 1888, and the chairman of the company says: "We have been at it night and day ever since. Now we have a very large engine house erected, and have engines and dynamos at work of 3,000 horse power. Two other dynamos and engines are in course of construction, of 5,000 horse power each. The boiler power we have put down is 14,000 horse power. We found, when we inquired as to the mains will be 2¼ inches over all, and the smallest 1¼ inches. There is no cable, but a tube of copper, having a quarter of an inch sectional area, through which the current is sent out. This has a cover of insulating material, and a second copper tube is compressed round that for the return current. Another thin layer of insulating material is used, and over all is placed an iron tube, also made tight for protection against pickaxes in the street.

"With this main we require no box or brickwork in the streets, as it is put naked into the earth. The outer tube is wrought iron a quarter of an inch thick and is sufficiently flexible to bend at right angles without breaking, while strong enough to resist any weight that may go over it without damage. There will be a joint for 'service' at each twenty feet, so that every house can have the light if required. A main on this principle is absolutely safe. A man can touch the naked copper with impunity, as it is already 'to earth.' There is the same protection against danger from the connecting wires. The primary current is sent up at a tension of 10,000 volts. That pressure has never been approached before in electrical work. We bring up our mains to distributing stations, where the tension is reduced from

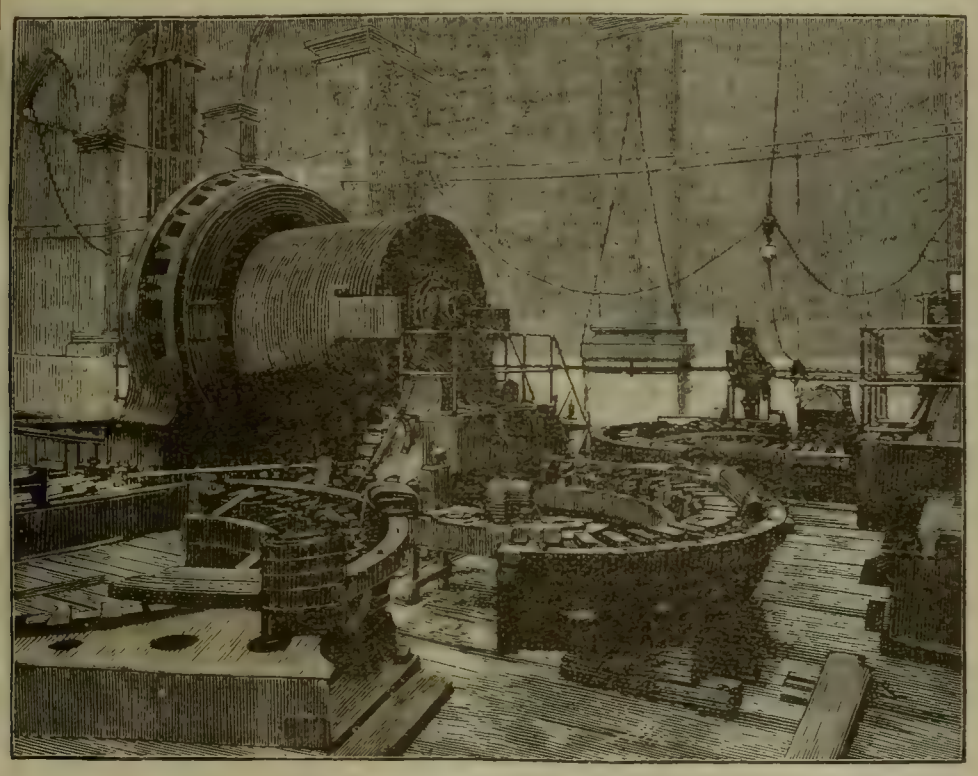


FIG. 1.—FERRANTI DYNAMO.

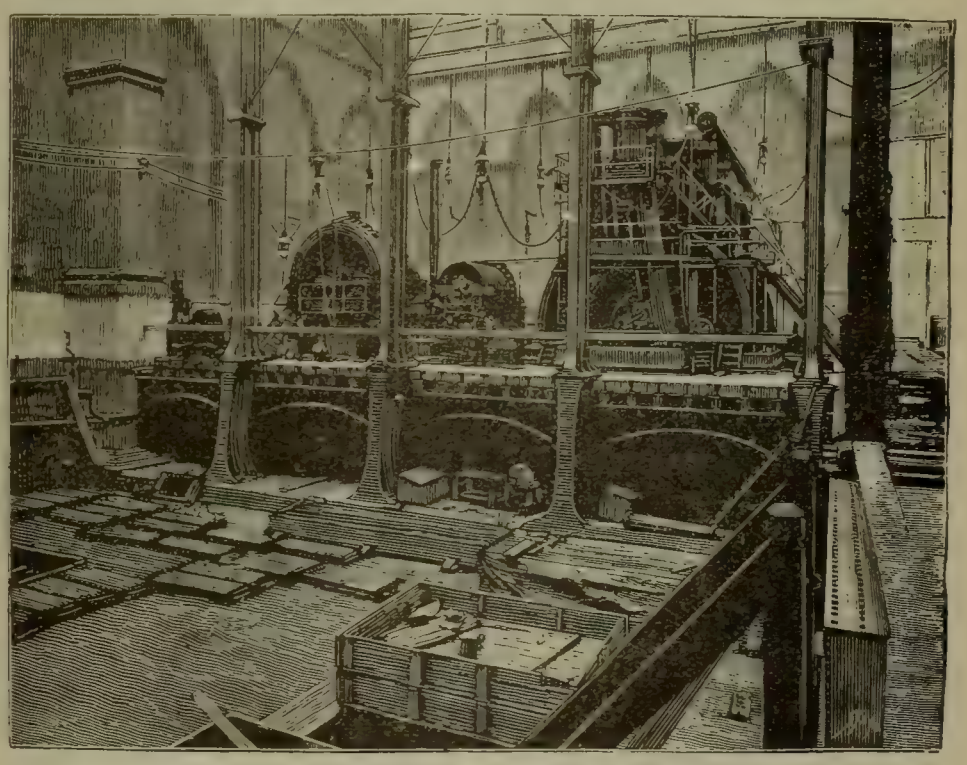


FIG. 2.—DYNAMO AND ENGINE.

construction of these dynamos, that there were no tools big enough to deal with them, except a few in arsenals and private works. We tried Krupp, in Germany, and the Creusot works, in France, and neither of them would contract to deliver under three years. As it did not suit our purpose to wait so long, we put up machinery ourselves, and we shall be able to complete these dynamos in a year. They are of unprecedented size.

"The lathe required to turn the main shaft is of the same dimensions as that used for turning the 100 ton gun at Woolwich. The shafts are 36 inches in diameter, and in the rough weighed 70 tons. They were the largest castings of steel ever made in Scotland. The dynamos are 42 feet in diameter at the armature. As to their lighting power, the dynamos working now at Deptford will supply 25,000 lights, and the two being constructed will rise to 100,000 each. These new ones are devised so that, as the demand arises, we can put another engine upon each dynamo of 5,000 horse power, so that each will be up to 10,000 horse power, making them 200,000 lights each nominally. We are also manufacturing the mains ourselves, and four machines are turning them out in 20 foot lengths. This is all that we require for 100,000 lights. The largest of our 10,000 to 2,400 volts. Then it is sent through the streets underground, and at each house it is again reduced by means of transformers to a working pressure of 100 volts. By arrangement with the railway company the current is brought up from our generating station at Deptford along the Southeastern line. We have running powers into Cannon Street station, over Ludgate Railway bridge, and over Charing Cross bridge. Two mains are laid alongside the line. The advantage of this is that we have got a private way, in addition to the right of way through the public streets under our order, which we intend in due course to make use of. We have also running powers over the District Underground for these mains. Eventually we shall have eight or ten stations to distribute the light from, and at the present we have practically six, including the Grosvenor, from which the machinery will be removed later on."

Fig. 2 shows the dynamos and engines, from which some idea of the immense proportions of the plant can be obtained.

The Edison Electric Illuminating Company proposes to increase its capital stock from $2,500,000 to $4,500,000. The company intends to enlarge its business.

TELEGRAPHY BY CANNON SOUND.

Guns have for some years been used with most satisfactory results for fog signalling on the Swedish coast. Their signals have been heard as far as twelve nautical miles, which we believe is a greater distance than the signal from a siren can be heard. A new gun has just been manufactured and stationed at Holmö Gadd, in Sweden, Commander Engström having furnished the drawings for this as well as the previous guns. The one in question is made of best wrought Sandviken Bessemer steel at the Stafsjö Engineering Company. It is ten feet long and the calibre is sixty millimetres. The breechloading mechanism allows of firing from twenty to thirty shots per minute. It will thus be possible to fire letters according to the Morse alphabet, one shot being a dot, and two shots close together a dash.

TELEGRAPH LINES AT THE ANTIPODES.—The New Zealand government has proposed to New South Wales that the two colonies should combine to lay a cable from North Cape to Brisbane. This route is 300 miles shorter than any other, and the cost is estimated at £200,000.

Mr. E. T. Greenfield, general superintendent of the Interior Electrical Conduit Company of this city, reports that the capacity of their factory is greatly taxed, owing to the large demand for their tubing. During the past six months the company has turned out over 1,000,000 feet of conduits, and the demand is increasing daily. It is proposed to enlarge the factory in order to supply the demand.

The Edison Electric Light Company of this city, has brought suit against the Perkins Electric Lamp Company of Manchester, Conn., to restrain the latter company from manufacturing certain electric lamps. The complainants aver that these lamps are an infringement on their patent.

The Erie Railway station and adjacent buildings at Jersey City were fitted up some time ago with an electric plant. The wiring, however, proved to be defective, and work is being done over again. This time white core Grimshaw wire is being used.

Messrs. Crane & Miller, patent experts, of Newark. N. J., have issued a table of electrical horse-powers ranging from 500 to 600 volts and 10 to 110 ampères. It is of a convenient size.

The electric light plant in the navy yard at Washington is to be increased by the addition of a Brush plant.

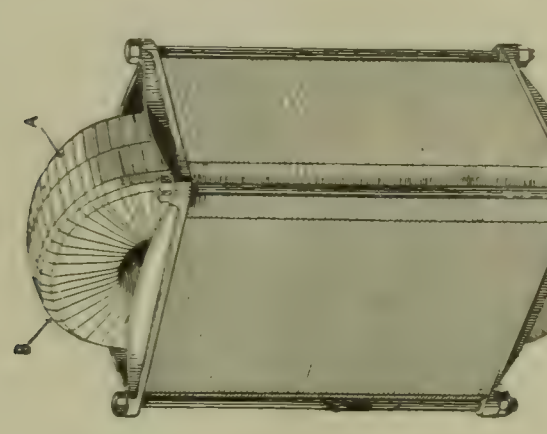
THE WESTINGHOUSE CONVERTER SYSTEM.

ELECTRIC LIGHTING MADE SAFE.

The New York *World* has of late been instrumental in educating the public on the safety and dangers of electric light currents, and its labor has gone far in allaying the fears of the public against the continuance of the light for street and residence use. In its issue of January 19, there appeared an excellent article on the new Westinghouse Converter System which is described and illustrated as follows :

In the exhibition room of the Westinghouse Electric Company, in the basement of the Equitable Building, all the appliances used in connection with the Westinghouse converter system are on exhibition and in practical use, and so arranged that even a lay observer can understand their general principles.

The converter consists of two entirely separate coils of wire, one of a great length of fine wire closely wound together, called the primary coil, and the other of a short length of large wire, called the secondary coil. Each of these coils is composed of doubly covered wire, coated with an insulating compound, each layer of wire insulated from its neighbor by additional insulation, and the completed coil is covered with three separate and distinct coverings of the best known insulating material, which entirely separates the two coils and makes contact between them absolutely impossible.

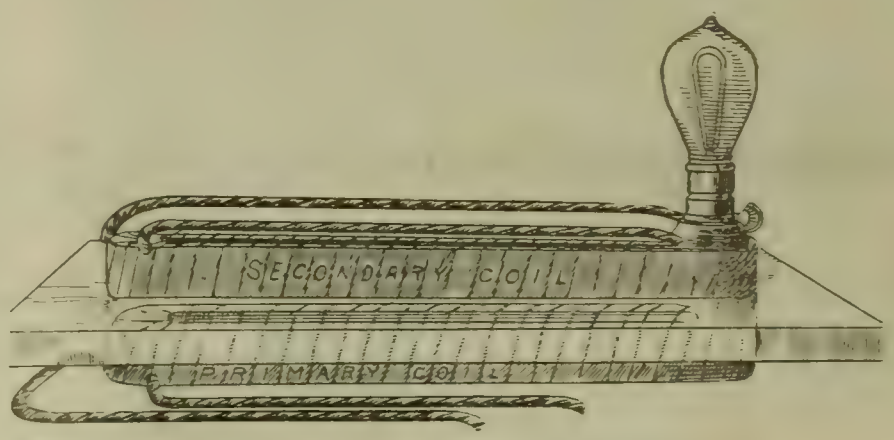


TRANSFORMER.

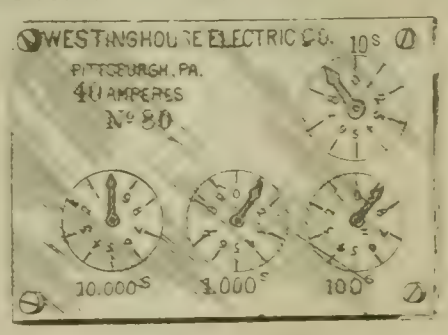
In the cut the coil marked A is the primary coil composed of fine wire which takes the high-tension current from the street mains. The coil marked B is the secondary coil composed of large wire, in which the secondary or house current is induced. The two coils have no electrical connection whatever one with the other, and are just as completely separated electrically as though a plate of glass two inches thick was placed between them Indeed, to emphasize this feature the gentleman in charge of the exhibit showed two coils exactly like those in the complete converter, between which was placed a thick glass plate. Into the lower coil was sent the primary current of 1,000 volts from the dynamo, and in the secondary coil was induced the secondary current of 50 volts, so that the incandescent lamp connected with it, as shown in the cut, burned brightly from the induced current.

In the cut, the wires going into the lower coil carry the 1,000-volt current, and the wires above the glass plate take the secondary current of 50 volts from the secondary coil into the lamp. This experiment was all the more impressive when it was remembered that the ordinary converter in actual use, is in principle, exactly the same thing, and the separation between the two coils is as complete as though the thick plate of glass was between them.

"We will," said the exhibitor, "take an actual case and start with one of the big 3,000-light dynamos at the station of the United States Illuminating Company on Twenty-ninth street and East River. A pair of large copper cables carry half the current from this dynamo, enough to operate 1,500 lights through the subway on Twenty-ninth street to Broadway ; from there down the Broadway subway to Twenty-third street and beyond. At the Fifth Avenue Hotel a pair of smaller cables tap into the main 1,500-light cables which we have followed and take off enough of the current to supply the 400 or 500 lights in the Fifth Avenue Hotel. This pair of wires again split up into pairs of smaller wires, each pair supplying a converter. We will follow one pair which leads into a 40-light converter, which is carefully boxed away entirely out of reach in the vault underneath the pavement- This small quantity of current is still of a 1,000 volts intensity as it flows into the primary coil of the converter, which, it will be remembered, is composed of many strands of fine wire. Here it stops, because the insulating material which separates it from the secondary coil is, like the plate of glass in the cut given above, an impassable barrier beyond which the high-tension street current cannot under any circumstances pass, but by a marvelous electrical sympathy there is at once induced in the secondary coil a current of 50 volts, which is absolutely harmless. This iuduced current then travels through the small wires in the building and supplies forty incandescent lights. Whatever happens in the street mains, however many crosses or disturbances there may be, none of the bad results of them can get beyond the converter, and the worst that can happen from disturbances on the street main is that the secondary current would fail and the lights beyond go out. With 20,000 Westinghouse converters in use, supplying over 300,000 incandescent lights, in connection with over 200 central stations, there has never been reported a single instance of a converter failing in fulfilling to the fullest degree its important function of protecting the consumer against the dangers of the electrical current.



SECTIONAL VIEW OF TRANSFORMER.



ELECTRIC METER.

A most interesting feature of the converter system is the almost perfect meter by which the exact amount of current used by each customer can be measured with the greatest accuracy. The meter is a comparatively simple mechanical device and its records can be read and understood by every customer. He can, if he wishes, every morning look at the dial upon the face of the meter and tell exactly how many hours he has burned his lamps during the preceding day and exactly how much the light has cost him. The small cut shows the dial upon the face of the meter with which every customer of the United Electric Light and Power Company and the United States Illuminating Company is provided."

ELECTRIC LIGHT COMPETITION.

The *Sun* of this city is responsible for the following : There is talk now of a trust or combination of some sort among the various electric light and power companies doing business in and around New York. An official of one of the smaller companies told a reporter that the companies would have to come to it, whether they wished to do so or not, because of the cut-throat condition of the trade.

"I know of one case in Wall street," said he, "where one company got a contract for putting its plant into a big office building at a price which left a modest margin of profit. When an opposition company heard of the contract an agent was at once sent to the engineer of the building to tell him that if the contract could be broken the company would give him $500 cash. The $500 was just the profit the successful company was making. The opposition company, being an old and wealthy concern, was willing to do the work at cost for the sake of keeping it away from the other company. Another case happened just over the North River, where about 300 lights were to be used. To get the job one company offered to put in a plant at a price that would leave a profit of $450. Another came in and offered to take the contract at $250 below the cost.

"The fact of the matter is that no company has all the good patents. Some of the newer companies have better dynamos than the old ones, but the old ones have more capital ; and so the fight has got down to price cutting. This thing cannot go on longer. Among other things, the trust would naturally put an end to the enormously expensive and tedious patent suits. Electricians have been thinking and talking over this matter ever since last fall, when the conflict between the direct and the alternating current men made so much stir. The trouble is to decide on a basis for fixing the commercial value of the patents held by the different companies. When that is settled, the electric light business of the country will be done by one company."

NEW ELECTRICAL ADVERTISING.—An enterprising advertising agent of a Boston theatre hit upon a brilliant idea in the line of his business a few days ago, and although he was mulcted to a slight extent, his scheme had the desired effect. He strung posters on the wires of the West End Electric Street Railway advertising the play then on the boards at his theatre, but the railway people objected to the use of their wires for advertising purposes, and had the originator of the scheme arrested and fined. The railroad company may take another view of the matter some time, and rent their wires for such purposes, thus increasing their revenue.

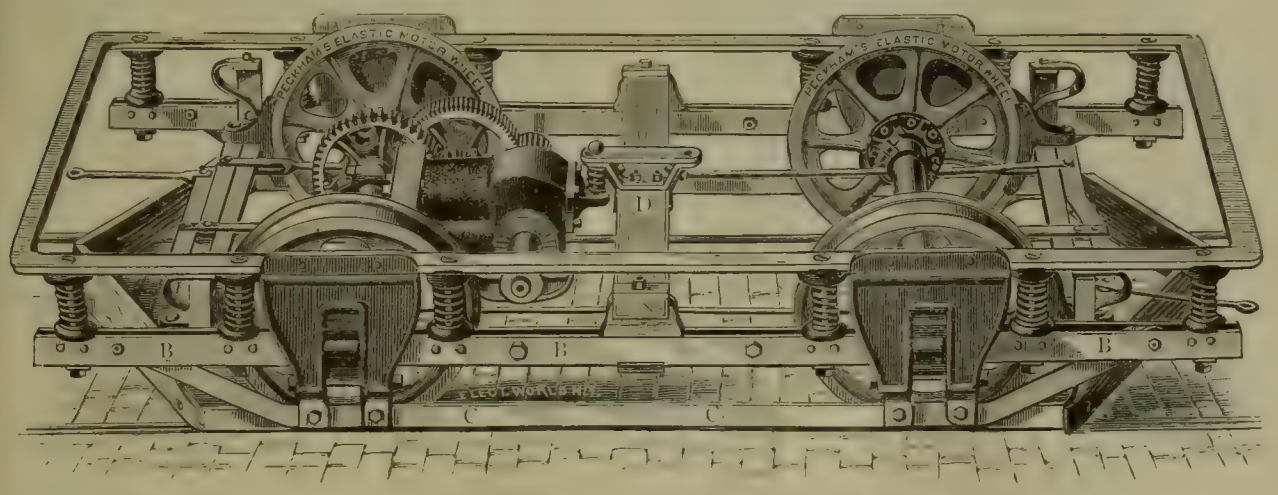
THE PECKHAM CANTILEVER MOTOR TRUCK.

The introduction of electricity as the motive power for street railway cars has rendered necessary improvements in the mechanical construction of the ordinary car trucks. The latest of these is shown in the accompanying illustration, which is of the Peckham patent cantilever motor truck. This truck is designed to prevent the oscillatory motion of cars, and also to strengthen the ends of the car-bodies by providing additional support at each end. The main double side bars "BB." which support the springs, are supported at their extreme ends by the cantilever trusses "CC." These latter are hung from the journal boxes by means of malleable iron yokes, to which the main bars "BB" are firmly united.

The motors are flexibly suspended from overhead by the motor hanger "D," and can be disconnected when desired, by the removal of only one nut.

When it is necessary to remove the armature for repairs this can be done without disturbing any of the main parts.

Each wheel is equipped with a brake, all four of which can be operated instantaneously with little power. Other mechanical improvements have been adopted in the manufacture of these trucks, and perfect satisfaction is guaranteed by the makers. The advantages claimed for the Peckham cantilever truck are great strength, simplicity of construction, ease of motion, durability, economy and facility of repairs, and prevention of oscillation. The wheel-base of the truck is six feet, and the entire length of the truck frame is twelve feet.



THE PECKHAM CANTILEVER MOTOR TRUCK.

THE COPPER PRODUCTION FOR 1889.—The *Engineering and Mining Journal* gives some statistics relating to the copper industry in this country for 1889. The production for the year, including the ores imported, was 241,600,000 pounds; consumption, 169,600,000 pounds; exports, 82,000,000 pounds, leaving a stock of 65,000,000 pounds on hand January 1st, 1890. The domestic production was 236,500,000 pounds, 8,646,000 more than in 1888. The consumption was 169,600,000 pounds, or 49,746,000 pounds more than during the previous year. The average price for lake copper during 1889 was 13¾ cents, against 16¾ in 1888. The general prospects are decidedly encouraging, although it is possible that consumption may not continue at its present enormous rate, and it is probable that Montana and Michigan will increase their output.

ELECTRIC RAILWAY SIGNAL.—Mr. James R. Branch, secretary and treasurer of the Universal Electric Railway Signal Company, gave an exhibition in Washington of the practical workings of the electrical railway signal that is designed for the safety of passengers on railway lines. The invention consists of a system of signalling by which trains, whether going in the same or opposite directions, signal each other when a mile or two apart. This is accomplished by means of an electric wire between the rails and a battery in the cab of each engine which also allows of telegraphic or telephonic communication between the engineers in the different engines. Under this system the engineers give notice to each other of their approach, and in case of a washout or broken bridge, the engineer of the approaching train at once becomes notified of the danger in season to stop his engine and avert an accident. Experts have pronounced this invention the most important ever produced for the safety of passengers. A working model of the invention was exhibited, and the electricians and telegraphers present agreed that the system was remarkable for its simplicity and practicability.

MR. EDISON'S PARIS ART PURCHASE.—A magnificent piece of statuary, representing "The Genius of Light," was received from Paris by Mr. Thomas A. Edison a few days ago. It now stands upon a pedestal in the centre of the library in Mr. Edison's laboratory at Llewellyn Park, Orange. The statue is about eight feet high and is of pure white marble. It was exhibited at the Paris Exposition, where it was seen by Mr. Edison, who admired it very much, and seeking out the owner purchased it on the spot. The statue represents an angel bearing aloft in her right hand an incandescent electric light. She has alighted upon a lamp post which she has completely crushed. In fact, she is sitting upon the lamp post, and a smile is portrayed on her features as she holds uplifted, very much after the style of Miss Liberty, a blazing incandescent light, the desideratum in illumination.

PHILADELPHIA ELECTRIC LIGHTING.—We call Philadelphia a slow city, says Electrician Markland of Altoona, Pa., yet on the question of electric lighting it beats the country. They have about 5,000 arc lights and probably 50,000 incandescent lights, and a record of only two killed up to date, but Philadelphia has a chief of the electrical bureau who is very careful about the way wires and lights are put up; also the fire insurance people are careful. They will not allow currents sent through wires until they come up to known laws. As a result they have had the best of success. Here is another point. The Philadelphia people can see that a dollar spent to-day in repairing a weak point may save them several dollars in the future, and they go in for keeping their system in first-class order. They do not appear to care for expense for a device that will insure safety. They also inspect their system very closely and do not go on the plan of letting it go until the whole thing breaks down or some one is killed.

The Italian government proposes to make telephonic communication a State monopoly.

ELECTRICAL PATENTS ISSUED JANUARY 14TH, 1890.

419,186. Hood for Electric Lamps. Daniel A. Culman, Jr., Kansas City, Mo.

419,245. Electric Motor. Stanley C. C. Currie, Philadelphia, Pa, assignor to the United Electric Improvement Company, Gloucester City, N. J.

419,264. Method of Making Electrolytic Meters. Arthur E. Kennely, Orange, assignor to Thomas A. Edison, Llewellyn Park, N. J. This is an improvement in the process of making electrolytic meters, which consists in heating both the solution and the electrodes to expel the oxygen therefrom.

419,282. Electric Steam Generator. Jeremiah O'Meara, New York, N. Y.

419,308. Conduit for Electric Railways. Bernard J. Black, Richmond, Va., assignor to himself, Wilton F. Jenkins, Erdmann Hoffman, Theodore Heinson, and Daniel Stephenson, all of same place.

419,309. Electric Street Railway. Bernard J. Black and Wilton F. Jenkins, Richmond, Va.

419,313. Electric Railroad Telegraph. Baylus Cade, Louisburg, N. C.

419,314. Electric Railroad. Baylus Cade, Louisburg, N. C.

419,365. Electric Connector. John A. Seely, Brooklyn, N. Y.

419,367. Meter for Alternating Electric Currents. Oliver B. Shallenberger, Rochester, assignor to the Westinghouse Electric Company, Pittsburg, Pa.

419,487. Electric Cut-Out. John F. Wollensak, Chicago, Ill.

419,588. Electric Railway. Isidor Kitsee, Cincinnati Ohio, assignor to Mayer Sulzberger, trustee, Philadelphia, Pa.

419,617. Socket for Incandescent Lamps. Charles H. Lawton, N. Y., assignor to I. S. Elkins and J. S. Zerbe, both of same place.

THE COMMERCIAL TELEGRAM COMPANY'S TROUBLES.

The following notice was sent out a few days since by the secretary of the Commercial Telegram Company:

The Commercial Telegram Company is compelled to announce that the property heretofore operated by it has been sold at sheriff's sale to satisfy judgments against the company and now finds itself unable to distribute after this date the quotations which have heretofore been supplied to its customers.

The company was organized in 1882 by Luther E. Shinn, Electrician Stephen F. Field perfecting the instrument that was used. After several changes the company came under the control of John W. Mackay, E. S. Stokes and their friends, A. B. Chandler, the president of the Postal Telegraph Cable Company, becoming president of the Ticker Company. The latter, however, could not be made to pay, and about a month ago its franchise and plant were sold at sheriff's sale to satisfy a judgment in favor of Mr. Mackay and E. C. Platt for about $300,000, these two gentlemen buying the property in on the sale. Recently there was incorporated at Albany a company called the New York Stock Exchange Quotation Company, its incorporators being some of Mr. Mackay's friends, and it is reported that the property of the Ticker Company will be turned over to this concern.

We are in receipt of a letter from Senator John C. Spooner, from Washington, in which he says in reference to bill No. 208, introduced by himself: "I think the bill has a fair chance to pass. It passed the Senate at the last session, and I have no doubt it will at this." The purpose of this bill is to bring telegraph companies within the provisions of the Inter-State Commerce law.

ELECTRIC TRAIN LIGHTING IN AMERICA AND EUROPE.*

Among the numerous papers read before the International Railroad Congress, recently held at Paris, was a report on the use of electricity, written by E. Sartiaux, chief engineer to the telegraph department of the Northern Railroad of France, and L. Weissenbruch, engineer to the Belgian post and telegraph department.

This paper treats of the present applications of electricity to railroad service, under three divisions; *i. e*, lighting trains, lighting stations and working brakes. This is an interesting paper from a European standpoint, and has some points of interest to the railroad men of the United States, particularly that portion referring to train lighting. The results of trials of electric lights on railroad trains in the United States are mentioned in the paper. Regarding the cost of electric lighting, compared with that of gas and oil in trains, the joint authors have come to the following conclusions:

1. That the cost of electric lighting by accumulators alone, charged at fixed stations, varies in the United States from 5 centimes to 5.6 centimes with lamps of from 12 to 16 candles, and that in Europe the cost is from 1.9 to 3 centimes for lamps of from six to eight candles, per lamp hour.

2. From experience obtained in Europe it is possible to charge accumulators by a dynamo driven off the axle at a cost not exceeding 4 or 5 centimes per lamp hour for 5-candle lamps.

3. That in the United States the cost of lighting varies between 3.5 and 5 centimes per lamp-hour for 16-candle lamps in installations comprising accumulators, dynamos, and an engine supplied with steam from the locomotive.

On the continent the cost of Pintsch gas per lamp-hour (five or six candles) is 3.764 centimes, and of colza oil, 5.635 centimes. It will be seen that for lights of the same candle power, gas would therefore cost about 11.3 centimes per lamp hour, and oil about 16.9, as against 5.6 for electric lights; but really these deductions are based upon too few experiments to render the comparisons reliable.

The authors further say: "It is impossible to consider the present condition of electric train lighting without being struck with the very considerable progress that has been made in the last few years; electricity comes very near meeting the requirements of the case, both as to the cost of maintenance and as to the beauty and intensity of the light. The almost entire absence of heat the steadiness of the light, and the facility with which it can be placed at any desired point of a car or compartment, certainly make it preferable to any other mode of lighting, if it is desired to be able to read a long time without fatigue.

"The arrangement which appears to be most advantageous, is to place accumulators under or on each car, a single group for all the lamps, or a separate battery for *each lamp*, these accumulators being charged at fixed points, either with or without removal from the train. The weight of the accumulators necessary for 22 lamps in a car is about 1,100 pounds. (This is no more than that of the Pintsch gas apparatus, which varies from about 1 000 to 1,300 pounds per car, as stated by Mr. P. Lefavre in a report on the dead weight of trains.)

"Where, for particular reasons, it is necessary to dispense with this additional weight, it is still possible to light successfully trains which are not to be broken up, by a dynamo placed in the baggage car and operated from an axle or by steam from the locomotive. When this latter plan can be combined with the heating of the train by steam, it seems to be a very economical method. The experiments in the electric lighting of trains are, however, so recent, that notwithstanding the importance of the results obtained, none of them are conclusive." The authors finish their report by recommending to the different railroads further experiments in this direction.

In our own country progress has been made principally in the direction of lighting by a dynamo and engine in the baggage car, supplemented by accumulators under each car, which are kept charged by the dynamo running in the day time as long as may be necessary. This arrangement seems to give the most satisfactory results, though it has yet been applied only to a few luxurious trains which are never broken up, and which run for long distances. It remains to be seen whether it can be made practically successful on trains of the usual character. Thus far it has been found necessary for a competent electrician to accompany each train, the apparatus requiring too much care to be put in charge of any of the trainmen in addition to their other duties.

The Intercolonial Railway of Canada has, however, continued experiments with accumulators alone, they being charged at three different points on its line, and running about 500 miles with one charge, when they are replaced by a fresh set. The number of 16-candle power lamps in each car varies from 11 to 22, and more than 40 cars have been fitted with electric lighting. In the number of cars lighted, this road is equalled or exceeded by but one or two in America. The results obtained are, on the whole, favorable, but the electric light is not exclusively depended on, the oil lamps having been retained in all these cars, and it may be said, frequently used. A fourth charging station is now being built, to save the necessity of sometimes extinguishing the electric lights on the return trip, owing to the charge in the accumulators having become exhausted

The Boston and Albany Railroad has lately discontinued the use of electric lights on the limited express trains between Boston and New York, and substituted Pintsch gas This step was taken partly because of the great expense attending the use of electricity (the accumulators being charged by electric lighting companies at either end of the line), and partly because of a considerable number of cases where the lights failed altogether or were unsatisfactory. It was precipitated by the suspension of electric service in New York City, rendering the use of the oil lamps necessary on one trip each day in one direction in such of the cars as were supplied with them.

The drawing-room cars were fitted only with electric lamps; hence these were in darkness, and after the second day were withdrawn from service, until they could be fitted with gas lamps.

Attempts were made, it will be remembered, for a few months in 1887, on the Connecticut River Railroad, to run a dynamo from one of the axles of a baggage car, but after successive trials of transmissions by belts, ropes and chains, it was abandoned as impracticable, and there have since been no experiments of this kind on this side of the Atlantic. The reason of its success abroad lies in the fact that the cars there have but a single pair of wheels at each end, and because of the few curves and high speed of trains on the principal lines. In all these installations, the direct source of supply for the lamps is a battery of accumulators, located either in the baggage car or distributed through the whole train. The function of the dynamo is to keep these fully charged. An automatic switch is also necessary to cut off the connection between the dynamo and accumulators whenever the speed falls below a certain limit, else the accumulators would discharge themselves through the dynamo and possibly ruin it, besides greatly injuring themselves. Skilled attendance is also advisable, and in many cases absolutely necessary.

Electric lighting of cars in America must, therefore, be considered at present a luxury, to be used on a few trains in exceptional circumstances, and not yet developed either in appliances or in cost, to a point where it can compete with oil or gas for every day use. But as the luxuries of one generation become the necessities of the next, the beauty, comfort and healthfulness of the electric light may yet make it indispensable to all first-class railroads, and inventive genius will yet produce apparatus for generating it, which is convenient, reliable and cheap.

The Swiss Railway Union, at a meeting on Nov. 2d last, passed the following resolution: "That, considering the actual position of electric lighting, it is not desirable to extend the lighting of trains by gas, but that it is preferable to continue the investigation of the eloctric lighting problem, and to extend experiment." Experience in this country will hardly warrant so strong a statement, but further investigation is certainly needed before a final determination.

* *Railroad Gazette.*

THE RHODE ISLAND STATE ELECTRIC LIGHTING ASSOCIATION.

THE FOURTH STATE ASSOCIATION.

A meeting of Central Station Companies, doing business in the State of Rhode Island, was held in Providence, Thursday, Jan. 7, for the purpose of organizing a State association.

A majority of the companies, and about seventy-five per cent of the capitalization in the State was represented. Letters were read from officers of companies who could not attend, expressing their approval of the movement and pledging their co-operation.

The organization was effected by the election of the following officers:

President, Saml. P. Colt, Bristol Electric Light Co.

Secretary, Saml. G. Stiness, Pawtucket Gas and Electric Light Co

Treasurer, Marsden J. Perry, Narragansett Electric Lighting Co.

The officers of the association constitute its executive committee, including Allen R. Foote, chairman, National Committee on State and Municipal Legislation of the National Electric Light Association.

THE MAINE ELECTRIC LIGHT ASSOCIATION.

THE SIXTH STATE ORGANIZED.

The Electric Central Station Companies in the State of Maine held a meeting at Portland, and organized a State Association on January 11th. The meeting fully represented the Electrical Central Station interests of the State, and was decided in its action.

The association was organized by the adoption of by-laws and the election of the following officers: President, Geo. P. Westcott; 1st vice-president, J. W. Wakefield; 2d vice-president, F. M. Laughton; treasurer, W. R. Wood; secretary, F. A. Sawyer; ass't-secretary, Geo. E. Raymond; executive committee: Geo. P. Westcott, Portland; J. W. Wakefield, Bath; F. M. Laughton, Bangor; W. K. Dana, Saccarappa; W. E. Maxey, Gardiner.

PROF. ANTHONY.—Prof. W. A. Anthony last Tuesday evening read a paper before the American Institute of Electrical Engineers, at the new hall of the Civil Engineers on East Twenty-third street, entitled: "A Review of Modern Electrical Theories.'

The Court of Appeals, at Albany, on the 14th inst., dismissed the appeal of John A. Roebling's Sons' Company from the order of the General Term denying their petition to set aside the foreclosure sale of the assets of the Bankers' and Merchants' Telegraph Company by the Farmers' Loan and Trust Company. The buyer was Edward S. Stokes, who assigned his bid to the United States Telegraph Company.

Mr. Charles Selden, of the Baltimore and Ohio Railroad, is now assistant to the president of that company. Mr. Selden is a very efficient officer, and we extend our congratulations on his deserved advancement.

ELECTRIC CAR BRAKES.

The expression electric brake is now often heard, and requires a word of explanation. There are various forms of so-called electric brakes which are practicable and even efficient working devices. In none of them, however, does electricity furnish the power by which the brakes are applied; it merely puts in operation some other power. In one type of electric brake the active braking force is taken from an axle of each car. A small friction drum is made fast to the axle. Another friction drum hung from the body of the car swings near the axle. If, when the car is in motion, these drums are brought in contact, that one which hangs from the car takes motion from the other. and may be made to wind a chain on its shaft. Winding in this chain pulls on the brake levers precisely as if it had been wound on the shaft of the hand brake. The sole function of electricity in this form of brake is to bring the friction drums together. In a French brake which has been used experimentally for some years with much success, an electric current, controlled by the engine driver, energizes an electro-magnet which forms part of the swinging frame in which the loose friction pulley is carried. This electro-magnet being vitalized is attracted toward the axle, thus bringing the friction drums in contact.

In an American brake lately exhibited on a long freight train, a smaller electro-magnet is used, but the same end is accomplished by multiplying the power by the intervention of a lever and wheel. The other type of so-called electric brake is that in which the motive power is compressed air, and the function of the electric device is simply to manipulate the valves under each car by which the air is let into the brake cylinder or allowed to escape, thus putting on or releasing the brakes. All of these devices have this advantage, that whatever the length of the train, the application of the brakes is simultaneous on all the wheels, and stops can be made from high speed with little shock. *Scribner's.*

RESUMED ITS WORK.—The Edison Electric Illuminating Company has resumed full service at their Pearl street station, which was destroyed by fire on the 2d instant. A fire-proof structure is to be erected at once.

THE JOHN STEPHENSON COMPANY.—The John Stephenson Company, the well-known street car builders, have just issued a very neat little book entitled "Motive Power for Street Cars." One-half of the book is devoted to a discussion of the conditions necessary to the financial success of electricity as a motive power, in which very valuable information is given. A chapter is devoted to "Street Railway Motors, other than Animal, Cable and Electric." These include steam motors, the Prosser motor, steam storage, compressed air and the caustic-soda motor. Each of these classes of motors is described, and their merits and demerits are briefly but plainly discussed. The extraordinary profits of the cable railways in Australia are considered in a separate chapter, and the book closes with Mr. Wm. Bracken's paper on "Electric Traction by Storage Batteries," which was read before the Convention of the Electric Light Association at Niagara Falls, last summer. Numerous illustrations are given of electric cars used in different portions of the country.

This book, which contains information of great value to all concerned in electric railway matters, can be obtained on application of the John Stephenson Company.

Mr. Samuel Insull, general manager of the United Edtson Manufacturing Company, has been appointed general manager of the Sprague Electric Railway & Motor Company of this city.

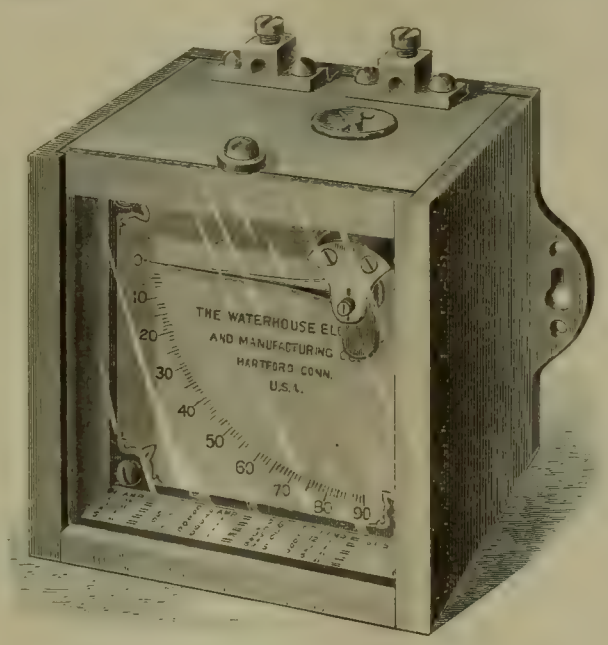
THE WATERHOUSE STANDARD AMMETER.

The want of a reliable ammeter among electricians has led the Waterhouse Electric and Manufacturing Company, of Hartford, Conn., to produce an instrument of this class, which for constant reliability and accuracy stands unequalled

The best electrical measuring instruments in use depend for their action upon a permanent magnet, or in their construction a coiled spring is used, so that the magnetism of the magnet, or the resiliency of the spring is a varying quantity, and frequent calibration is necessary to correct these variations. The object in producing the Waterhouse Standard Ammeter was to build an instrument on a new principle, with the action always the same, so that when once standardized its reliability would be lasting.

The instrument is most sensitive to the variations in the current transmitted through it, and is not only adapted for use in electric light stations, but also for the finest laboratory tests. A number of these instruments have been in use for some time, and are giving entire satisfaction.

The illustration shows the ammeter as finished. A volt-meter is also made on the same principle, and an ammeter and volt-meter combined.



On the top are the binding posts for circuit wires, and also a small compass for denoting direction of the current. The front presents a dial with silver indicator, and on the floor is a table on which the calibration of the instrument is recorded. These are enclosed by a glass that is secured in position by a screw and washer on top.

The working parts, consist of a coiled conductor wound around a stationary soft iron core. said core having a longitudinal slot situated to the left of the median line of the upper edge of the periphery of the core. In this slot is placed a soft iron armature, which is provided with iron pendant pole pieces and a silver pointer. The armature and its pole pieces and pointer are all one piece, and are finely pivoted at each end and free to swing or vibrate, while the core is stationary.

The current in the coiled conductor polarizes each end of the core and the armature alike, so that the poles attached to the armature are of the same sign as the same ends of the core. The result is, that like poles repel, which causes the pendant parts of the armature to swing away from the centre of core—carrying the pointer to an angle corresponding to the intensity of the current passing through the conductor to be measured. Use is made of the repelling power of magnetism for the reason that it is prolonged and exerted evenly, while that of attraction would be variable. When the current is cut off gravitation carries the pointer back to O.

The use of the repelling power of magnetism and gravitation for returning the indicator to O, overcomes the necessity for a permanent magnet or a coiled spring.

PROTECTION OF TELEGRAPH AND TELEPHONE LINES AGAINST ELECTRIC LIGHT WIRES IN ITALY.

The Italian government has recently taken measures to protect telegraph and telephone lines against the harmful influence of electric light systems, and other industrial applications of electricity. The *Electro technische Zeitschrift* describes the method as follows:

The lines used for electric lighting, or for other industrial objects, must form a closed metallic circuit, and having no earth contact throughout its length. It is forbidden to attach them to water or gas mains. The conductors of electric light systems situated in the neighborhood of a telegraph or telephone line must be covered with a substance impermeable to water, and sufficiently insuring their insulation. In places where the workmen of the telegraph or telephone administration would risk, in the course of their work, coming in contact with electric light conductors the latter must be provided with a special insulation, and placed far enough from the telegraph or telephone lines, so that a simultaneous contact with the wires of each other cannot take place. Immediate contacts between electric light wires and those of the telegraphs and telephones must be absolutely impossible, either in a normal state of the wires, or in the event of a breakage of the the wires. The lines must be constructed under such conditions of solidity that they are capable of resisting all the attacks to which they are likely to be exposed. In case of need they must be supported throughout their length by cables of suitable strength. It is necessary to avoid, as much as possible, the running of electric light lines parallel with those of the telegraph and telephone. When a parallel course is inevitable, the electric light lines must be kept at a distance of at least twelve metres from the telegraph and telephone systems. At the points of intersection, the electric light wires must pass below, and at right angles to the telegraph or telephone lines. The distance between the lowest telegraph or telephone conductors and the nearest electric light wire must be at least two metres. The posts or supports of the electric light conductors must be, at these crossing points, kept at a distance of at least three metres from the telegraph or telephone lines. In order that the latter shall not, in case of breakage, come in contact with the electric light lines, a safety wire of sufficient strength must be placed immediately over each electric light conductor throughout the whole of the crossing. Those establishing or working a system of electric lighting must take all the precautions of which science and experience have proved the utility. They must bring all their care to bear on the maintenance of their lines, which must be daily subjected to a minute inspection, and be kept constantly in a good state of repair. The constructor will be responsible for all damages and accidents caused by the system of electric lighting.

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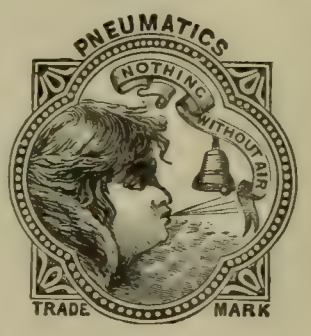
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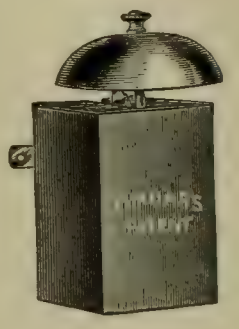
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H. W. BURGETT,
Treasurer Dover Electric Light Co.

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GEO. H. ROE,
Secretary San Francisco Electric Light Co.

BROOKLYN, N. Y.

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C. J. FIELD,
General Manager Edison Illuminating Light Co.

MANCHESTER, CONN.

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WM. A. ANTHONY,
Mather Electric Light Co.

LYNN, MASS.

Dear Sir:—The Aron Electric Counter works very satisfactorily. Yours, etc.,

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THE RESIGNATION OF COMMISSIONER GIBBENS.

The resignation of Commissioner Gibbens of the Board of Electrical Control, which was announced in our last issue, caused a great surprise in electrical, political and legal circles. He was the working member of the Board, the others generally acquiescing in everything done by that Commissioner. There is a report in circulation that he is after larger game. There is a bill now before the Legislature providing for the creation of a State Board of Electrical Control. It is asserted that Mr. Gibbens has his eye on a position on this Board, which will pay a salary of $8,000 per year. In speaking of this desire on the part of Mr. Gibbens, a gentleman well-known. said:

"A position on the State Board holds out glittering promises to a man like Gibbens, who possesses enough knowledge of electricity to be dangerous, and has shown that he is not troubled with any scruples as to what is right. Gibbens likes notoriety, and the State Board will give him a chance to spread himself all over the Empire State and to imagine himself a great man."

Another said:

"Let me tell you one thing. Gibbens is not going to step out into this cold, bleak, wintry weather without a good, warm overcoat on." Meaning, of course, that Mr. Gibbens undoubtedly had in mind something better than the position he had just vacated.

It is said that the electric light companies are elated over Mr. Gibbens' resignation. Upon his shoulders is laid all the blame and responsibility for the existing state of affairs in electric lighting.

Electrical people are busily speculating upon Commissioner Gibbens' probable successor in the Board. They are unanimously in favor of the appointment of a man familiar with electrical affairs. The work to be done by the Board of Electrical Control during next summer is of more importance than all that has been done so far. Now there are fragments of subways scattered about the city, and electrical wires run in and out of them in such a manner as to cause heavy losses to the companies, and they are anxious for the introduction into the work of subway building a comprehensive system, in order that the prevailing disadvantages may be removed and the wires buried properly. The mixed and fragmentary system of underground and over-head wires combined is more expensive to the companies than a complete underground system would be. The representatives of electrical companies say, that with a Commissioner of experience in electrical affairs in the Board the Mayor would be able to obtain reliable information, and then two votes would at least counterbalance the votes of Commissioner Hess and Moss and modify the evils of ignorant management.

It was rumored a few days ago that Commissioners Moss and Hess were about to resign, but the report could not be verified.

Both these gentlemen are reported to have said that they do not propose to withdraw under fire. It would be better for them and better for the electric light companies and the public if they would resign at once. A more incompetent Commission was never created, and that such large powers should have been placed in he hands of three politicians, pure and simple, teems incomprehensible.

Everything is electricity at Albany these days. A general investigation is authorized by the legislative authorities into the methods of furnishing electricity for lighting and power purposes as now conducted in this State, and the committee is to be empowered to do pretty much as they please. Our legislators should handle electricity with more circumspection. What electricity wants is just enough legislation, but not too much. If our Solons would undertake to investigate the nature of electricity instead of the methods of production, some good might result.

THE WESTINGHOUSE COMPANY.—The rapidly growing business of the Westinghouse Electric Company demands so much additional space for the extension of the works that it has been decided to remove the plant from Pittsburgh. It is to be located at a place about 12 miles from the city, where land is cheaper and in abundance. This is a wise move. A rapidly expanding business needs plenty of room for future use, which cannot be had in a crowded city.

SOME VALUABLE SUGGESTIONS.—We print elsewhere a letter from Mr. W. H. Markland, of Altoona, Pa., on "How Shall we Make our Wires Safe?" This is a very timely subject, and Mr. Markland gives some very valuable suggestions in that direction. If all managers of electric light plants were as careful and painstaking as Mr. Markland, accidents to life and property would be reduced to a minimum. This letter can be read with much profit, and we commend it to our readers for their careful thought.

SIGNALS IN FOGGY WEATHER.—A new idea in the line of signals between vessels during a fog comes from Albany, N. Y. The plan contemplates the use of an electric search light on steamboats, but instead of projecting the beam of light ahead, it is to be thrown upwards. It is claimed that a vertical beam of light can be seen at a greater distance in thick weather than a horizontal one. It is proposed to use red and green slides in connection with the light, and by the combinations of the colored and white lights, and variation in the duration of the flashes, a code of signals can be established. By this means communication between distant vessels can be carried on during foggy weather.

THE DANGERS OF ELECTRIC LIGHTIGN.

Messrs. Ferranti & Ince have undertaken to educate the British people on the "dangers of electric lighting," in an article published recently. The first portion of the article deals with a general explanation of the advantages of the high tension system in the economy which it effects by enabling small mains to be used; then the question of the insulation and the heating of the conductors is fully gone into. With reference to this, great stress is laid upon the fact that if an accidental contact causes a rush of current, a safety fuse will cut the current off before any damage is done. Safety fuses, we believe, will, sooner or later, be looked upon as barbarisms; gas companies do not cut off their mains with a safety valve, and electric conductors must be protected by making the generating plant regulate automatically. Arguing with reference to the calorific effects of the low tension system, the writers say: "We have seen that to do the same work, the low tension system requires 1,750 ampères against 17 5 on the high pressure, and thus, if an accident does happen on the low tension system, the immediate calorific effect of 1,750 ampères is called into play. Now, if on the high tension system such an effect could be reached, our engines would be called on to do an absolute impossibility, as they would be required to give 100 times their normal power before the quantity and equal heating effect of 1,750 ampères could be reached."

EARLY TELEPHONES.—Telephones are of greater antiquity than is generally supposed. Wheatstone describes his "telephone" in 1821, and in 1854 Ch. Bourseul said: "Suppose a man speaks near a movable disk, sufficiently pliable to lose none of the vibrations of the voice, that this disk alternately makes and breaks the currents from an electric battery, you may have at any distance another disk which will simultaneously execute the same vibrations. It is certain that in a more or less distant future, speech will be transmitted by electricity."

THE RUBBER QUESTION.—At a recent meeting of the dealers in India rubber connected with the London Chamber of Commerce it was resolved to memorialize the Marquis of Salisbury against the monopoly established by the Para government, and the export duty it has imposed. Sixty firms have already petitioned the government on this subject.

Later information from Para is to the effect that the concession of 20 reis in favor of the Companhia Mercantil of Para on the export duty on rubber granted by the Government has been revoked. This bounty was allowed a few weeks after the establishment of the republic, and there was immediately a strong protest from other houses in Para engaged in the exportation of rubber. Its continuance, it was declared, would give the Companhia Mercantil a practical monoply.

It is asserted that the concession was revoked on the strength of a petition of the large rubber manufacturers in the United States, to bring to the notice of the Brazilian government the injury to American interests caused by the increased duty on rubber.

THE MICHIGAN ELECTRIC LIGHT ASSOCIATION, just organized, is not going to lose any time in demonstrating the usefulness of state organizations. The first business of the association will be to establish a general system of rules and regulations for the wiring of buildings, so as to secure the safest and best construction and service. We are glad to note the promptness with which this important matter is taken up. It will inspire the Michigan people with confidence in their electric light association.

CAN ELECTRIC LIGHT CURRENTS BE MADE SAFE?

WHAT PROMINENT ELECTRICIANS HAVE TO SAY ON THE SUBJECT.

In reply to our circular on the above-named subject, which we sent to prominent electricians throughout the country some time ago, and many of whose replies have been published in previous issues, we have received the following:

MR. C. S. VAN NUIS,

ELECTRICAL EXPERT, NEW YORK.

1.—Can over-head electric light lines be rendered reliably safe at all times? If so, how?

Answer. Yes, by using good insulation, careful construction and rigid inspection at short intervals.

2.—In your opinion, is there any reliable and durable method of insulation which can be applied to over-head electric light wires, and which will absolutely prevent any escape of current, particularly in wet weather?

Answer. No; but the escape can be kept within safe limits by frequent insulation tests and the necessary repairs.

3.—Is there, in your opinion, any reliable method of laying electric light wires underground?

Answer. Yes; in tunnels.

4.—In your opinion, would the existing dangers be entirely overcome by placing the wires under ground?

Answer. No. Dangers will exist as long as careless methods are employed on high tension currents, either aerial or under ground.

5.—How, in your opinion, can the danger to life and property, so frequently exemplified of late, be completely overcome?

Answer. To completely overcome danger to life will be to confine the E. M. F. to a safe limit. Danger to property can be overcome by suspending all wirès in air space, or non-combustible insulators, or encasing them in insulating tubes, which are water and fire-proof, and the proper use of safety fuses to guard against abnormal currents.

6.—What means should be adopted to prevent fire in case of derangement on electric light circuits running into buildings?

Answer. Answer to fifth question covers this.

LONG DISTANCE TELEPHONE IN SOUTH AMERICA.—The trunk telephone line connecting Buenos Ayres and Montevideo was opened recently with great ceremony. The line is carried on posts along either side of the River Plate from Buenos Ayres and Montevideo, respectively, to the points where the river is crossed. The connection here is established by means of submarine cables, which cross the river at a breadth of 28 miles. In the vicinity of Montevideo the bronze wire spans a distance of 460 yards across the river Santa Lucia, by means of poles 108 feet in height. The charges for the use of the telephone are worthy of notice. During the busiest part of the day they are as follows: For five minutes' use, $5; for five to ten minutes' use, $12.50; for ten to fifteen minutes' use, $25. The line has so far given satisfaction both as regards articulation and loudness.

OPEN CIRCUIT TRANSFORMERS.—Mr. Joseph Wetzler at the last meeting of the New York Electrical Society, among other things, referred to the work of Mr. J. Swinburne on open circuit transformers. The "hedge-hog" pattern of open circuit transformer is claimed to be more efficient than the closed circuit type. In the designing of this new style of transformer Mr. Swinburne sought to overcome certain difficulties in the closed circuit pattern.

HOW SHALL WE MAKE OUR WIRES SAFE?

BY W. H. MARKLAND, ELECTRICIAN OF THE PENNSYLVANIA RAILROAD COMPANY.

I have read with considerable interest the various answers to the questions put out by THE ELECTRIC AGE on "can electric light wires be made safe?" I think they should be followed up by the question, "How shall electric wires be made safe?" Of course for new work the answer is, use the best insulation. There is no excuse at the present day for using underwriters' wire, as wire of a fair insulation can be had for about the same money.

There are hundreds of miles of underwriters' wire now in use. The managers of electric light stations would say, if you told them to take their underwriters' wire down, that they have never had any serious trouble from the wire now up, and that they bought the underwriters' wire in good faith, believing it to be the best for the purpose. Why should they go to the additional expense of putting up new wire, and what real assurance have they that the new wire they get may not become as bad in time as underwriters' now is? If they go to wire maker A, he says he makes the only good wire. Wire maker B says he makes the only good wire, and so on. The only thing left is to go to your neighbor and ask him what he uses, and test the insulation resistance of the wire, if the proper apparatus is handy, which is not always the case in a central station. A simple test of insulation is not conclusive proof that a wire will stand when exposed to sun, heat, cold, weather changes, etc.

I have had grounds occur when one of the best known insulations was used, and have lines run with underwriters' wire that have never given trouble.

I think the great question now is "How shall the present wires be made safe?" I will mention a few suggestions from my experience, hoping they may lead to others from parties who have had experience in other places.

Underwriters' wire will eventually wear or fray out; it then could and should be replaced with better wire. This could be done piece or loop at a time, so the expense may not be great at any one time.

When a wire is taken down to be replaced by new, I consider it a good plan to put up new insulators also. The old insulators can be cleaned off when dirty and put in use again if whole.

I always make it a point to go over all my lines at least twice a month and have my men go over them very often. If any point looks as though it might give trouble, I have it repaired as soon as possible. I do not consider it good policy to say that because a wire has been up two or three years it is all right for ever.

I believe in testing as often as possible, say every hour while lamps are burning. A line will often test clear during the day and develop trouble while lights are burning and clear again when lights go off. If I know there has been trouble I can have it looked up and remedied, possibly, before any damage is done.

I believe in dividing lines into as many loops as possible, where it can readily be done, as it is much easier to hunt trouble when you know it is on a loop with 15 lamps than where you have to go the length of three such loops all in one with 45 lamps.

If some person puts up a telegraph line over my high potential wire, I put an insulated guard wire over my wire, if possible; so in case of the telegraph wire falling it may not fall on the electric light wire and do damage. I would rather spend a little money for protection than burn the other parties' machinery up. I had a case lately where a telegraph wire was put up over an arc wire. I had the arc wire lowered and an iron guard wire put on the very insulators where the arc wire was. Not two months later the telegraph wire sagged so it came in contact with the guard wire. If the arc wire had been in its former place, the chances are there would have been trouble. As the guard wire and erection cost about $2.00, I thought it a good investment. The electric light companies should take the lead in the matter of protection where they go near telegraph or telephone wires. If the other electrical companies refuse to assist, public sentiment will soon compel them to.

In all new work I intend to place iron guard wires put on glass over all high potential wires, and only have the stretches to connect from one pole to the next, that is, one stretch will be tied in the groove of the insulator, the next over the petticoat of the insulator and so on, so there will be no connection from one stretch to the next. I don't consider a continuous guard wire of any advantage, as it may be in contact at one point with a telegraph wire and at another with an electric light wire, thus forming a cross between the two.

If necessary to go near a telegraph pole, I put a cross arm on the pole, if possible, but never use the inner pins for arc wire if there are telegraph wires above. My reason for not using the inner pins is to prevent line men when going up and down a telegraph pole coming in contact with high potential wires. Telegraph linemen do not take the precaution that electric light linemen do, as they are used to harmless wires.

If a wire is in such a position that it can sway and touch a guy wire, building or anything that can make connection to ground, I make it a point to put an insulator at that very point. If a wire runs in front of a building I want that wire very well protected.

I always make it a point to live up to the rules of The Board of Fire Underwriters. Their rules are not all the best, but it does no harm to go by them and make wires a little safer than they call for.

If I see carpenters or painters working near a wire, I caution them to let the wires alone and then see that they do so, as they generally take delight in twisting a wire around a lightning rod or pipe.

I believe in and use good insulation for new work, but always construct a line, using the same precautions I would if a bare wire was used.

I always make it a point to insulate the hanger boards of arc lamps if possible. This I did on some lamps and find a marked improvement in insulation. This only costs a few cents per lamp and was money well spent. I always, when possible, put low potential wires on porcelain or glass insulators. It costs very little more than cleats, and makes a much better insulated line, especially in damp places.

ELECTRIC LIGHTING IN WASHINGTON.—The evils of trying to solve the underground wire problem through the instrumentality of irresponsible persons are exemplified in Washington. So unsatisfactory have been the efforts to abolish overhead wires by placing them under ground that Congress has had to take a hand in the matter and prescribe certain regulations. No one, except companies now organized and doing business in the District, will be permitted hereafter to lay wires underground. This action excludes from Washington such companies as the Westinghouse, Edison and Thomson-Houston, and as the local company and the gas company are practically one in their efforts to keep competitors out of the field, there is likely to be lively times some time before long. After all that has been done towards putting the wires underground, there is very little to show. It is suggested that the Government ought to take hold of the matter, in part, and investigate the subject thoroughly, and co-operate with the private concerns in placing the wires underground in the most reliable manner.

THE PHENOMENA OF RETARDATION.

The phenomena of retardation in telegraphic circuits are not altogether electro-static, but in part electro-dynamic. The magnetic properties of iron—*i. e.*, the material of the wire—are capable of themselves of giving rise to reactions in the current passing through them, aside from those due to electro-static induction. The passage of a current in an iron wire produces a magnetic field, which in the expansion or contraction of its lines of force reacts on the conductor, and can produce a more or less marked electromotive force. The action, in all cases, would be in accordance with Lenz's law, and, consequently, the effect would be to tend to oppose the current as long as it was *increasing* during the beginning of an impulse, and thus produce "retardation," while at the end the effect would be to *prolong* the impulse and produce the phenomenon of "tailing" or "kick." When a current is passed through an electro-magnet, the motion of the lines of force as they expand is such that in cutting the coils of the wire, it gives rise to a *counter* E. M. F. that diminishes the main E. M. F. by so much, while when the current is suspended, the collapse of the lines of force gives rise to an E. M. F. in the same direction as the main E. M. F., and, consequently, tends to prolong the current. This is what happens in the iron wire, only in this case the wire fulfils the function of the iron *core* of the magnet as well as of magnetizing helix.

The proof that this action accounts for a good deal of the so-called electro-static effects of wires is shown. Copper-iron wire, is remarkably free from them, while, on the other hand, it ought to exhibit them to a greater degree on account of its greater "capacity" (length x surface.) The reason why copper does not give rise to the electro dynamic induction to the same extent, is that it is a so-called non magnetic (diamagnetic) metal; it does not have the power of collecting and concentrating lines of force which iron possesses in such an eminent degree; in a word, the magnetic field around the copper-wire is *rarer* than that around an iron wire of the same size, and the same motion does not give rise to the same effects.

THE WESTINGHOUSE ELECTRIC PLANT TO BE REMOVED.

The Westinghouse Electric Company, which has its main plant almost in the heart of Pittsburg, has decided to move out of the city. It will erect, as soon as possible, immense new works near Brinton, on the main line of the Pennsylvania railroad, about twelve miles from Pittsburg.

This removal is made necessary on account of lack of space and the cost of enlarging a plant in the city. The present buildings are to be sold and will yield $500,000. This money will be used in the construction of the new shops, which will occupy a plot of fifteen acres. It is the purpose to lay out and build up a new borough surrounding the plant, as is being done at Wilmerding, several miles distant, where the new Westinghouse air-brake works are nearing completion. The electric company since a year ago has increased the number of its workmen from 600 to 1,300, and these, with their families, will give the new town a population of about 5,000 souls.

The company in 1889 set up 134 central stations in Europe and America, with an aggregate of 234,250 lights. This represents a business of between $4,000,000 and $5,000,000. The new town will have connections with the Pennsylvania and Vanderbilt systems of railroads.

The servant girl of the future will refuse employment in a family that does not use the electric light in the house.

THE FRANKFORT ELECTRICAL EXHIBITION.

The committee in charge of the work of organizing the International Electrical Exhibition at Frankfort-on-the-Main, Germany, have issued a general circular on the subject. Among other things it says:

We have obtained the assignment of land belonging to the State, situated between the town and the new central railway station, having an area of 50,000 square metres, and which will be directly connected with the State lines of railway, so that the arrival and departure of articles for exhibition may be effected in the simplest and least burdensome manner. Thanks to the favorable conditions, the direction of the exhibition will be in a position to reduce to a minimum the expenses to be paid by exhibitors. The direction undertakes to supply exhibitors with sufficient motor power, and to obtain freedom from customs dues and transport facilities for exhibits from abroad. The exhibition will include everything which is connected with electricity so long as it be new or represent a notable progress compared with the special exhibitions of Paris, Munich, and Vienna. The exhibition will remain open from June 1st to October 31st. The exhibits will be divided into 12 groups as follows:

1. Electric motors, steam engines, hydraulic motors, aeromotors, gas motors, as well as their boilers and accessories. 2. Production of electricity. 3 Means and processes for the distribution of electricity. 4. Accumulators and transformers. 5. Electrical transmission of power and its application to industry. 6. Electric lighting installations, &c. 7. Telegraphy and telephony, lightning conductors, electrical apparatus for protection from fire, thieves, etc., electric bells. 8. Application of electricity to railways, tramways, and ships, electrical railway signals, etc. 9. Electro-metallurgy and electrolysis. 10. Electrical apparatus of precision, measurement, acoustics and optics. 11. Electro-therapeutics. 12. Publications relating to electricity,

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Damaged Electric Light Property.—Business men experienced in electrical affairs, but in no way connected with any of the electric light companies, say the damage to those corporations that has been uselessly and unnecessarily inflicted will exceed a million dollars, and that burdens have been put upon the companies which will increase their deficit by another million before the end is reached. Incalculable damage to electrical progress has also been done by New York's demonstration of how easy it is to ruin electric light securities.

The directors of the New England Telephone and Telegraph Company, of Boston, have declared a dividend of $1.25 per share, payable Feb. 15th.

Resumption of Electric Lighting.—A gentleman, who is said to practically represent all of the electric light companies, asserts that the city will be re-lighted by electricity within 60 days.

"The companies," he went on, "have been hard at work getting their cables under ground. They have been delayed somewhat by the manufacturers being unable to make the cables fast enough for the demand. The cables, however, are being shipped here rapidly, and the subways are being built with a fair degree of rapidity. Of course, all the city districts will not be lighted by means of underground wires within sixty days, but wherever there is a subway it will be occupied by electric light wires. Where there are no subways the streets will be lighted by overhead wires.

Accident to a Cable.—While a cable ship was laying a submarine cable recently, between Zanzibar and Mombasa, the cable was broken.

PHILADELPHIA NOTES.

The annual meeting of the Franklin Institute was held last week. The reports showed a favorable condition of progress. The receipts from all sources for the year amounted to $32,462.97; payments, including investments, $30,290.64. The report of Secretary Wahl embraced a review of the year's industrial and scientific progress. The following officers were elected: President, Joseph M. Wilson; Vice-President, Charles Bullock; Secretary, William H. Wahl; Treasurer, Samuel Sartin; Managers, Charles H. Banes, Washington Jones, Edward Longstreth, Isaac Norris, Jr., Theodore D. Rand, Stacey Reeves, Coleman Sellers, F. Lynwood Garrison; Auditor, Samuel H. Needles; Committee on Science and the Arts, Arthur Beardsley, Hugo Bilgram, J. H. Eastwick, N. H. Egerton, G. M. Eldridge, John Hall, Rufus Hill, George A. Koenig, E. Alexander Scott, H. W. Spangler, Coleman Sellers, William H. Wahl, John H Cooper; F. Lynwood Garrison, Wm. Harkness, Jr.

It is proposed to build an electric railroad from Ashbourne to Cheltenham, suburbs, to afford rapid transit facilities, and aid in the development for suburban residences of that portion of Montgomery county contiguous to the Tacony creek, along which the line is to run. It is proposed to operate with the line an electric light plant.

At the annual meeting of the Edison Electric Light Co. of Philadelphia, held last week, a report was presented showing the monthly expenses to have been about $8,000, and the income $20,000, leaving a monthly profit of about $12,000. The debt is about $200,000. The officers of the corporation were elected as follows: President, L. D. Brown; Vice-President, B. K. Jamison; Secretary and Treasurer, A. V. Sloan; Solicitor, Samuel B. Huey; Supervising Engineer and General Manager, Wm. D. Marks.

Mr. Maris, a member and manager of the house of Thomas H. McCollin & Co., No. 635 Arch street, tells the Age correspondent that they are handling a large quantity of their draughtsmen's sensitive paper for making blue prints. The house make quite a specialty of this paper, and as it is particularly adapted to the uses of electricians and electrical engineers, their business in the electrical field is rapidly increasing. The house is an old and reliable one in the photographic supply and apparatus line, and is being extensively patronized in this direction as well as in the way of draughtsmen's paper.

Mr. W. O. Snyder, the manager of the Spellier Electric Time Company, reports that the company have now in use nearly five hundred clocks, and as the system has proved a superior one, the business is growing largely. The company are now negotiating for the establishment of branch offices in Boston and other large cities. The rapid strides taken by Philadelphia in the electrical field is convincing evidence that it is not so proverbially slow as some of the paragraphers assert it to be.

There is on foot a scheme, of which William Wharton, Jr., is at the head, to purchase the Citizens' Passenger Railway system, which covers a large portion of the populated section of the city in a northerly and southerly direction, and to amalgamate it with the Lehigh Avenue Railway, which is already owned by Mr. Wharton's company, and which will soon cover in an easterly and westerly direction the northern, northeastern and northwestern portions of this city. These lines are to be operated by the Wharton electric system, and in connection with the proposed gravity railway in and through Fairmount Park (of which Mr. Wharton, heavily backed by leading capitalists, is the promoter), will control an immense amount of traffic, as it practically covers every portion of the city.

Electro.

ACCUMULATORS.

An "accumulator," or "secondary battery," usually consists of a cell containing slightly acidulated water and two lead plates, treated in various ways. It is not our purpose to attempt a description of every kind of secondary battery in use or made. There are but two sorts which are of real value. To these we shall confine our remarks. The first has the plates composed of lead in a spongy or granular state; and the second has lead plates, or some alloy of lead, perforated with holes, and filled with lead compounds. Of the latter type there are numerous modifications to attain the same end. The reversibility of these cells was first shown by Planté, although it is said that earlier investigators had discovered this property of lead plates. To Fauré appears to belong the merit of having modified the Planté cell so as to make it a practical one. Most all secondary batteries now used are but improved Fauré cells.

The chief aim of all improvements in the lead plate type is to make the plates porous, yet strong, so as to offer as large a surface as possible to the electrolyte.

The second type may be termed "pasted plates." Here the perforated or honey-combed plates are filled with paste, made of red lead mixed with sulphuric acid for the positive element, forming lead sulphate, the negative paste being made with litharge. In this type of cell, as well as in the Planté, dilute sulphuric acid is employed as the electrolyte. There are many modifications of the pastes and in plates. The chemical action is the same for both types of plates, and may be explained in a general way by saying that, when the cells are charged, more oxygen exists in the positive, and more hydrogen in the negative plates than when discharged. First, let us consider those of the Planté type. Each maker of this kind of cell has his own way of rendering the lead plates porous. Some cast them porous to start with, others build them up of lead ribbons, and most all treat the plates with nitric acid before placing them in the cells. Porosity is the object to be attained in all cases.

The positive and negative plates are identical at the start. Each plate is made with a lug to project above the electrolyte. A strip of lead is then soldered to the lugs of all the negatives, and the same is done with all the positives for one cell. The two sets of plates are pushed into one another so as to make a compact block, positive and negative alternately, each plate being insulated from the one next by some non-conductor, such as india rubber bands, blocks, vulcanite, etc., but they remain joined by the lead strips described above. Such a block of plates is then firmly held together by rubber bands, or a wooden frame, and the whole is then termed a "section." These sections are ready for "forming." This process consists of passing an electric current for a long period through the cell, a large number being coupled together in series to undergo the process. The result is that, though both positive and negative plates start identically, after a time they alter their chemical composition, and soon become capable of retaining a charge, which means, scientifically, that a good primary battery is obtained with reversible properties. The chief drawback to this type of cell is that frequent reversals are necessary to obtain good storage capacity, and when the maximum capacity is reached, the plates become rotten. It therefore takes a long time before the cells have much storage power, and reversals are troublesome as well as expensive. A "reversal" is accomplished by completely discharging the cells through a resistance. They are then charged the reverse way, and to complete the process another discharge must be given, followed by a re-charge in the original direction. Such cells are also very heavy for their storage capacity. The only point in their favor is that a very large charging current or rapid discharge does not appear to injure the plates, which is the case with the pasted type. Such a battery is, therefore, very suitable for regulating the light, and for short heavy discharges, but undesirable for storage, although a few authorities say that such cells have proved successful in their hands.

The second type is unquestionably the most useful, notwithstanding the extra care required, and it is these which are almost universally used at the present day. What is said henceforth applies almost exclusively to this latter type. All of the general phenomena occurring during charging and discharging are the same in both types, however.

Pasted plates are made in many ways, but the object in all is to produce an efficient support of lead or other material for holding the paste. The plates of one of the most efficient storage batteries in use consist of lead, or an alloy of lead, cast into plates covered with small square holes, pyramidical in form, with the bases on the surface of the plate minute-glass shape in section, with a lug for use in the manner already described. An alloy is preferable for the plate, or "grid," as it is technically called, as it makes a stronger plate than lead alone. The plates intended for the positive element are pasted with red lead and sulphuric acid. Water would answer the purpose of the acid, but it is not so coherent.

Figure 1 shows a group of plates already connected, and the receptacle for the same. This is one form of cell, one of the principal features being the advantage of sealing it.

Figure 2 shows a different form of cell. The receptacle is of glass, and unsealed. The choice of style is, of course, dependent a good deal upon the uses to which the battery is to be put.

The number of negative plates always exceeds the positives by one, so that a negative is seen at each end; of the remaining ones the edges only are in view, the plates being about a quarter of an inch apart, positive and negative alternately. There is no connection between the positives except through the strip connecting the lugs of the plates, this being long enough to connect with the next cell.

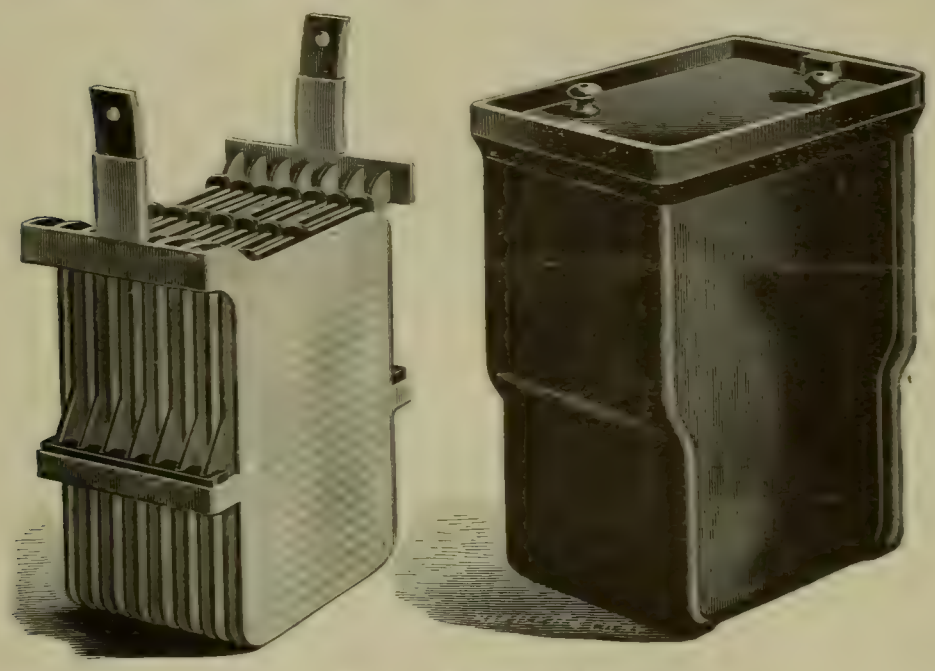


FIG. 1.—PLATES AND JAR.

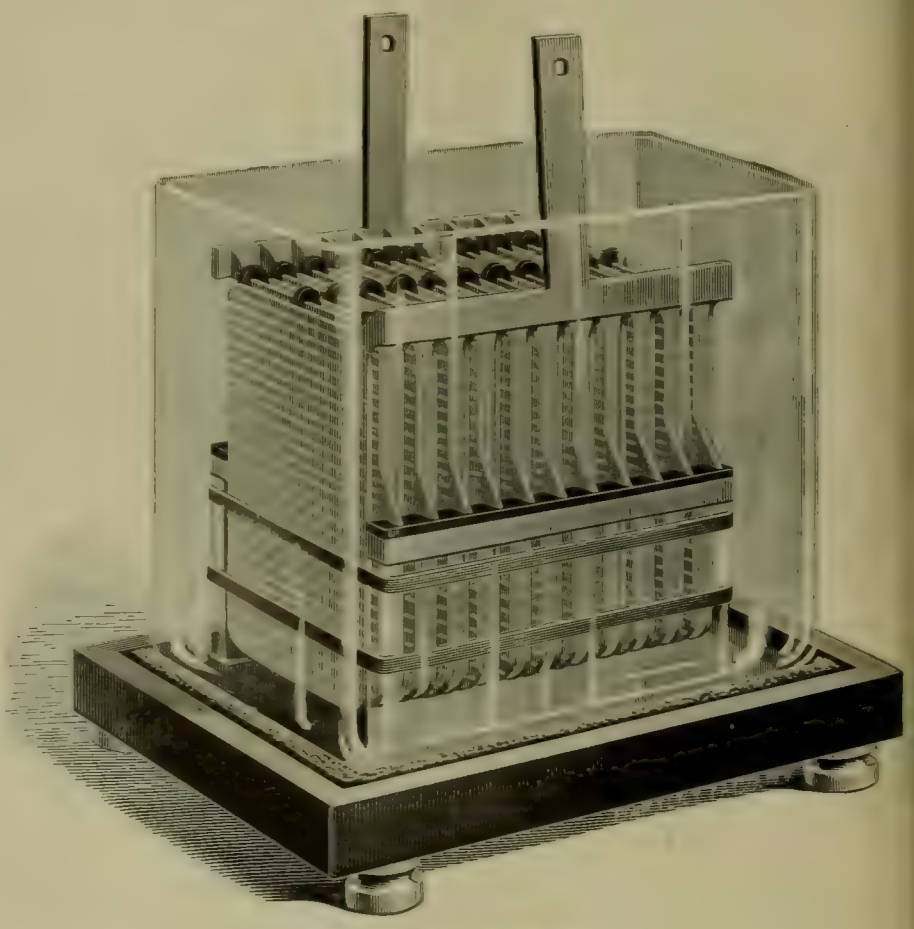


FIG. 2.—CELL COMPLETE.

An improvement in assembling the plates has recently been introduced, which overcomes the difficulty experienced sometimes by plugs or paste falling out of the holes and lodging between two plates. These accidents, of course, reduce somewhat the efficiency of the cell. The trouble is overcome by widening the space between the plates, so that dislodged plugs may fall to the bottom of the cell, clear of the plates.

Many improvements are now in progress to enable larger currents to be passed in and out without injury to the plates, as well as in the methods of making the paste to make it harder.

The frame, or projection on two sides of the assembled plates, is made of wood, and is used to support the plates, so as to avoid touching the bottom of the cell.

After the cells have been connected as desired, the current is passed through them for a long period, causing the paste on the positives to become converted into lead dioxide; and the paste on the negatives becomes partially reduced to finely divided lead. After this process is completed the cells are "formed," and ready for use.

The positives may be distinguished from the

negatives by their color, which is that of a chocolate or a dark red. The negatives have a yellowish tint on the surface, and pale slate color at the edges.

No matter what cells are used care and attention are necessary to get the best results.

Every cell with lead plates, irrespective of form, gives about 2 volts. It is necessary therefore to employ from 25 to 50 cells to obtain light for a small installation. Cells are connected in series or parallel as occasion requires, and they are subject to the same laws as are primary batteries, or other sources of electricity.

In the matter of making plates, improvements are being constantly made. One of the necessities which claims a good deal of attention from inventors, is in so making the holes in the plates as to hold the paste with which they are filled firmly in place. It is self-evident that if holes could be made with smaller diameters at the two surfaces than at the centre, the difficulty would to a great extent be overcome. The difficulty in accomplishing this is to make such holes.

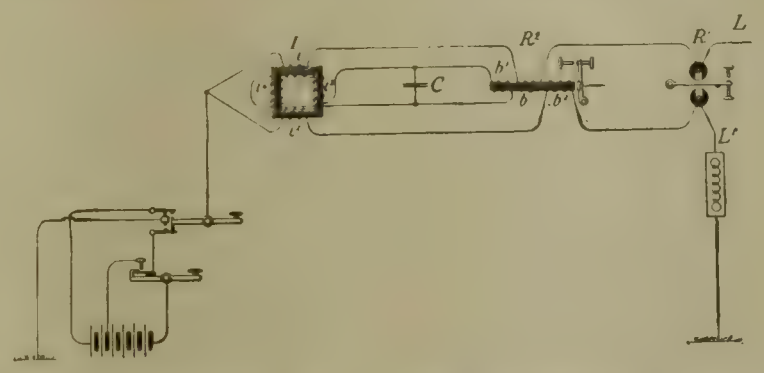
In a future issue we will discuss the general management of accumulators.

ELECTRIC LIGHTING IN SHANGHAI.—The new Shanghai Electric Company has now 90 arc lamps in use, with two No. 8 and three No. 7 Brush dynamos. There are also two 40 H.P. Tangye engines, one being always kept in reserve. The company is now intending to supply incandescent lights on the transformer system with Mordey's apparatus. There are considerable difficulties to be overcome in introducing incandescent lamps, in consequence of the result of the Cleveland Brush Company's enterprise some three years ago in Shanghai. Still, the company has booked promised orders for 4,000 lamps, if the 800 which it now starts with prove successful.

A NOVEL ELECTRIC RAILWAY.—An enterprise of much importance is projected in Georgia. It is proposed to establish an electric railway from Atlanta to Savannah, a distance of 250 miles, the electric power of which is to be generated in a novel way. The current of the rivers along the route are to be utilized as the power for the generation of electricity. It is thought that if this scheme is successful a new field would be opened up to development.

INCREASING THE EFFICIENCY OF THE QUADRUPLEX.

The accompanying drawing illustrates the invention of J. M. Moffatt and Edward Blakeney, of New York, for increasing the efficiency of the quadruplex. Referring to the diagram: R^1 is a differentially-wound, polarized relay, with its coils included respectively in the main line L and the artificial line L^1. R^2 is a neutral or No. 2 relay, and is constructed with three sets of coils, b, b^1, and b^2. The coil b is included in the main line-circuit, and the coil b^2 in the artificial line. The supplemental coil b^1 is included in an independent circuit, and is employed for maintaining the magnetism of the core of this receiving instrument during the reversals in the main line current. This is accomplished by sending a momentary impulse through the coil b^1 at the moment of reversal. Such an impulse is derived from an inductorium or induction coil I. This coil is constructed in any convenient manner. For instance, it may be a closed magnetic ring or rectangular frame, having coils i^1, i^2, i^3, i^4, wound upon it. The coils i^1, i^2, are included, respectively, in the main line L and artificial line L^1. The coils i^3 and i^4 are connnected through the supplemental coil b^1 of the receiving instrument R^2.



THE MOFFATT AND BLAKENEY ARRANGEMENT

Variations in the strength or reversal of the polarity of the current traversing the line will, it is evident, cause variations in the magnetism of the core, and thus induce currents in the coils i^3 and i^4.

The effect of this induced current is to prevent the armature of the neutral relay from falling against the back stop and giving a false signal at the instant of the reversal of the line current. This effect is produced in the following manner: When a current in one direction is passing through the neutral relay, it produces magnetism in the core of a certain polarity.

When this current is reversed, the magnetism in the core of the neutral relay must first be discharged, and it then charges itself anew with the magnetism of a polarity due to the reversed current. Ordinarily this discharge and recharge occupy time enough for the armature to be drawn by its retractile spring to the back contact and give a false signal. Now, the effect of the induced current referred to is first to aid in the rapid discharge of the magnetism in the core of the neutral, and then immediately to aid in the rapid recharge of the cores with the magnetism due to the reversal of the current. Thus both operations are facilitated by the operation of the induced current, and the time so shortened that the armature cannot reach the back contact, but is held practically without interruption to its front contact.

For the purpose of assisting the operation, a condenser, C, may be connected across the terminals of the induction coil, as showñ, and the discharge from this condenser upon variation or reversals in the magnetism of the induction coil will serve to send impulses of the proper character through the coil b^1 momentarily. There are several different ways in which the same general result is accomplished by the inventors, but the above will suffice to illustráte their system.

A VALUABLE TABLE.

By permission of Messrs. Crane & Miller, patent experts, of Newark, N. J., we publish the accompanying table of electrical horse-power. It will be found very useful to those interested in electric power.

TABLE OF ELECTRICAL HORSE POWERS.

CALCULATED BY W. F. D. CRANE, M. E., E. E.

Member of Franklin Institute and American Institute Electrical Engineers.

VOLTS OR AMPERES.

VOLTS OR AMPERES.	10	20	30	40	50	60	70	80	90	100	110
5	.067	.134	.201	.268	.335	.402	.469	.536	.603	.670	.737
15	.201	.402	.603	.804	1.005	1.206	1.407	1.608	1.809	2.010	2.211
25	.335	.670	1.005	1.340	1.675	2.010	2.345	2.680	3.015	3.350	3.685
35	.469	.938	1.407	1.876	2.345	2.814	3.283	3.752	4.221	4.690	5.159
45	.603	1.206	1.809	2.412	3.015	3.618	4.221	4.824	5.427	6.030	6.633
55	.737	1.474	2.211	2.948	3.685	4.422	5.159	5.896	6.633	7.370	8.107
65	.871	1.742	2.613	3.484	4.356	5.227	6.098	6.969	7.840	8.712	9.583
75	1.025	2.010	3.015	4.021	5.026	6 031	7.037	8.042	9.047	10.05	11.05
85	1.139	2.278	3.417	4.557	5.696	6.835	7.975	9.114	10 25	11.39	12.53
95	1.273	2.546	3.820	5.093	6.366	7.639	8.913	10.18	11.46	12.73	14.00
105	1.407	2.814	4.222	5.628	7.035	8.444	9.851	11.26	12.66	14.07	15.47
115	1.541	3.083	4.624	6.165	7.707	9.248	10.79	12.33	13.87	15.41	16.95
125	1.675	3.351	5.026	6.702	8.377	10.05	11.73	13.40	15.08	16.75	18.42
150	2.010	4.020	6.030	8.040	10.05	12.06	14.07	16.08	18.09	20.10	22.11
175	2.345	4.691	7.035	9.380	11.72	14.07	16.41	18.76	21.11	23.45	25.79
200	2.680	5.360	8.040	10.72	13.40	16.08	18.76	21.44	24.12	26.80	29.48
300	4.021	8.043	12.06	16.08	20.10	24.12	28.15	32.17	36.19	40.21	44.23
400	5.362	10.72	16.08	21.45	26.81	32.17	37.53	42.89	48.26	53.62	58.98
500	6.702	13.40	20.10	26.81	33.51	40.21	46.91	53.61	60.32	67.02	73.72
600	8.042	16.08	24.12	32.17	40.21	48.25	56.29	64.33	72.38	80.42	88.44

NOTE: The unit of electric power is the watt, or the equivalent product of one volt and one ampère. 746 watts constitute one Electric Horse Power, which is equivalent to the mechanical horse power of 550 foot pounds per second. Hence, $\frac{\text{volts} \times \text{ampères}}{746} = \text{E. H. P.}$, from which formula the figures in the body of the table have been calculated for the index figures on the upper and left hand edges of the table, which stand for either volts or ampères.

Example: What electrical horse power do 110 volts and 55 ampères represent? At the junction of the respective columns of 110 and 55, we find 8.107, which is the result of the operation $\frac{\text{volts} \times \text{ampères}}{746} = \text{E. H. P.}$

Example: What is the E. H. P. corresponding to 550 volts and 70 amperès?

Ans. $5.159 \times 10 = 51.59$ (since $550 = 55 \times 10$.)

Example: How many E. H. P. are contained in an arc light circuit carrying 9.5 ampères under a pressure of 3000 volts? Ans. 9.5 volts $\times$ 30 ampères $= 3.82$, which, multiplied by $10 = 38.20$ E. H. P. (since $9.5 = \frac{95}{10}$ and $3000 = 30 \times 100$. Hence, $\frac{100}{10} = 10$, the required multiplier.)

In the same manner, either from the table direct or by an application of the formula, the electrical horse power may be found for any combination of volts and ampères.

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ON THE RESPECTIVE MERITS OF CONTINUOUS AND ALTERNATING CURRENTS.

The question has been very often discussed whether it is preferable to make use of continuous or alternating currents in an installation of any importance; the question has been for some time to the fore, and the most celebrated electricians have held diverse opinions as to the respective merits of the two systems.

Undoubtedly each system has its advantages and its demerits, and the recent progress made in alternating currents has placed them in a position to hold their own in the controversy.

If we discuss the matter, says M. Dubourg in *La Lumière Electrique*, it is because we have seen in a foreign publication (*Elektrotechnisches Echo*) a lengthy argument in favor of continuous currents and accumulators, which appears to us sufficiently interesting to be reproduced.

The article commences with an exposition of the system of continuous currents with 2, 3, and 5 conductors. We quote from the principal passages.

In the old central stations the radius of distribution does not extend beyond 500 metres. The conductors in the dual conductor system are not so costly as to furnish an argument for their abandonment.

Their weakness is in the area of distribution, which makes it necessary, generally speaking, to instal the central stations in the quarters to be lighted; that is to say, in the most populous quarters.

The invention of transformers has furnished a method of transmitting electricity from a single station even to out-of-the-way quarters. True it is that to do this it is necessary to waive some of the advantages obtainable from continuous currents when employed with the dual conductors. It is necessary that the primary conductors should be worked at a high tension, and, consequently, that transformers should be introduced to form an intermediary; thus introducing a new cause of accidents and losses. It has been found necessary to abandon the use of the continuous current to some extent.

The progress made in transformers has compelled a corresponding advance towards perfection in the system of continuous currents by making the principal conductors work at the highest tension, thus allowing for a diminution of the section of these conductors.

From this has resulted the system of three and finally of five conductors; from it also we have the system of indirect distributions with the aid of secondary generators, as well as accumulators, transformers of continuous currents, and dynamos for transmission to long distances.

We will not speak of the two last because, within our knowledge, their employment has not been successful so far. The principle of the three-lead system is as follows: There are always two groups of lamps in the principal circuit, and these are joined together in a series. These groups are connected together by a conductor which derives all difference of potential from the side of the dynamos where the tension is least.

In placing the lamps in a series of twos we can make use of conductors of a section which is less by half, and afford a loss of tension double that of the dual conductor system; it will be enough therefore if the principal conductors have one-fourth the diameter which they would otherwise have.

We will now point out a primary drawback—viz., that instead of one large dynamo we must make use of two small ones, and consequently we shall require duplicate measuring apparatus and commutators. Further, it will be necessary always to have the same number, more or less, of lamps working in each half of the circuit, as otherwise there will be no compensation.

It is possible to imagine the three-conductor system in another form: Instead of two dynamos in circuit, each of them with 100 *volts* difference of potential, we have one large dynamo with a double E. M. F.

However, as in this case the conductor-compensator cannot be led up to the dynamo, it will become necessary to insert in both parts of the circuit an absolutely equal number of lamps. But as in practice, even with an excellent installation, this is hardly possible, it will also become necessary to insert resistances into the part which has least current, and to keep them there until the currents in both portions become equal. The best compensation resistances will be found to be batteries of accumulators, because they give back a part of the stored-up energy, and allow of a part of the electricity they have received being used, and that directly their circuit receives an excess of current.

One advantage of the three conductors over the two-conductors system is that it allows of the current being economically distributed within a radius of 1,200 metres. The disadvantages of the system—which, however, are not fundamental—are: that the electro-motive force of the electric installations of the central station is a little higher, the regulating is a trifle more complicated, and the installation for large buildings is rather more costly, it is necessary to introduce the three conductors into each building, and that the lamps must be divided into two groups.

Siemens and Halske say that with the three-conductors system it is possible, without augmenting the cost of the wire, to dispense with the resistance adjustment for the principal conductors; and they say this will mean a great simplification in the regulating apparatus.

M. Schuckert admits that the system allows of economy of wire as compared with the two-conductors system; but he prefers the latter as being the more simple to instal, and as offering greater security in use.

On the other hand, the Helios Company, of Cologne, instances two cases of installations in which the conductors were destroyed by polarization of the dynamos.

The five-conductors system is only the logical development of the three-conductors system. It is composed of two portions, having each three conductors, and placed in series. It has been recommended by Siemens and Halske. It may be worked either with the separated dynamos, as in the case of the three-conductors system, or with one dynamo and four compensation resistances, or four batteries of accumulators.

The tension in the principal conductors is about 400 volts; that between the two neighboring ones is about 100 volts.

The branching off of the conductors may occur at a subordinate station, and, in certain cases, one may fix the place for producing the current at a distance from the distributing zone.

The central conductor may, if necessary, be divided into two, so that on either side of the road three conductors shall pass, each side being served by its line of three cables.

So far, we have no really practical experience of this system; further, its application has been very contradictory.

Siemens and Halske, thanks to an ingenious combination of accumulators and of incandescent lamps placing themselves in circuit automatically, thanks also to the method of disposition invented by Thompson, hope to be able to maintain without difficulty an equal tension in the four circuits of consumption.

If we may believe them, the laying of the canalization is not more complicated than in the three-conductors system, since the distributory conductors are composed of three wires.

Mr. Miller observes that the cost of the system is greater in consequence of the great number of points from which the current is taken; of the very great number also of apparatus needed for the measuring, circulating and regulating of the current; of the very great costliness of house installation, and of the necessity for distributing the consumption in four equal portions. The difficulty of distributing the current and of regulating it will limit the application of the system unless recourse is had to accumulators.

According to the Helios Company of Cologne, the five conductors system is a very dangerous one, owing to the 400 volts tension which it demands. This system, according to the writer in the *Elecktrotechnisches Echo*, permits of a rational distribution of energy to a distance of 3,000 metres from the central station. On the same authority we learn that stations on this system are going to be established at Trent, Vienna, Paris, and Kœnigsberg in Prussia.

As regards Paris we believe the Clinchy section is the one which has been chosen for this purpose, but we do not know whether the plan will be carried out. There is nothing to prevent the employment of systems with more than five conductors for the distribution of continuous currents, but then the ramification at the points of consumption and the maintenance of the tension would be very difficult. The number of conductors of batteries of accumulators or of resistance required would be so great that this method of direct distribution of the current may provisionally be looked upon as impracticable. Furthermore, the commutator, which is part of all continuous current machines, will, practically, not permit of the production of currents at a very high tension.

It is possible, however, to achieve this high tension, not merely by direct ramification, but also by the aid of transformers and of secondary generators, especially with the assistance of batteries of accumulators.

We have, for example, ten groups of accumulators inserted in successive series; from a distant station they are charged with 1,000 volts tension; for the discharge they are grouped in parallel, and arranged in the lines of distribution at 100 volts tension. According to our authority, there are many partisans of the alternating current, even, who admit that this system would be the better did not the accumulators leave so much to be desired as regards their price and the loss involved, for which, so far, no remedy has been discovered.

Mr. Kittler proposes to organize the central station at Frankfort with alternating currents, with the design of ultimately transforming it according to the principle above mentioned.

Another function reserved for accumulators is to serve as a reservoir in case of disturbances taking place in the working of the dynamos. With accumulators in reserve in the secondary stations, we could better count upon being able to furnish the light without fear of sudden interruption; moreover, the dynamos would be considerably relieved during the evenings, so that the installation of the machines could be reduced; and, furthermore, the principal conductors might be smaller; lastly, the day service and the late night service, which are so costly without accumulators, might become economical.

The day service without accumulators is as expensive as having a great number of central stations, especially those which make use of alternating currents, suspending the service during the day.

The author of the article in the *Echo* mentions some criticisms on the employment of accumulators.

Siemens and Halske estimate that, the factories being only in full work during one or two hours of the night, the employment of accumulators will admit of the equalization or regulation of the work.

They, therefore, recommend the use of accumulators where the consumption is great.

M. Ruhlmann thinks that in a region where electric energy is constantly at work accumulators are not needed, except in a small num-

ber of cases, such as for relief lighting in case of sudden extinction, and for electrolytic applications.

According to the Frankfort Commission, it is better, in a large installation, to have reservoirs of electricity than to have large machines working during the day. When the consumption falls off motors will be utilized in charging the accumulators; but in order to obtain all the results possible, they must be distributed among divers points, such as secondary stations, in order to relieve the cables.

It should be mentioned, says the author, that the advocates of continuous currents exaggerate the cost of the depreciation and working of the accumulators.

He enumerates the advantages of the continuous current system as follows:—

1. The continuous currents are extremely economical in work, and they may be placed in circuit as desired.

2. The slight tensions employed render the danger of death or fire much less.

3. The arc lamps fed by continuous currents are irreproachable; they burn steadily and noiselessly.

4. The motors cannot be too highly praised; it is equally easy to maintain a constant speed as to vary this speed at will.

5. It is possible to accumulate electric energy and apply it to various purposes.

The author then enumerates the demerits of the system.

1. The central station must necessarily be in the centre of the region supplied.

2. The zone of distribution is limited—that is to say, unless we choose to employ conductors at a price out of proportion to the profits, or to suffer enormous leakage of electricity.

3. The system is too costly for use in sparsely populated quarters.

4. The arc lamps fed by the continuous currents must be connected in series of twos, or the energy of the one must be taken up by a resistance.

The author deals with an objection taken by the Frankfort Commission, viz., that the degree of efficacy of the electrical apparatus of a central station is only shown by the amount of coal consumed, and that this represents only a feeble proportion of the total cost of the establishment and of the distribution of the electric current.

This assertion is in accordance with the facts, but it might lead persons, whose knowledge of the whole question of central stations is slight, to believe that the quantity of coal is of little importance from the point of view of the profits to be made out of the enterprise, which is not the case.

The salaries, the cost of repairs, interest and depreciation for a well-installed central station are absolutely invariable in amount. That which varies with the activity of the factory is the cost of working, and not merely the consumption of coal. This cost of working, together with the wear and tear of the lamps, is the only thing which is variable in the installation, the receipts being fixed. The profits of the enterprise vary only in consequence of the variation of the cost.

Let us now proceed, with the author, to examine the disadvantages of stations working with continuous currents:

1. The necessity for the central station to be in the centre of the area supplied.

Land is costly. But for an ex-central station the cost of conductors and the uncertainty as regards the regularity of the lighting are greater in direct proportion to the distance. *Per contra*, the five-conductors system, being capable of supplying a radius of 3,000 metres, it is possible to place the central station at a considerable distance away.

Furthermore, whichever system be employed circumstances will arise to make the acquisition of this or that piece of ground necessary.

The noise made by the plant depreciates the value of the surrounding property. By making solid foundations and by making use of large slow speed direct action dynamos, this drawback may be lessened, if not got rid of altogether. The working of the central factory will not be found more troublesome than is the case with numerous other enterprises, especially if towards the end of the night accumulator working is used.

There is the fetching of the coal and the carrying away of the cinders, and these obstruct the roadway. The reply to this is that as the carts are loaded and unloaded in the frctory yard the general traffic is not impeded. Sometimes, in carrying the coal, &c., it becomes necessary to make detours by which the net cost of coal is increased.

It is difficult to obtain water for condensing purposes, nor is there any outlet for it after use. We may observe that the factory should always be built where water is procurable; as regards the second objection it will very rarely occur.

The smoke is sometimes a nuisance to the neighborhood. This objection may be completely obviated; witness the central factories at Berlin.

There is danger from the explosion of the boilers, especially in the case of stations where the number of boilers is considerable. But has not a central factory more interest in avoiding explosions than any other, since the least irregularities will have their immediate consequences on the production of light?

The zone of distribution is limited as regards the present, unless we choose to employ conductors at a price out of proportion to the profits, or to submit to an enormous leakage of electricity; but this objection applies also to gas.

The author advances another objection, viz., that if private individuals take to installing electricity in their houses it will mean so many clients less later on. This is evident: but when later on the central station comes to offer its services to these people they will have recourse to it if it is worth their while.

An important question for large towns is whether the central station should be divided into several stations, or whether it is practicable to have secondary stations. Directly a central station oversteps a certain limit, it necessitates almost as many inspectors and *employés* as two small stations conveniently placed.

The cost of working is not considerable; there is only the cost of the first establishment, which is slightly lower. The division has the advantage of securing a much greater regularity in working; since should it happen that one of the central stations suddenly stops work, many quarters could be supplied by the second station, supposing that the two lines meet; and if by an accident one of the stations should be disabled, one could even provide for an intermediary supply of electricity in a combination of lines. During the day the electricity could be supplied by one station only, whilst the others were at rest.

When these two systems were contending for the lighting of London, it was insisted that it only required the breaking of the principal cable—caused, for example, by the falling in of a tunnel through which the conductors pass—in order to plunge an entire town in darkness. It is necessary, also, to take into account accidents due to malevolence.

THE WEST END RAILWAY OF BOSTON.—This road is meeting with great success as an electric railway. The open winter is very favorable to the carrying on of the work of extending the line. Everybody in Boston seems to be of one mind, and that is that the road is a great success.

Carnegie, Phipps & Co.'s steel works at Beaver Falls, Pa., are to be illuminated throughout by electricity.

ELECTRIC PATENTS ISSUED JANUARY 21ST.

419,618. Electric railway system. Thomas E. Adams, Cleveland, Ohio.

419,633. Galvanic battery. Wm. Burnley, North East, Pa., assignor of two-thirds to Chas. A. Hitchcock, same place, and Samuel A. Davenport, Erie, Pa.

419,642. Insulator for Electric Wires. Isaac P. Cornog, Philadelphia, Pa.

419,645. Telephone Circuit and Apparatus. John N. Culbertson, Buffalo, N. Y., assignor to the American Bell Telephone Company, Boston, Mass.

419,660. Electric Commutator. Ludwig Gutmann, Fort Wayne. Ind.

419,661. Dynamo Commutator. Ludwig Guttmann, Fort Wayne, Ind.

419,662. Electric Commutator. Ludwig Guttmann, Fort Wayne, Ind.

419,663. Method of producing alternating Electric Currents. Ludwig Guttmann, Fort Wayne, Ind.

419,664. Alternating current Motor Regulator. Ludwig Guttmann, Fort Wayne, Ind.

419,673. Electrical Railway System. Thos. H. Hicks, Detroit, Mich., assignor by direct and mesne assignments to the Electrical Invention Company of Michigan.

419,674. Shield or Protector for Electric Conductors of combined gas and electric fixtures. John C. Hollings, Boston, Mass.

419,709. Electric Railway System. Charles Richter, Camden, N. J.

419,710. Electric Protector System. Arthur C. Robbins, Brooklyn, N. Y.

419,727. Method of treating secondary battery plates. Charles Sorley, New York, N. Y., assignor to the Anglo-American Electric Light Manufacturing Company of West Virginia.

419,728. Electrode for Secondary Batteries. Charles Sorley, New York, N. Y., assignor to the Anglo-American Electric Light Manufacturing Company of West Virginia.

419,730. Galvanic Battery. Lucius T. Stanley, Brooklyn, N. Y., assignor to the Stanley Electric Company, Philadelphia, Pa.

419,731. Portable Faradic Battery. Lucius T. Stanley, Brooklyn, N. Y., assignor to the Stanley Electric Company, Philadelphia, Pa.

419,733. Cut-Out. Charles B. Story, Brunswick, Me.

419,740. Electro-Thermal Current Regulator. Frank C. Wagner, Ann Arbor, Mich.

419,753. Electric Locomotive. William H. Darling, New York, N. Y., assignor of two-thirds to Leo Bock, Jr., and Gardner P. Harrington, both of same place.

419,766. Electric Door Opener. Ado Glaeser, Brooklyn, N. Y.

419,771. Overhead Contact and Switch. Robert W. Hawkesworth, East Orange, N. J.

419,774. Galvanic Battery. William E. Irish, Cleveland, Ohio, assignor to the Irish Electric Company, same place.

419,776. Electrical Clock. Ansel B. Jones, Cleveland, Ohio.

419,805. Thermo-Dynamic Motor. Carl W. Weiss, Brooklyn, assignor of one-half to Chas. Kruse, New York, N. Y.

419,808. Electric Motor. Le Roy S. White, Waterbury, Conn.

419,829. Electric Lamp. Sam B. Cobb, Chicago, Ill.

419,841. Electric Railway. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place.

419,861. Electric Reciprocating Tool. Harry N. Marvin, Syracuse, N. Y.

419,902. Automatic Fire Alarm. Eugen Wider, Stuttgart, Wurtemberg, Germany.

419,923. Electrical Conductor. Hiram H. Carpenter, New York, N. Y.

419,986. Mechanical Telephone. Robert C M. Bowles, Boston, Mass.

GAS BATTERY.

The purpose of this invention is the direct conversion into electricity of the energy contained in gases by means of the apparatus described below.

Attempts in this direction have already been made at different times, but all unsuccessfully, in part, on account of the unsuitable construction of the apparatus proposed, and in part from the use of the gases in wrong proportions.

All gases or vapors may be applied in pairs so that their reaction in a battery of suitable construction may yield an electric current. I use by preference either two gases, each belonging to one of the classes *a* and *b*, or a gas and a liquid.

The gases may be: *a*, hydrogen, water gas, generator gas, coal gas, or all the vapors of the more or less volatile hydro-carbons of mineral oil, such as petroleum, gasoline, naphtha, etc.; and, on the other hand, *b*, air, oxygen, chlorine, fluorine, etc.

In the cases where I use a gas and a liquid, the one selected is used in place of a gas of the class *b*.

Hydrogen peroxide (H_2O_2) or nitric acid is suitable.

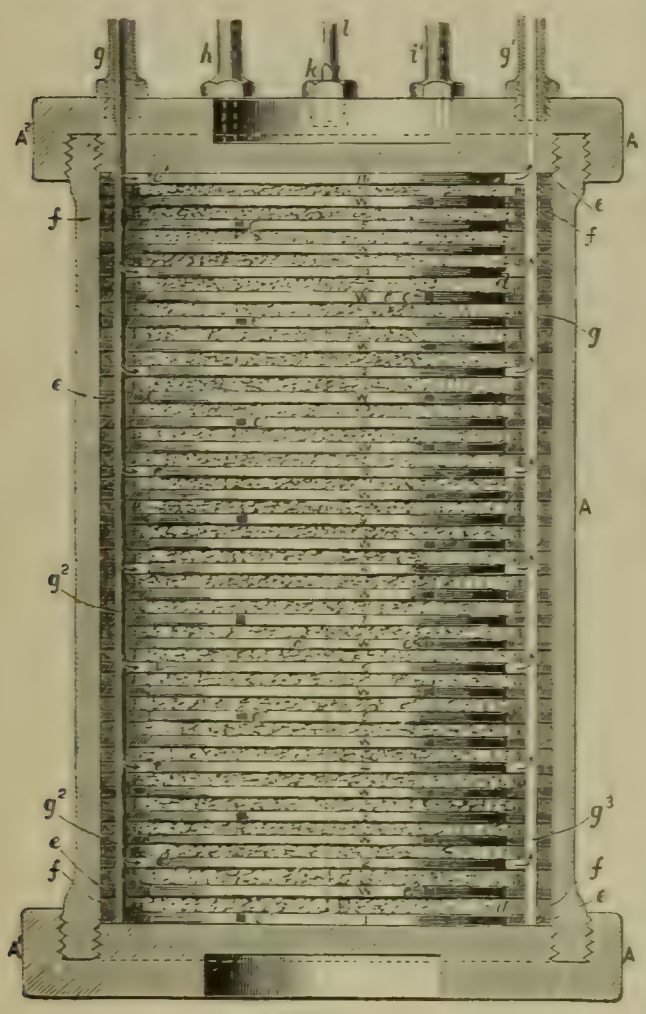


FIG. 1.

The above-named gases of either or of both classes may, as described below, be used either in their natural state or compressed into a liquid, preferably water.

It is especially important that all the gases which I employ are not generated in my apparatus itself, but independently according to any known or customary process.

Two gases having the properties above mentioned—*e. g.*, coal gas on the one hand and oxygen or air on the other—are generated or stored separately. Each gas is then forced into a special holder—a pressure reservoir—in which a pressure of any required height can be maintained as nearly constant as possible. The pressure is given to the gases by any known apparatus, pumps, etc., and preferably direct. Each of the gases is then passed under pressure into the battery or current generator to be described below, where they remain at equal pressure, and still separated from each other by the electrodes.

The pressure may be strong enough to liquefy either or both gases, though this is not necessary for the result. Or the gases, or either of them, may be condensed in a liquid, such as water, and introduced into the cells.

Such a battery is shown in the accompanying figures, where fig. 1 shows a longitudinal section, and fig. 2 a plan and section of a single electrode with its contact

The apparatus consists of a holder A, preferably of metal, and of any desired form. I have given it here, as the most suitable, a cylindrical form. The holder, A, is provided with a bottom or cover, A, A, by means of which it can be closed hermetically, either with screws or in any other known and suitable manner. In this holder, A, are the cells, formed each of two electrodes, *c*, the latter forming an interval. As electrodes, I use porous carbon in plates or any other form; here, *e. g.*, they have the form of discs, to suit the receiver, A.

Each electrode, *c*, is enclosed by a metal ring, *d*, which is preferably (as shown in fig. 2), provided at one part with a projection, d^1.

This ring serves exclusively for securing a good contact for conducting the electricity into the two polar wires, and can, therefore, be replaced by a piece of any other conductive material of any other convenient shape, which can be connected with the carbon.

Any oxidation or formation of salt at the surface of contact of the ring, *d*, or its substitutes, arising from the penetration of the reagents in the porous electrode, may be prevented by closing the pores near the surface of contact with paraffin.

In order to keep the electrodes, *c*, at suitable intervals for the formation of cells, there is placed between each two electrodes an insulation, *e*, of hard caoutchouc, pressed paper, or any other insulating mass, which must fit accurately and closely

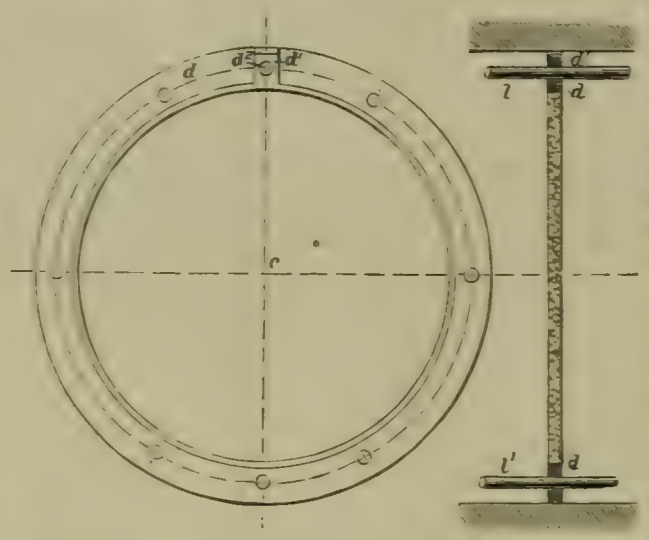


FIG. 2.

into the recipient, A. After prolonged experiments I have succeeded in finding a mass which fulfils in the best manner both purposes of the rings, *e*, *i.e.*, insulation of the electrodes and rendering the recipient, A, compact. It is asbestos. I use rings moulded of asbestos, or cut out of plates which have been already employed for similar purposes. The electrodes, *c*, which with their rings, *d*, are smaller in diameter than the internal diameter of A, and are also surrounded by insulating rings, *f*, of hard caoutchouc, or preferably of asbestos, fitting closely on the insulating rings, *e*. As it may be seen from fig. 1, a number of electrodes with their metallic divisions and insulating rings, form a series of cells separated from each other. Every alternate interval, *w*, *i.e.*, the space between every two cells, is completely filled with a liquid conductor, for instance acidulated water.

These intervals, instead of being filled with a liquid conductor, may contain porous non-conductive bodies, plates or discs in which the liquid conductor is absorbed and thus effects a connection between the electrodes.

All the cells of even numbers 2, 4, 6, 8, etc., contain one gas, and the odd cells, 1, 3, 5, 7, etc,, the other. All the electrodes which form cells for the same gas are in conductive connection with each other.

The introduction and removal of the gases and the water into and from the cells is effected as follows; the cover or one end of the recipient, A, is provided with eight apertures. Of these, *g* is the one gas inlet (*e g*, hydrogen) and g^1 the corresponding outflow; *h* is the other inflow for gas (*e. g.* oxygen) and h^1 the corresponding outflow; *i* is the inflow and i^1 the efflux for the acidulated water.

At *k* and k^1 are the two negative and positive polar clamps corresponding to the apertures *g*, g^1, *h*, h^1, *k* and k^1; all the insulating and tightening rings of the apparatus are provided with apertures which coincide with each other so as to form the channels g^2, g^3, h^2, h^3, etc., through which the gases or the acidulated water flow in or out. Each of the insulating rings, *e*, is traversed inwardly by one of the influx or efflux channels, or provided with a notch, e^1 or e^2, by which is effected a communication of the channel in question with the interior of the cell formed by the insulating ring affected. Each cell and each interval has thus an influx and an efflux aperture, e^1 and e^2. The hydrogen—*e. g.*, here employed—is introduced at *g*, passes through the channel, g^2, and enters the cells, 2, 4, 6, 8, etc., through the apertures, e^1, e^1, e^1. It fills the cells and passes out through the openings, e^2, e^2, e^2, into the exit channel, g^3, leaving the apparatus at g^1. Here, as at the other efflux openings, h^1 and i^1, a pressure valve must be applied in order to regulate the flow. As such valves are well known articles of trade, they need not be here described. The filling of the cells, 1, 3, 5, 7, with the other gas and that of the intervals, *w*, with acidulated water are also effected in the manner just described. The electric conduction to the poles, *k*, k^1, is effected as follows:

The projections, d^1, of the metal rings, *d*, or the connecting pieces in place of the latter, are perforated in such a manner that a metal rod, *l*, passes through each of these apertures, d^2, or rings, *d*, or through those of the substituted connecting pieces. The electric connection of the electrodes with the two polar clamps, *k* and k^1, is effected by means of the two metal rods, *l*, l^1, which proceed from the latter, pass through all the insulating rings in the apparatus, and are in contact with the corresponding electrodes by means of the projections, d', of the rings, *d*, through the openings of which they pass. The pressure at which the liquid conductor (*e.g.*, acidulated water) is passed into the intervals depends on the pressure of the gases in the cells; hence the influx and efflux of the water as well as of the gases must be regulated by valves.

The apparatus may be simplified as follows:—Instead of using cells from which the gas passes into the electrodes, the electrodes themselves may be connected with the gas inlet in the apparatus, so that the gases pass direct into the pores of the electrodes, which thus, in connection with the liquid conductor, produce the same effect as that of the arrangement above described. The cells 1, 2, 3, 4, 5 for the gases are thus dispensed with, whilst the position of the electrodes remains the same, since they are only separated by the intervals containing the liquid conductor.—Paul Scharf in *Zeitschrift für Elektrotechnik.*

The Broadway line of electric cars in St. Louis has begun operations after 18 months of experimentation. They are running regularly to the satisfaction of the company.

THE ELECTRIC LIGHT IN BOSTON. — Boston is very much agitated over the electric light question. The principal cause of discontent is the fact that the Suburban Light and Power Company has secured the contract for lighting the city, over the heads of the two older companies. Efforts are being made, no doubt backed by the latter companies, to have a reconsideration of the contract. Another objection is the fact that the wires are likely to be strung overhead, and as the company proposes to use the alternating high tension current, Bostonians do not relish the idea of permitting any risks to be taken. There are good grounds for this objection, too, when it is considered how narrow and crooked the Boston streets are. Its geographical deformities would necessitate the crowding and crossing of overhead wires. There is good reason, however, to believe that sooner or later the wires will be put underground.

ELECTRIC LIGHTING REGULATIONS IN LONDON.

The regulations proposed by the London Board of Trade for electric lighting require that the maximum working current in any conductor used in connection with the supply of energy shall not be sufficient to raise the temperature of the conductor in any part to such an extent as to materially alter the physical condition or specific resistance of the insulating covering, if any, or in any case to raise such temperature to a greater extent than 30° of Fahrenheit's thermometer, and efficient automatic means shall be provided, which shall render it impossible for this maximum working current to be by any accident exceeded to the extent of 25 per centum, even for short intervals of time; and special care shall be taken that the cross-sectional area and conductivity at joints are sufficient to avoid local heating, and that the joints are protected against corro ion.

Conductors used for a high pressure supply shall be either separately or collectively completely enclosed in wooden pipes or casing, not less than one-quarter of an inch in thickness, placed in efficient connection with the earth, either throughout their length, or at points not separated from each other by more than 100 yards. Provided that where the conductors pass through any junction or draw-box, which is not also used for low pressure conductors, the portions so passing through such junction or draw-box need not be so closed.

Every conductor used for high pressure supply must be continuously insulated with a durable and efficient material, to be approved by the Board of Trade; and the insulation resistance of any high pressure conductor, including joints, shall not be permitted to fall below fifty megohms per mile. This insulation must be further efficiently protected on the outside against injury or removal by abrasion. Provided that when one of the two conductors forming the line and return for any circuit or part of a circuit completely incloses the other conductor, the outer conductor, if efficiently connected to earth at the source of supply, need not be continuously insulated except to such extent as may be necessary to avoid disturbance to other lines or works.

Except where concentric conductors are used as provided in the preceding regulation, the insulation resistance of any complete circuit used for high pressure supply, including all devices for producing, consuming, or measuring energy, connected to such circuit, shall be such that should any part of the circuit be put to earth, the leakage current shall not exceed $\frac{1}{25}$th of an ampère in the case of continuous currents, or $\frac{1}{50}$th of an ampère in the case of alternating currents. Every such circuit used for high pressure supply shall be fitted with an indicating device, which shall continuously indicate if the insulation resistance of either conductor fall below the conditions required by this regulation.

In the case of a high pressure supply on any alternating current system, where separately insulated conductors are used, precautions shall be taken against the discharge of electric sparks between the insulating covering of oppositely charged conductors, by providing a sufficient connection of a conducting nature between these coverings throughout

Where any portions of any conductors belonging to the undertakers are exposed in such a position as to be liable to be struck by lightning they shall be sufficiently protected by appliances of such pattern and construction as may from time to time be prescribed or approved by the Board of Trade.

Conduits.—All conduits used as receptacles for conductors shall be formed of durable material, and of ample strength to resist any reasonable pressure due to heavy traffic, or other forces to which they may be subjected.

Where the conductors in any circuit are not sufficiently insulated, the conduit must be efficiently drained, so that no accumulation of water can take place in any part sufficient to raise the level of the water into contact with the conductors.

All conduits for conductors laid in streets, in which gas mains are also laid, must be thoroughly ventilated, or otherwise efficiently protected against an accumulation of gas.

All street boxes, manholes, junction and draw-boxes must be efficiently drained and vent lated and their covers so secured that they cannot be opened except by means of a special appliance.

NEW BOOKS.

Messrs. Munn & Co., of 361 Broadway, have just issued a book which is one of the most valuable and interesting of its kind ever published. Its title is "Experimental Science," and the author is the well-known scientist, Mr. George M. Hopkins.

This book treats of the various topics of physics in a popular and practical way. It describes the apparatus in detail, and explains the experiments in full, so that teachers, students, and others interested in physics may readily make the apparatus, and perform the experiments without difficulty.

The aim of the writer has been to render physical experimentation so simple and attractive as to induce both old and young to engage in it for pleasure and profit. A few simple arithmetical problems comprise all of the mathematics of the book. Many new experiments are here described for the first time.

To the student is presented a world of material that will help him on in his scientific studies and render his work light and agreeable, rather than dry and monotonous.

The amateur electrician will here find simple instructions in the measurement of resistance, and of electro-motive force and current strength; the best arrangement of batteries; the construction of dynamos and motors. He will also find the principle of the dynamo, the telephone, and other electrical machines and apparatus fully explained.

Altogether the book is one of a very practical character, and no one of a scientific turn of mind could fail to find in its pages an unlimited fund of valuable information. Of the various subjects treated, electricity in all its branches is given a large share of the room. Magnetism is discussed first and is illustrated in a manner that is at once instructive and pleasing. Usually such abstruse subjects are considered very dry, but this cannot be charged as a fault in this case. The illustrations at once impress us with the idea of interest in the subject, and this fact no doubt more than any other will help the sale of the book wonderfully. After magnetism comes frictional electricity, which is profusely illustrated in just as interesting a manner as the previous subject. Dynamic electricity comes next in order. The subject begins with the action of the simple galvanic cell, and an illustration thereof shows, in an exceedingly clear manner, the evolution of oxygen and hydrogen at the immersed plates The various kinds of practical batteries are next described and illustrated. Secondary batteries are next considered and very clearly illustrated. The arrangement of battery cells in the various ways, for quantity or potential; electrical measuring apparatus and rules for measurement follow with the same distinctness, and then we approach the region of dynamos and motors. This last subject is treated with a completeness and clearness that make the book worth its price for this section alone. The chapter on electric lighting is in these days by far the most valuable in the book, and to this we feel compelled to give a more extended review. The Weston dynamo is shown first, with a diagram showing the circuit in and construction of the armature. The feed mechanism is also shown in a very clear manner. The Edison system then receives a good share of attention and is fully and well illustrated. The three-conductor system is well set forth. Then follows the system of the Westinghouse Company, with illustrations of their alternating current dynamos, transformers, etc. Induction is the subject of the chapter following that on electric lighting, and the applications of the phenomena are in the same able manner set forth. The section on electricity is concluded by a chapter on the telephone. microphone and electrical magic.

While the electrical section of the book will be of great value to all interested in any way in electrical matters, there is very much more in the book outside of electrictty, but within the domain of physics, that will interest even electricians, who are supposed to be so wedded to their branch of science as to lose interest in everything else. They will find much in this book that will help them in many ways in the prosecution of their studies and investigations. The book has 740 pages and 680 illustrations. Price, $4.00, post-paid. For sale by The Electric Age Publishing Company, 5 Dey street, New York.

Telephones Cut Out of Public Offices.—An employe of the Chicago Telephone Company walked into the City Clerk's office, in that city, a few days ago and asked to be shown the general telephone. It was pointed out to him, and in five minutes he had the wires cut and had walked off with the instrument. All the other city departments were served in the same way. The company claims that the city has not paid for the use of the telephones; but an official said that when the company was granted the privilege to string its wires a condition was that the city departments were to have telephones free of charge.

A Big Treat for the Delegates.—The delegates to the National Electric Light Convention at Kansas City next month will probably make a portion of their trip on a train drawn by an electric motor. The Woodward Electrical Company, of Detroit, are now getting up the equipment, and propose to convey the delegates to Chicago by electric power over the Michigan Central road. The motor is of new design, the details of which are not yet made public, but the promoters are confident of the success of their enterprise.

Electric Welding.—The war department of the United States government has ordered a Thomson welding machine for the Watervliet arsenal at Troy, to be used in welding wire for the manufacture of rifled cannon. A commission from the navy department is expected in Boston in February to examine the electric welding process and report upon its adaptability to the welding of boiler flues, etc., for the government cruisers. The commission will also test a chain welder for the Charleston navy yard.

Patent Decision.—In a recent decision by the United States Supreme Court, in a patent case, a principle was decided which has an important bearing on electrical inventions. The Court ruled that a patentee will not be permitted to say that certain specified elements of his combination claim are not essential to the combination. An alleged combination which consists in a mere aggregation of parts, each to perform its separate and independent function substantially in the same manner as before combination with the other and without contributing to a new and combined result, is not patentable.

General Manager T. F. Clohesey, of the Interstate Electrical Company, Kansas City, Mo., reports business unusually brisk. This company owns the electrical accumulator patents for this section of the country.

The Kansas City Electrical Society has adopted an admirable constitution and by-laws, and it is expected that the society will be prosperous, as the electrical fraternity is heartily supporting it. Headquarters containing a complete electrical library are being established.

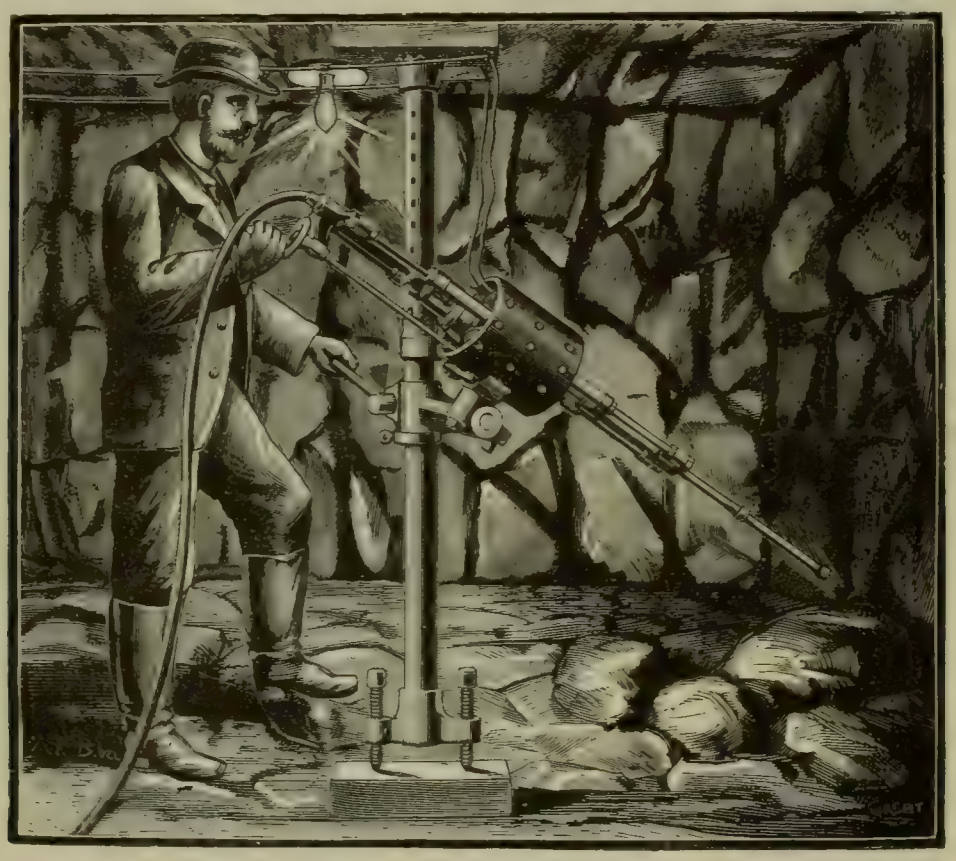
An electric railway and light company has been organized at Vancouver, B. C.

It is reported that a carbon factory is to be erected at Peterborough, Ontario.

ELECTRIC ROTARY DIAMOND DRILL.

The accompanying view shows a new electric mining rotary drill which has shown very good results in experimental work, and which will soon be applied to regular mining work in several leading mines.

A good electric mining drill has always been desired by miners, and this drill seems to meet all the requirements. It is light, compact, simple and easy to operate. The motor is completely encased, so that it is impossible for dust, dirt or stray stones to lodge in the working parts. The whole drill is mounted on an adjustable frame, so that it can be very easily set in any position desired, or set at work at any part of the mine. The current for operating the drill is supplied at a constant voltage or potential; the number of volts depending on the potential used for transmitting power throughout the mine. If lamps are needed, they can be supplied with current from the same wires which supply current to the drill, and when in such use are connected in multiple arc across the main current wires



ELECTRIC DRILL.

These drills are manufactured and sold by the Sprague Electric Railway and Motor Co. of New York, under patents granted to Mr. I. E. Storey. We understand that the Sprague Company is now at work on, and will soon be able to furnish a number of special mining applications, among which are an electric percussion drill.

PRODUCTS OF THE EDISON WORKS.—There were over 2,500 dynamos and motors manufactured at the Edison machine works, at Schenectady, during the year ending November 1st, 1889. At the Edison Lamp Company's factory at Harrison, N. J., between 7,000 and 8,000 lamps are produced a day. As many as 11,000 lamps can be turned out in one day in case of necessity. The United Edison Manufacturing Company has been reorganized, and is now working with a capital of $1,000,000, $500,000 of which has been paid up. The Canadian Edison Manufacturing Company has charge of the Edison manufacturing business, except the making of lamps, in Canada. Its shop is at Sherbrooke, near Quebec. The Sprague Electric Railway and Motor Company has at present in use 3,000 of its motors. The number of street railway cars equipped with electric motors during the last year by the company was 551.

THE INTERIOR ELECTRIC CONDUIT COMPANY.—Mr. Frank Kitton, inspector of the Buffalo Board of Fire Underwriters, states that he has examined the system of the Interior Electrical Conduit Company, and has made many tests as to the fireproof and waterproof qualities of their conduits. He approves and endorses it highly for use in his jurisdiction. The residence of Mr. Elihu Thomson, of the Thomson-Houston Company, is wired by the Interior Electrical Conduit Company's system, and in speaking of it Mr. Thomson says: "It is one of the best means of electrical wiring, and it has my full endorsement."

PHOTOGRAPHING RIFLE BULLETS.—Rifle bullets are now photographed in their course by means of the electric spark. The camera is taken into a dark room, which the bullet is caused to traverse. As it passes the camera it is made to interrupt an electric circuit and produce a spark which illuminates it for an instant and enables the impression to be taken. The wave of condensation in the air before the bullet and the rarefaction behind it are visible in the photograph, and can be studied by experts, thus enabling the form of ball or rifle which minimizes the resistance of the air to be selected.

THE FRENCH TELEPHONES.—There is now, and has been since their acquisition by the State, considerable agitation regarding the French telephones and their working. The government has been almost overwhelmed with complaints, regarding which a French contemporary says: "Considerable discontent exists among the Parisian public, which at last sees that the question has been badly studied and badly understood, and that it is likely to become liable to feudalism, on account of the monopoly which has been demanded to satisfy State socialism."

A CABLE TO SAMOA.—It is reported from Berlin that German, American and Dutch bankers intend to lay a cable from San Francisco to Tutuillo, in Samoa. That would greatly promote the extension of cable service around the world, for it would hardly pay to stop at Samoa.

TELEPHONE ENTERPRISE.—The recent cyclone in St. Louis disabled 656 wires of the telephone company. By the aid of calcium lights the work of repair was prosecuted at night, and in 48 hours all damage was repaired.

ELECTRIC LIGHTING IN OMAHA.

The recently reorganized Thomson-Houston Electric Light Company is now engoged in the erection of a commodious and substantial power house at the foot of Jones street. The building is to be three stories in height, of brick and stone, supplied with every modern mechanical and electric convenience. There will be a battery of boilers for creating steam of a combined capacity of 2,400 horse-power. The boilers will be supplied with automatic stokers and other labor-saving inventions. Three ponderous engines will be set up, two of 500 horse-power each, and one of 200 horse power to commence with, with others to follow. Fourteen new dynamos for creating the electrical current have been ordered. They will be able to furnish power to small manufacturers having light machinery to run, such as sewing machines, small printing presses, machine shops, etc. Electrical motive power has proven a success in establishments requiring less than twenty horse-power. It is not only a success, but a great saving. An electrical motor takes up but a small amount of space in a manufacturing establishment. It dispenses with coal bins and licensed engineers, saves fuel bills and the salary of help necessary where steam engines are used. Omaha's city council has entered into a contract with the new Omaha Thomson-Houston Electric Light company to light the city by electricity. On February 15 the contract goes into effect and over 100 arc lights must be in operation. The company expects to be in readiness to comply with their part of the contract by February 1. To construct the circuits for street lighting, $50,000 has been expended, and forty men have been busily employed and will be until everything is completed and in readiness to comply with the contract. Twenty-seven miles of wire will be used. The local Thomson-Houston company is backed by an abundance of Omaha and Boston capital. S. L. Wiley is president and general manager of the company, and Frank Warren secretary and treasurer.

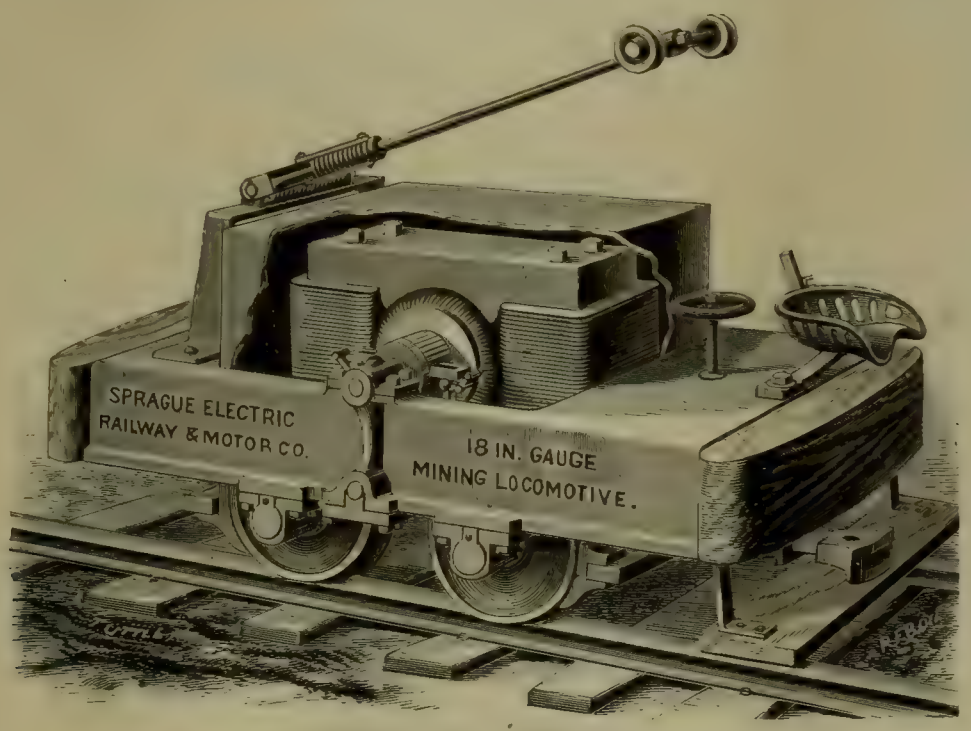
THE FIRST TOWN LIGHTED BY ELECTRICITY.—At Kimberly the public lighting of the streets has been effected by means of arc lamps, which have been in continual operation for the past seven years, and it is somewhat extraordinary, but nevertheless a fact, that it should be left to a town in the heart of South Africa to be the first in the world to have its streets illuminated by electricity without previously having any other artificial light for this purpose. The nearest approach on record to this is the case of a town in Portugal, which is just about to make the transition from oil lamps to electricity for street lighting. Another interesting fact in connection with electric lighting at the Cape is that the introduction of the incandescent light in the private houses and warehouses within the docks at Cape Town was so rapid and complete, that in two years from the first electrical installation gas was entirely cut off from the main at the entrance to the docks.

A use of the telephone, which is very suggestive as pointing to future possibilities, is reported in an English paper. The parish clerk in a Norfolk village, being prevented by rheumatic gout from attending church, was presented by the manager of the local telephone company with a double telephone, which was fixed from the church to the old man's cottage, so that he and his wife could follow all the services. The old man is quite unable to hold anything, so the telephone is arranged so as to fit against both his ears. He can hear anything in the church quite clearly, and if a book is dropped or if any one coughs the sound is as distinctly heard as if he were in the building.

Phonograph parties are getting popular. It is a big advantage to be able to hand a windy guest a tube and let him fire away at one of the machines instead of into already overbored ears.

ELECTRIC LOCOMOTIVE FOR METAL MINES.

We show in another part of this issue a view of a new electric rotary diamond drill manufactured by the Sprague Electric Railway and Motor Co. of New York, which has shown very gratifying results in the tests to which it has been put, and which promises to fulfil a long-felt want in electric mining. On this page we show another special electric mining application, *i. e.*, the electric locomotive. This locomotive is simple, powerful and compact, and is built with special reference to the arduous duties required of such a machine. The gauge of the locomotive is eighteen inches, but it can be accommodated to any gauge used in ordinary commercial work. In order to protect the machine from damage, all the working parts are completely boxed in, as shown in the view. The speed of the motor is under complete control by a switch which throws the winding of the field into different electrical combinations, thus varying the speed of the motor without the use of any wasteful resistance. The direction of rotation is also governed by the same switch. so that the operation of the motor is very simple, and it can be put in charge of an ordinary workman.



ELECTRIC MINE LOCOMOTIVE.

Any system of conveying the current from the dynamo to the locomotive can be used, either using the rails as one side of the circuit for the return of the current, or else employing a complete metallic circuit by the use of a double over-head trolley wire. In this latter case, a trolley pole, shown in the view, carrying at its upper end two trolley wheels for making running contact with the over-head wires is attached on the rear of the locomotive car.

This mining locomotive is now being manufactured by the Sprague Electric Railway and Motor Co. from designs made by Mr. I. E. Storey. One of the most noticeable advances made in modern mining science is the adoption of electricity as a medium for transmitting power and producing light, and such applications as the above indicate the growing demand of mining companies for just such apparatus, and the ability of the leading electric companies to supply the need.

In the Cape de la Hogue lighthouse in France a windmill is used to drive two dynamos, the current being stored up in accumulators.

The magnetic iron ore beds of Boyertown, Berks County, Pa., have been worked for about 125 years.

MIGHIGAN ELECTRIC LIGHT ASSOCIATION.

SEVENTH STATE ORGANIZED.

A m eting of the companies doing business in the State of Michigan was held at the office of the Brush Electric Light Co., Detroit, Jan. 17th, for the purpose of organizing a State Association. The attendance and the response from companies throughout the State was good. The desirability of organizing such an Association was agreed to without dissent. The Association organized by adopting By-Laws and electing the following officers :

President, Geo. Peck, Pres. Edison Illuminating Co., Detroit; Vice-President, Jas. R. Dee, Gen'l Manager Peninsular Electric Light and Power Co. of Houghton & Hancock; Secretary and Treasurer, Jos. E. Lockwood, Gen'l Manager Brush Electric Light Co , Detroit. Executive Committee: Geo. Peck, Detroit; James R. Dee, Houghton; Jos. E. Lockwood, Detroit; W. H. Powers, Grand Rapids.

The Association will give its first attention to the establishing of a general system of rules and regulations for the wiring of buildings, so as to secure the safest and best construction and service.

THE BRUSH ELECTRIC COMPANY.—The annual meeting of the Brush Electric Company was held in Cleveland, on January 20th. Several months ago a controlling interest in the Brush plant was sold to the Thomson-Houston Company of Boston, but the sale has not been closed entirely. There were 40.000 shares in the company before it was sold, and the Boston corporation bought in all 30,000 of them. A written protest representing 3,562 shares of stock was presented at the meeting, and spread upon the minutes. It set forth that inasmuch as the majority stockholders had received $25 per share premium for the 30,000 shares sold to the Thomson-Houston Company, or $750,000, the "bonus" should be divided pro rata among all the shareholders. The meeting adjourned without any settlement of the controversy.

THE PHONOGRAPH IN SAN FRANCISCO.—San Francisco seems to be taking the lead in the matter of putting the phonograph to novel uses. The latest story from that city is that some rich families are using the phonograph as a companion for the sick, a negro being hired to turn the crank while it sings, talks and plays. Some of the undertakers are about to employ it for short prayers and sermons at the burial of the friendless poor. Thus progress marches on hand in hand with business.

THE ILLINOIS ELECTRIC LIGHTING ASSOCIATION.

THE EIGHTH STATE ORGANIZED.

A meeting of the representatives of Central Station Companies, called for the purpose of organizing a State Association, was held in the rooms of the Chicago Electric Club, Saturday, January 18th. The organization was effected by the adoption of a Constitution and the election of the following officers :

President, C. H. Wilmerding, Sec'y and Treas. Chicago Arc Light and Power Co.; 1st. Vice-President, A. L. Ide, Prest. Springfield Electric Light and Power Co.; 2nd Vice-President. Douglass Hapeman, Sec'y and Treas. Ottawa Electric Light and Power Co.; Secretary and Treasurer, Chas. E. Gregory, Sun Electric Light Co., Chicago. Executive Committee: C. H. Wilmerding, Chicago; A. L. Ide, Springfield; Douglass Hapeman, Ottawa; Chas. T. Page, Englewood; and M. A. Beal, Rockford.

COPPER MANUFACTURERS.—The American Copper Manufacturers' Association held their annual meeting on January 22d, at Delmonico's and ended the session with a banquet. Nothing of importance was transacted at the meeting,

The officers elected were: President—George A. Pope of the Baltimore Copper Smelting and Rolling Company; Vice President—Joshua Hendricks of Hendricks Brothers, of New York; Secretary and Treasurer—William H. Matthews of the New Bedford Copper Company.

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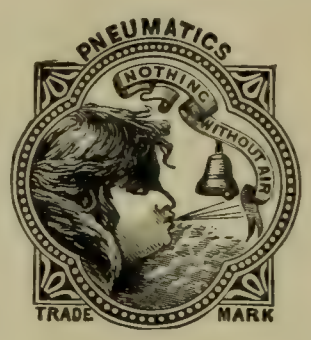
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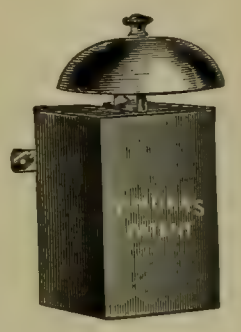
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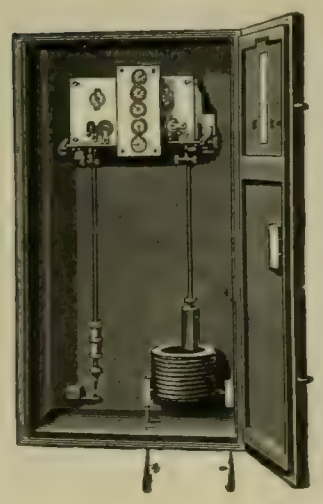
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BURYING THE HATCHET.—A healthier condition of affairs seems to exist in the electric light situation in this city, and from what we hear, the authorities are now disposed to take a reasonable view of the matter—after all the damage has been done. The subway company, report has it, has sufficiently freed itself from its entangling alliances to come forward and take a hand in the restoration of order and light. It is said that the subway company and the electric light companies have come to an agreement whereby subways will be built more rapidly and in a much more satisfactory manner. Efforts are to be made also to remedy the defects of the existing subways. It will be a great relief to the public mind to know that travel in the streets may be accomplished without danger of being blown into the clouds by the explosion of some subway manhole. In the line of improvements it is said that the dynamo stations are to be connected directly with the subways, and that the subways will hereafter be built as nearly as possible to the stations. These subways are also to be built with reference to the requirements of the service. This will obviate the necessity of the companies having to pay rental for a large duct when a smaller one would answer every purpose. We hope the good feeling existing between the contending parties will continue, and that their new plans will be carried out in good faith.

GLASS CONDUITS.—Experiments have been successfully concluded at Penderton, Ind., with a view to constructing tiles and tubes of glass for underground wire work. A company has been organized with a capital of $500,000, and work will at once begin.

CONDITION OF THE SUBWAYS.

In the report of the Board of Electrical Control we find the following :

"In a portion of the city, where the steam heating company maintains an imperfect construction and allows steam to escape in large quantities from its pipes, serious damage to the electrical conductors in the subways has been caused.

This has been made the ground of an attack upon the system of subways laid in this city, and opponents of underground wires have not hesitated to assert that, because of this impairment of the efficiency of the cables where the steam was allowed to escape into the streets, the entire construction of conduits for electrical conductors is a failure.

The steam-heating company is at present endeavoring to stop this escape of steam from its pipes in the localities referred to, and has expended up to the present time more than a quarter million dollars in repairs of defective construction. Should it succeed in remedying the defects, the subways in the locality will again be effective. Otherwise the steam heating company must either rebuild or cease from using this section of its plant.

In other localities of the city where the construction of the steam heating company is proper, and steam does not escape, the existence of the steam pipes in the same streets with the underground wires has no effect upon the latter.

The frequent explosions of illuminating gas escaping from leaky mains into subways, sewers and house vaults, is a matter which requires attention."

It looks a little like putting the vehicle before the animal to dismiss so briefly the subway explosions matter, and discuss so fully a question that does not concern the public. On account of the dangers ever present underneath our streets due to these gas-accumulating man holes, public safety should be the first consideration. The question of leaky steam pipes can be settled between the companies involved, and to make it one of public importance looks to us like a blind to divert public attention from the real danger.

Referring to the condition of the underground electric light wires, Dr. S. S. Wheeler, Electrical Expert of the Board of Electrical Control, in his report says :

"The results of the use of the underground conductors in the subways are very satisfactory. The tests of the conductors used for high tension currents show that there is no deterioration perceptible in the cables by reason of such use as they have been subjected to, in some instances, for six months. Whenever imperfections in the underground circuits have been ascertained as existing, by the tests furnished by the companies, they have proved due to bad workmanship in making joints and connections, or the exposure of the ends of cables to the weather."

THE WIRES IN WASHINGTON.—Congress has indulged in a preliminary skirmish against overhead wires in the District of Columbia. The antagonism broke out in an attempt to attach to the District appropriation bill an amendment prohibiting the maintenance of any overhead electric light wires after the 30th of September next. The amendment was, however, defeated, and it is likely that some arrangement will be patched up to carry through the year. The cry for years has been "put the wires underground," but nothing practical has been done. The government itself should set the example by putting its own wires underground. Its poles and lines are as unsightly as the worst of those of any other concern. The government has not even taken any steps towards looking into the practicability of any one of the many underground systems.

THE MORSE CODE ADOPTED BY THE NAVY.

The Morse Code of signals has been adopted by the Navy Department for signalling purposes. It is strange that the simple Morse characters have not long ago displaced the present cumbersome methods of transmitting signals between armies, vessels, etc. The extreme simplicity of the code has been shown time and again. There have been several spasmodic attempts to improve the original, but they were all futile.

Experience has demonstrated that it is the briefest and quickest means of signalling between distant points, and for the government to recognize this merit in it, although at a very late day, does honor to the memory of the man whose name is inseparably united with the alphabet of dots and dashes.

Mr. Walter P. Phillips, General Manager of The United Press, also comes in for a share of honor in the adoption of this code. It was he who, some years ago, originated the punctuation characters embraced in the system. Their superiority over the old were at once recognized by operators, and now they are very generally used in the United States. It did not need official authority to cause their adoption.

The basis of signalling by dots and dashes in whatever manner is two simple, opposite motions—one representing a dot and the other a dash. The combination of these with varying intervals between signals constitutes the code, and what could be simpler? The flexibility of the system is a great point in its favor. Dots and dashes can be made on a whistle, by light flashes, swinging flags, and in innumerable different ways. It will not be long before ocean steamers in passing each other at sea will communicate signals by means of their whistles and the Morse alphabet. A whole message can be transmitted in this way long before Jack Tar has had time to properly arrange his signal flags and haul them aloft.

ANOTHER SUBWAY EXPLOSION.—Another of the periodical subway upheavals occurred in this city on Sunday, January 26. The explosion took place about 10 o'clock in the morning, at the corner of Broadway and Forty-second street. The manhole cover, as usual, soared aloft for a time and then returned to earth. The paving stones in the immediate vicinity of the manhole were displaced, and the street torn up. Fortunately no one was injured, although at the time the streets were crowded with pedestrians and vehicles. These subways are getting to be dangerous to life and property—far more so than electric light wires ever were. Some of these days an explosion of this sort will kill several persons at once ; then there will be a great cry against the subways. If these are raided in the way the wires were, where shall the wires go? The authorities should lose no time in providing means to ventilate the subways. These explosions occur very frequently now-a-days, and if they are allowed to continue there certainly will be war against these alleged underground conduits. If the Board of Electrical Control had any foresight whatever these dangers would have been overcome long ago, but it seems to be their way of doing business, to wait until some injury or damage is done before the necessity of doing something dawns upon them.

RUMORED DEAL.—A rumor reaches us that the Westinghouse Company has secured control of the electric light subways in this city. The explanation comes with the rumor that the telegraph and telephone interests will not be affected by this deal. The electric light wires only are those involved in the scheme. If this report is true it will give the Westinghouse Company a great leverage on the business in this city, and it seems to agree with reports published in the recent past of that company going to light the entire city, etc., etc.

ON THE RESPECTIVE MERITS OF CONTINUOUS AND ALTERNATING CURRENTS.

In our last issue we published the first part of an interesting discussion on the respective merits of continuous and alternating currents. It dealt almost entirely with the first-named class. The alternating current now receives a thorough consideration in the following article which appears in our esteemed contemporary, the London *Electrical Review.*

We have been speaking of the disadvantages of factories working with continuous currents, viz:

1. The necessity for the central station to be in the centre of the region supplied.

2. The zone of distribution is limited. To these we must add:

3. The system is too costly for sparsely-populated districts; this is admitted even by the advocates of the system.

4. The arc lamps fed by these currents must be set in a series of twos, or the energy of one in every two must be taken up by a resistance This is not denied by any advocate of the continuous current, but it is not considered sufficiently important to nullify the striking attributes of the system.

The author now turns to the second system of electric distribution of energy, viz., the system of alternating currents and transformers.

He criticises the advantages claimed for this system; it admits of the use of slender conductors, and consequently, of the central stations being established outside of the circle of lighting; moreover, the electricity can be distributed in sparsely-populated districts.

The radius of distribution is not so strictly limited, since the net cost of the conductors is less.

It facilitates the cheaper use of natural forces, even at a distances from the quarters to be lighted.

If desirable, we can make use of incandescent lamps with only 50 volts tension. We can also employ arc lamps fed by alternating currents without loss of energy, and the tension need not be so great as when continuous current lamps are employed.

The regulation of the tension on the entire system is simplified; it is effected without loss, and is more reliable than when continuous currents are employed.

As regards the demerits of the system:

It necessitates the use of high tension in the principal conductor.

Alternating current dynamos give a smaller yield than continuous current ones.

It is not so easy to couple the machines upon one exterior circuit.

The transformation of the energy in the transformers involves considerable loss, and increases the uncertainty and the dangers of the working.

Alternating currents wear out the incandescent lamps more rapidly than continuous currents.

The arc lamps with this system have less of effective power, and in many establishments their noisiness would be an obstacle to their use.

A really practical motor in connection with this system is as yet unknown.

It is not possible to accumulate the electrical energy produced by alternating currents machines.

The alternating current is less easily measured.

The incessant reversal of the current's direction is fatal to insulation, and is a bar to the complete utilization of the section of the copper wires.

The opponents of the system dispute the reality of the advantages claimed for it.

It is a fact generally recognized that the alternating current makes the use of light wires feasible, especially in a case of overhead conductors.

But as against these advantages it is necessay, in the case of subterranean conductors, to take the following into consideration: the price of the copper is but a small part of the cost; the insulation of the cables has to be performed with very great care, and is therefore expensive; the cost of the sheathing and of the cable laying does not alter in proportion to the diameter of the wires.

The alternating current permits of the central station being established outside of the circle of lighting; but it remains to be seen whether this is really practicable, and whether the advantages inherent in distance are counterbalanced by the increase in the price of the conductor, and the decrease in the uncertainty in the working:

The author's calculations, with reference to the Schwartzkopff project for the town of Halle, indicate that, even under very favorable conditions the advantages of alternating currents are not very considerable.

Then we must take in o consideration that it means the employment of not merely one, but several cables.

It is otherwise. he adds where natural forces, waterfalls for instance, can be made use of, as then it is much more advantageous to employ alternating currents,

In such cases overhead conductors may be used; but obviously this can only be for portions which are altogether outside the town, and this means a considerable increase in the extent of a rat onal service.

By means of alternating currents electricity may be distributed in sparsely-populated quarters; no one disputes this.

The area of distribution is not so strictly limited, because the net cost of the conductors is less. The author has already noted this.

The alternating current system permits of the cheap utilization of natural forces, even at a distance from the area to be lighted.

It is possible, when desired, to make use of incandescent lamps with only 50 volts tension. Low tension incandescent lamps with a thick carbon filament give an excellent light, and the filaments are not easily broken. When the current is continuous they can only be used in series of twos, or with a resistance to take up the current of every second lamp.

Arc lamps fed by alternating currents may be even burned singly without loss of energy; nor will they need so great a tension as the continuous current lamps.

As this has often been claimed as an advantage compensating for the many drawbacks of the system, we will pay it some attention. We need hardly say that a transformer of a special pattern is necessary in employing a different tension to that which is used with incandescent lamps.

The peculiar conditions of the working of an apparatus of this kind, nevertheless, involves considerable leakage, which will be proportionately great as the apparatus itself is small. The installation, therefore of a transformer for a single arc lamp will not only be costly (the transformer and conductor being supplementary), and will also involve losses of sufficient importance to make it preferable to insert the lamp within the circuit of incandescent lamps, in combination with appropriate resistances. The installation of a transformer with a special conducting wire is only recommendable when the number of lamps are very large, in which case, even with continuous current lamps, the difficulties need not be very grave, since the necessity for placing two pilot lamps in series will no longer exist, as by placing two groups of lamps in a 3-conductor system, it will always be possible to make a uniform distribution of the lamps at work.

Whilst an arc lamp with the alternating current only demands a tension of 35 to 40 volts, an arc lamp with the continuous current requires about 50 volts. This increase of tension is made necessary by the counter-electromotive force which is generated in the hollow of the positive carbon of the continuous current lamp; the result being that a continuous current lamp of 10 ampères consumed nearly as much energy as an alternating current lamp of 12 ampères.

The regulator of the tension over the entire system is simplified; it is effected without loss, and it affords greater certainty than is obtainable by employing continuous currents.

He then proceeds to discuss the alleged disadvantages of the alternating current system with transformers.

1. The alternating current necessitates the use of high tensions in the principal conductors. This fact, which has the great advantage of allowing the use of small section principal conductors, has also two drawbacks.

The tension being greater it is more difficult to insulate the conductors. The insulation of the cables on a system of alternating currents with high tension should, it is well known, be more thorough than is necessary in a system of continuous currents with low tension. The condition, enforced in every European city, of placing the cables underground, side by side with telephone and telegraph lines, necessitates further the employment of concentric cables for avoiding the disturbances occasioned by induction upon the latter. The price of the conducting cables is consequently raised to a point at which the advantages of slender copper conductors largely disappear, to vanish altogether when it becomes a question of long distances.

The necessity for perfect insulation has a considerable restrictive effect upon the tension that might be employed.

According to Spencer, who is said to have installed 400,000 lamps, a tension of 1,000 volts is the best to work with. The fact is, the majority of American central stations use this tension, and none go beyond 2,000.

Crompton asserts that even with 1,000 volts the insulation is still uncertain, and that in America difficulties are still met with when this tension is used. According to him the insulation must be affected by alternating currents at high tension; and he doubts if the insulation of the central station at Nancy, which works with 2,000 volts, will continue to be as efficient as hitherto.

It may also be presumed, as a matter of fact, that it is impossible to predetermine the duration of a cable for high tension.

On the other hand, the firm of Siemens & Halske has frequently supplied concentric cables for 2,000 volts, and these cables have so far done well.

The high tension of alternating currents may occasion fatal accidents and fires. The best thing to be done is to make contact very difficult, if not impossible, with the primary conductors.

Some companies place transformers with their customers. The Société Hélios is for supplying each customer with a transformer and meter combined; this would not be larger than a gas meter. Other forms propose to enclose the transformers in safety cases beneath the pavement. For transformers in the interiors of houses complete insulation, and something in the nature of a fire safe would be necessary. In America the insurance companies insist upon the transformers being placed outside of the buildings. An English society has, nevertheless, declared that it will not raise its premiums if the transformers used in the Ferranti business are carefully made and installed. In any case an extreme prudence will be necessary.

Another question is whether there is not a great danger in the contact, which is often necessary, with secondary conductors. The enemies of the system of alternating currents have so strongly insisted upon this danger, as to make a close examination of the question necessary.

For such contact to be dangerous, a combination of three conditions is necessary.

1. The principal conductor must communicate with the earth.

2. The primary conductor must be connected with the secondary conductor.

3. There must be communication between the person and the earth.

The first of these conditions can hardly be qualified.

The third becomes realized if the person in question rests upon the damp ground, or is in contact with pipes for either gas or water.

Absolute security will only be attained by making the second impossible. It will not be enough to apply cut-outs to the principal conductors, since it is possible and even likely that the communication does not consist in a short circuit without resistance, but in a luminous arc offering sufficient resistance to prevent the production of a current capable of melting the cut-out.

In such a case cut-outs in the secondary conductor would be of no use at all, as they are intended for a current of much greater strength (with low tension). The only real protection, then, consists in laying the insulating stratum between the primary and secondary conductors thickly enough to maintain insulation, at all events, and in carefully avoiding anything like heat or damp.

It is a choice between sacrificing something of the utility of transformers, and of abandoning the principle which consists in obtaining the maximum of action with the minimum expenditure of copper and iron.

In many cases, might it not be better to make use of a protecting box? It would always be feasible, and it would certainly avoid the danger to life and property.

It has, we are aware, been proposed to insert between the two conductors a conducting stratum in connection with the earth, or to connect the secondary conductor with the earth in a permanent manner; but these methods involve greater losses and sacrifices than the insertion of an insulating stratum.

Submarine Telephone.—The opening of the first submarine telephone cable has just taken place. The cable runs between Montevideo and Buenos Ayres, and is thirty-two miles long, the total length with the overhead line being 180 miles. On this line there are five intermediate stations, all of which can telephone and telegraph simultaneously with all the other stations.

Electric Brakes.—An electric brake, designed by Professor Forbes, has been tested with great success on an entire train of carriages with which it has been fitted for use on a line in Russia. The chief gain is in point of rapidity of action. A train of average length will feel the brake power throughout its length almost simultaneously, as against three or four seconds required by the vacuum brake.

Electric Door Openers.—An admirable arrangement looking to the quick and safe emptying of the house has just been adopted at the Tremont Theatre in Boston. At any time, by simply touching a button in any one of the eight handy places in different parts of the theatre, seventeen sets of folding doors, leading to as many exits, open simultaneously, actuated by electrical apparatus. The expense of the improvement is said to have been considerable, but it is safe to say that the public will appreciate the advantage of being able to take their pleasure without any dread of fire or panic.

An Explanation Needed.—It is remarked on the Vienna Leipsic telephone line that while the speaker at Vienna is heard with remarkable clearness and accuracy at Leipsic and at all points along the route, as at Prague and Dresden, a speaker at either of these points is heard with much more difficulty at Vienna. The electricians of the company are as yet unable to furnish a satisfactory explanation of this phenomenon. Why sounds traveling from east to west should be clear and distinct, while those traveling in the other direction are more or less blurred, is a puzzle.

ELECTRICAL PATENTS ISSUED JANUARY 28TH.

420,057. Wind-vane indicator. Henry J. Haight, New York, N Y.

420,070. Electric detecting apparatus for coin-actuated boxes. William J. Howey, New York, N. Y.

420,077. Incandescent-lamp socket. Hermann Lemp, Hartford, Conn., assignor to the Schuyler Electric Company, of Connecticut.

420,079. Electric reciprocating tool. Harry N. Marvin, Syracuse, N. Y.

420,080. Electric reciprocating tool. Harry N. Marvin, Syracuse, N. Y.

420,091. Testing apparatus for te'ephone-exchange switches. Joseph J. O'Connell, Chicago, Ill.

420,096. Lightning arrester. Charles A. Pfluger, Chicago, Ill., assignor to David P. Perry, same place.

420,101. Conduit for electric street railways. Jesse W. Reno, Boston, Mass.

420,102. Telegraphic transmission of index movements. Felix Richard, Paris, France, assignor to the Société Richard Frères, same place.

420,109. Electric-arc lamp Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place.

420,117. Electric motor and regulator therefor. Elmer A. Sperry, Chicago, Ill.

420,171.—Insulating casing. John A. Seely, New York, N. Y.

420,173. Electric fire-alarm system. John Speicher, Jersey City, assignor, by direct and mesne assignments to the Newark District Telegraph Company, Newark, N. J.

420,183 Telephone exchange apparatus. Franklin G. Beach, Chicago, Ill., and Frank B. Cook, Toledo, Ohio.

420,198. Automatic safety cut-off for electric circuits. George M. Guerrant, New York, N.Y., assignor to himself and H. A. Wise Wood, same place.

420,214. Electric meter. Walter P. Smith, Philadelphia, Pa., assignor to the United Electric Improvement Co., Gloucester City, N. J.

420,234. Plate for secondary batteries. George A. Johnson, Boston, Mass.

420,240. Printing-telegraph. James F. McLaughlin, Philadelphia, Pa.

420,255. Electric signal. John D. Taylor, Piketon, Ohio.

420,300. Therapeutic magnet Thomas H Hicks, Detroit, Mich., assignor, by direct and mesne assignments, to the Therapeutic Terrestrial Equ poise Company, of Michigan

420,314. Electric-arc lamp. Rupert Schefbauer, New York, N. Y., assignor of one-half to Charles Bell, same place.

420,334. Magnetic separator. Gurdon Conkling, Glens Falls, N. Y.

420,351. Advertising automaton for store-windows. George Music, Berlin, Germany.

420,358. Printing instrument or apparatus for telegraphic or other uses. James H. Rogers, Bladensburg, Md., assignor to the Visual Synchronism Company, of West Virginia.

420,370. Incandescent-lamp socket. Merle J. Wightman, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut.

420,384. Electrical communicating system. Alfred G. Holcombe, New York, N.Y., assignor to the Electric Signal Manufacturing Company, same place.

420,393. Telegraph apparatus. Ebenezer B. Shafer, New York, N. Y.

420,396. Electric trsnsformer. Elihu Thomson, Lynn, Mass.

420,398. Governor for dynamos or motors. Addison G. Waterhouse, Hartford, Conn., assignor by mesne assignments, to the Schuyler Electric Company, of Connecticut.

420,422. Current-direction indicator. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place.

Sheep Shearing by Electricity.—A remarkable application of electricity is being made in Australia. The problem of shearing sheep economically and speedily has been solved by the use of the electric motor in conjunction with a new shearing machine invented by Frederic York Wolseley, a brother of the eminent General bearing that name. The method of using the shears is very simple. From one to one hundred shears can be operated at one time accord ng to the power used. The loss from injuries primarily due to shearing by hand, reckoned at no less than one per cent. of the animals operated upon, is entirely avoided; while the pelts, being free from cuts, stabs, and holes, command a readier and better market. The operators themselves are protected from the numerous self-inflicted injuries to which they are liable when using the ordinary hand shears. The time occupied in shearing the sheep by the new method is only from 3½ to 5 minutes. As the machine takes the whole of the wool off at one operation, all second cuts are avoided, and thus considerable saving in time is effected.

Electricity in the Future.—Prof. R. H. Thurston, in a recent article, gives a graphic description of what electricity will do in the near future. He says it will break up the present factory system and enable the home worker once more to compete on living terms with great aggregations of capital in unscrupulous hands. Great steam engines will undoubtedly become generally the sources of power in larger cities, and will send out the electric wire into every corner of the town, helping the sewing woman at her machine, the weaver at his pattern loom, the mechanic at his engine lathe, giving every house the mechanical aids needed in the kitchen, the laundry, the elevator, and at the same time giving light and possibly heat in liberal quantity and intensity.

Handy Electric Power.—An explosion of the boiler in a large printing house in Chicago recently completely wrecked the engine. To suspend operations until the damage was repaired meant a loss of thousands and thousands of dollars, so an electric motor was secured and attached to the shafting. The next day work was resumed in the factory, and the firm are now firm believers in electric power.

Underground Light Wires.—In placing light wires underground in Bath, England, the troughs used are of sufficient width to take four cables packed side by side, but kept apart by wooden separators, or bridges, placed at intervals of a few inches. The spaces between the cables and troughs are then filled in with bitumen poured on in a liquid state, which on solidifying encases the cables in a solid damp-proof mass, in the centre of which the conductors are buried. The troughs are of sufficient depth to take two layers, or eight cables, or less number, according to requirement of the districts.

Electricity Through Gas Mains.—At a recent meeting of the Manchester association of engineers, the president, Mr. John West, said that in practice he thought the most economical and satisfactory way of producing and supplying electricity to the consumers would be by gas engines on their own premises, or a system of very small central stations where a few houses or shops in close proximity could be worked by the direct system of distribution. At the present time they had in Manchester excellent distributing plant for the purpose in the existing gas mains, which, by the aid of gas engines (which could be placed in a cellar, outbuilding, or any other position), would supply a power available at any time, requiring no constant attention and causing no smoke nuisance.

A VISIT TO EDISON'S FACTORY.

The Edison factory at Orange, N. J., is probably the most famous establishment in the world. All classes of people flock thither, some on business and others out of curiosity. They all go with one object in view, however, and that is to see the famous inventor if possible. But many are disappointed in this respect. Mr. Edison is too busy to keep himself on exhibition; but, were he not a busy man he would not show himself much, as his aversion to personal publicity is well known. He does not, however, turn his admirers away unsatisfied. He has provided a means for their enjoyment, which is one of the most unique and pleasing entertainments imaginable. In the library is placed a phonograph, which, in the hands of a young expert in attendance, turns out some of the most delightful music, instrumental and vocal, it was ever the pleasure of mortal ears to listen to. The performance of the instrument is marvelous, and the pieces are reproduced with wonderful effect. Among the many pieces permanently recorded on these wonderful little wax cylinders are the following:

"Down upon the Suwanee River," on the flute, with piano solo. The soft notes of the flute are reproduced with astonishing accuracy; indeed, the listener is frequently deceived, and imagines himself listening to the original music, so realistic is the reproduction. A cornet solo is given with the same wonderful effect, and at the end the applause of the audience is heard as distinctly as though it was actually taking place in the big room. The yells, cheers, clapping of hands, whist ing and stamping of feet are perfectly rendered.

Another piece is the whistling of a negro with piano accompaniment. If the listener were not told beforehand what it was, he would certainly say the notes were those of a flute, so liquid and clear are they. Their immense volume is a striking feature of the piece. Some one took this darkey out to the factory one day and Mr. Edison had him whistle in the phonograph. Mr. Edison was so well pleased with the result, that he gave the darkey a check for $50. The negro is a familiar figure on the North River ferryboats, on which he makes a living by whistling for the passengers.

One of the most amusing pieces is the reproduction of Bill Lyle's "Barnyard song," with banjo accompaniment. All through the song is heard with astonishing naturalness his imitation of the crowing of the rooster, the cackling of the hen, and the gobble of the turkey. When Bill finishes, the yelling and applause which follow is deafening. After this has sufficiently subsided, a voice is heard above the din, saying, "Lyle's all right; ain't he!"

The beautiful "Monastery Bells" are rendered in a charming manner, including the ringing of the bell.

The piece called "The Descriptive Fire Alarm" is well worth going many miles to hear. The band plays a funeral dirge to represent the sleeping firemen. All at once there is great excitement. The ringing of the fire alarm on the gong and the clatter of the horses' feet as they run to their proper places at the engine, etc., are distinctly heard above the sound of the music. All this time the box number is sounding, and in a few moments the engine is heard going out of the house down street. As it speeds to the fire, the sound of the bell on the machine grows fainter and fainter, until it is lost altogether in the distance.

Excellent music is rendered by full brass bands, and the accuracy with which every sound and note is recorded is marvelous.

One of the most pathetic features of the entertainment is the reproduction of some of the ravings of John McCullough, the famous tragedian, just before he died in the mad house. We give herewith the exact words, which we copied directly from the phonograph:

"Ah! they say I'm mad. Right they are, for I am mad—for it is my plays that sent me so, and as I appeared on the stage, rang out the name of John McCullough. Ha! ha! ha! ha! Ah! (at this point McCullough drew in his breath, which gave forth an unearthly and sepulchral sound). But I'm mad now; I can play no more, and as I appeared in the throne scene, leading on my daughter before *Appius Claudius*, I said: '*Appius Claudius*, you have sent for me and I have come—come to defend my daughter's honor. Go on with your trial; go on, I'm ready to defend her with my heart's blood. Ha! ha! ha! ha!' Ah! (here he uttered the same blood-curdling sound.) But I am mad now. And as I appeared in the arena scene as *Spartacus* in 'The Gladiator,' I said: 'Peter, kill; I'll kill no more. Then thou'st wife and child shall suffer. Ah! not then. Then send down all Rome and I'll make R-r-rome howl.' Ha! ha! ha! ha! ha!" And with this last mad laugh his tongue ceased its ravings, and the stillness of death seemed to overcome all.

TERRIBLE ENGINE OF DEATH.—New Jersey's reputation as the home of queer things is being maintained in an admirable manner. It is generally supposed that the principal products of the State are mosquitoes and a beverage known as "apple-jack." This is a mistake. Inventions—and great ones—are made in this land. The latest of these is that of a citizen—a farmer probably. This inventor proposes to revolutionize every existing methods of warfare, on land or by sea. He claims to be able to produce artificial thunder storms, and by the proper use of the lightning so generated can annihilate an entire army or fleet. A thousand soldiers may be killed at a flash. He hopes that the terrible efficiency of his invention will have the effect of putting an end to all war. He has not had a chance yet to practically test his invention; he has, however, tested it in a small way by clearing his room of pestiferous flies. How easy it would be to settle all international difficulties by the new system of warfare. All that would be necessary would be for Russia, for instance, to call on the famous Jerseyman, and direct him to turn his attention and machine on, say, Bulgaria or Turkey, and in a few minutes the war would be over. The inventor would soon realize a fortune by hiring out to European nations in this way and charging so much a head for results.

AMENDING THE EXECUTION LAW.—An amendment is proposed to the Electrical Execution bill, which compels the attendance of the agent and Warden of the prison where the execution occurs, and upon three days' notice a Justice of the Supreme Court, the District Attorney, and the Sheriff of the county in which the conviction took place, two physicians, twelve citizens, and seven Assistant Deputy Sheriffs. It also authorizes the holding of a post mortem immediately after the execution and the destruction of the body by quicklime unless it is claimed by relatives or friends.

ELECTRICITY ON WAR SHIPS.—The American squadron of evolution is the subject of comment in foreign military papers, and the electrical appliances on board the Chicago and Atlanta seem to attract a good deal of attention.

AGITATION IN THE ENGLISH TELEGRAPH SERVICE.—At a large and enthusiastic meeting of telegraph clerks, held in Newcastle on January 11th, to consider their grievances, resolutions were adopted in favor of at once combining with the clerks in London and other offices throughout the kingdom to memorialize the postmaster-general to secure a reduction of hours, increased pay, quicker promotion, extended annual leave, and overtime payment at the rate of time and a quarter for all Sunday work.

A CANADIAN ATLANTIC CABLE.—A petition for the incorporation of the Canada Cable Company has been presented in the House of Commons at Ottawa Several wealthy Canadians are interested in the scheme, and that assert it will be to Canada's advantage to have an Atlantic cable wholly Canadian. These gentlemen represent several millions of dollars of capital and are very enthusiastic over the prospect of placing Canada in an independent position as regards getting European news.

The cable will be laid from Ireland to a point in Quebec, on the north shore of the Gulf of St. Lawrence. It will run through the Straits of Belle Isle. A special station will be erected on the Canadian side and direct communication made with the Canadian Pacific Telegraph Company.

Work will begin as soon as the act of incorporation is passed.

The company has already made a contract with a London firm for the laying of the cable and the supplying of material. This has been accomplished at a cost of $250,000 less than the Mackay-Bennett cable cost

It is thought that an advantage will be gained by the Canadian cable in its course, being so much north of any of the others. There will be no difficulties of crossed cables or unpleasant mistakes when a break has to be attended to.

The only difficulty is in the laying of the cable in the Straits of Belle Isle, but the submarine engineer who reported on the course says that there is a regular bank through the Straits under which the cable can be safely laid. One of the promoters intimates that the Canadian Company will compete for American business, cutting rates if necessary.

NEW BUILDING WIRING.—The C. B. Rouss building, on Broadway, just being completed, is equipped with a model light installation. Both incandescent and arc lights will be used. The incandescent plant will consist of 150 lights of 16 c p. The dynamo will be the newest type of compound automatic Mather machine. The wire used is the well known Grimshaw white core, of heavy insulation. The branch wires are laid in the plaster, and the mains in moulding, and the wiring has been done in such a way as to allow the use of either the two or three wire system. The arc light plant consists of two 40-light Thomson-Houston machines, for 78 lights. Grimshaw B. D. wire is used, and the wire having the heaviest insulation is run on porcelain insulators, and is readily accessible and in plain view. Each insulator is firmly secured in a wooden block placed in the ceiling. A circuit from each dynamo runs through the entire building, giving two independent circuits. The advantage of this is, in case of derangement of one dynamo only one half of the lights will be affected, and the interior of the building will not be entirely deprived of light, as the other circuit will remain intact. Each floor is wired with this end in view. Every second lamp is on one circuit, while the alternate lamps are on the other. All lights on each floor are controlled by an independent switch placed at a convenient point on the floor. The power for these plants is to be derived from two 50 horse-power Buckeye engines.

Bessemer, Colorado, is to have an electric street railway, operated by the Pueblo City Railroad Co.

The Thomson-Houston Company has secured the contract for building the Forest Park electric street railway extension at Springfield, Mass.

The Eddy Electric Mfg. Co., of Windsor, Conn., has increased its capital stock from $30,000 to $100,000.

The Royal Electric Light Company has more than double its plant in Quebec and Montreal, so great is the demand for lights.

VOLTMETERS.

Some years ago it was generally supposed that voltmeters should be wound with German silver, because its temperature co-efficient is small. Lately, however, the practice has been altered, and it is generally, but erroneously, considered best to wind with copper, because, though its temperature co-efficient is greater, the power absorbed by a given volume at a given current density is less

The error due to differences of temperature must be due to differences of temperature of the room, or to rise of temperature due to the current in the coils. If a voltmeter wound with copper wire and calibrated at 50° C. were used in the engine-room of a steamer, it would read about five per cent. too low; whereas, by the use of German silver, with its ingredients in proper portion, the error would be comparatively small. German silver is very much better than copper, as far as alterations of external appearances are concerned. Platinum-silver and gold-silver alloys need not be discussed as they are too expensive for ordinary use in voltmeters.

The rise of temperature due to the current depends chiefly on whether the voltmeter is used continuously or not It has already been pointed out that most voltmeters have persistent magnetism errors, and should therefore be provided with keys, so that the error does not come in. The instruments which have persistent magnetism errors are just those that take a great deal of power to work them, and are apt therefore to get hot if left on. The error from rise of temperature due to the current or power error is therefore avoided by the key, which also avoids persistent magnetism errors. Such instruments as Sir William Thomson's "graded" galvanometer take so little power, even when wound with German silver, that the power error is less than the room error.

If two voltmeter coils of a certain volume were wound with copper wire and German silver wire respectively, and the wires were of the same size, so that the number of turns were the same, the power spent in the German silver coil would be very much greater than that in the copper coil of the current, and therefore, the ampère turns were the same in both. The specific heats taken by volume would not be widely different in the two cases, so that the German silver coil would rise to a higher temperature in a given short time than the copper; and though the variation in resistance per degree of rise of temperature for a copper coil is much greater than for a German silver one, the German silver coil would rise so much higher that its percentage alteration of resistance would actually be greater—that is, assuming the temperature co efficient generally given in books and tables. This would also be true when the ampère turns were the same in both cases, and the coils wound to work with the same electromotive force instead of the same current, if the insulation occupied no room.

In a fine wire galvanometer coil, the insulation, instead of being a mere thin skin outside the wire, occupies four or five times the space that the wire does. If a voltmeter wound with reasonably small wire, as, for instance, 100 or even 50 volts is made with copper wire, the insulation will cut down the volume of the copper so much that it would have been better to have used German silver with a co-efficient of .044 per cent. per degree C

It has been determined that the specific resistance of German silver varies greatly according to the proportion of nickel, and that the temperature co-efficient falls as the specific resistance is increased by adding nickel. For voltmeters, an alloy is wanted with the lowest specific resistance and the lowest temperature co-efficient; for resistance coils the temperature co-efficient is the most important.

In considering the various nickel alloys, there is another point that must not be overlooked, and that is, permanence. Before makers can safely use platinoid or German silver with much nickel, it must be shown that the resistance does not alter with time.

Some makers prefer to wind voltmeter coils with copper wire and put an external resistance of German silver wire in series, and where this can be done it is the best arrangement. The power absorbed in the whole instrument may then be less than would have been taken by the coil or coils wound with German silver, and give the same ampère turns. One maker winds the active coils with copper, and puts a German silver resistance in series nine times the resistance of the coils. The temperature error due to the room is thus very small, and the instrument does not heat so quickly as it would if the active coil were wound with high resistance wire, as a lower current density can be used in the resistance so that there is more metal for each joule to heat. If a voltmeter is to be left on continuously, so that the specific heat does not come in—that is to say, so that the coils rise to that temperature at which rate the heat is carried away by radiation and convection is equivalent to the power spent, the external resistance arrangement is again superior, as it may be easily ventilated.

So far it has been assumed that what is wanted is a given number of ampère turns in a coil of given dimensions. As a matter of fact, however, in most all voltmeters the relative positions of the ampère turns is of paramount importance. Thus, an Ayrton and Perry ammeter, wound with 100 turns of uniform wire, would give a smaller reading with a given current than it would with 50 turns of small wire wound inside and 50 of large outside, occupying the same total space. They therefore wind the wire in several layers of different sizes. The considerations as to the use of German silver or copper wire apply just the same whether it is a question of total ampère turns or of their disposition, provided a coil is wound with the same size of wire throughout. It would be of little use discussing the question of best winding when a voltmeter coil is wound with wires of different sizes, as makers do not generally care to go into such refinements. The action of the coils in most voltmeters is also incalculable. A voltmeter might generally be wound with two sizes of wire with advantage.

The induction balance has been used for testing coils for leaks between wire and wire. If the coil, with its ends unoccupied, affects the exploring coil, the insulation is bad.

COMMUNICATION BETWEEN LIFE-SAVING STATIONS.—An illustration of the necessity of suitable communication with lifeboat stations was given recently off Holyhead, on the Welsh coast, where a vessel was wrecked and eleven people were drowned. The London *Times*, in commenting on the occurrence, says: "It is indeed a disgrace to us, as the greatest maritime nation in the world, that not alone the lighthouses of America, but also those of Denmark, Russia, Sweden, Holland, and France, are fitted with telegraphs or telephones, yet Great Britain still remains without this aid to live-saving appliances."

ELECTRICITY IN IRELAND.—The employment of electricity for lighting and power purposes, says the London *Electrical Review*, has not yet made very great progress in Ireland. the development of these two branches taking place but slowly. This is partly due to the lack of capital on the part of the inhabitants, and partly to the want of enterprise shown by them. In some of the northern counties small arc and glow lamp installations have been put up in different bleach works, spinning, and scutching mills, distilleries, clubs, shipbuilding yards, etc , whilst a few examples may be found in the midland and southern counties.

PHILADELPHIA NOTES.

The firm of de Kosenko & Hetherington, so Mr. G. S. Hetherington tells me, are increasing their business at an unusually rapid rate. Among the most recent contracts which this firm have completed are the beautiful electrolier and combination fixtures for the Girard Building; the Brown Building; the Art Club; the Commercial Title & Trust Company building, all in this city; the new Duquesne Club, and the Fidelity Trust & Title Building in Pittsburg; and the high school at Allegheny. Pa. The Pennsylvania Trust Company's Building in this city is also about finished.

The fixtures in all of these establishments are a permanent testimonial of the artistic taste and thorough workmanship of this firm, and their expression of pride in such handsome and durable work is quite pardonable.

Manager W. C. Pearse, of the United Press in this city, has been decorated with a Grand Army badge, of which he is very proud. He ran away from home when he was but fourteen years of age, and entered the army as a drummer, serving for two years in the Gulf department. Since the close of the rebellion he has drummed up an enviable reputation, which is a matter of considerable consequence to the United Press in a general as well as a local way.

The idea of having the initial letters of the proprietor or members of the firm formed of groups of incandescent lights, prettily displayed in front of store windows, is quite a novelty to Philadelphians, and is rapidly increasing in popularity. Quite a number of these designs are now seen, and they furnish a striking evidence of the immense growth of, and satisfaction with, the incandescent lamp in "quiet" Philadelphia.—ELECTRO.

EDISONS' TALKING DOLLS.—An addition is being made to the Edison factory, at Orange, N. J., for the manufacture of dolls. Judging from the dimensions of the new building doll-making must be a profitable business, and the demand for these talking dolls must be enormous. Anything with Edison's name connected therewith is sure to meet with a great demand.

CATALOGUES.—We have received the new catalogue and price list of the Electric Gas Light Company of Boston. It is very neatly and tastefully gotten up. The company are manufacturers and dealers in electrical goods in general, and not only gas lighting apparatus, as the title would naturally imply. The catalogue is profusely illustrated, and some valuable information on wiring is added.

THE NEW YORK QUOTATION COMPANY.—The stockholders of the New York Quotation Company, which succeeds the defunct Commercial Telegram Company in the delivery of Stock Exchange quotations by means of tickers, on January 27th, elected the following Board of Directors: Robert J. Kimball, Charles Merritt, George G. Ward, John O. Stevens, Edward C. Platt, William H. Baker, and A. B. Chandler. Then the Directors elected Mr. Chandler President, Mr. Ward Vice-President, and George W. Casper Secretary and Treasurer.

The city of Springfield, Mass., granted permission recently to a local company to erect overhead wires for street railway purposes after a thorough investigation of the subject, but Toledo, Ohio, proposes to place as many obstacles in the way of the advancement of electric power as possible.

The new steam cruiser Philadelphia will have two electric light plants of the most approved pattern, and the most compact system adapted to marine work.

NAVY DEPARTMENT SIGNALS.

By a recent general order of the Secretary of the Navy, the following are the signals now used:

The American Morse code, having been adopted by the army, will be substituted for that now used by the navy

The following is the American Morse code:

A - —	F - — -	K — - -	P - - - -	U - - —
B — - - -	G — - -	L — -	Q - - - —	V - - - —
C — - -	H - - - -	M — —	R - - -	W - — -
D — - -	I - -	N — -	S - - -	X - — - -
E -	J — - - -	O - -	T —	Y - - - -
				Z - - - -

NUMERALS.

1 - — — —	3 - - - - -	5 - - - —	7 - -	9 — - - -
2 - - — - -	4 - - - - -	6 - - - - -	8 — - - - -	0 — —

PUNCTUATION MARKS.

Comma - - - - —	Interrogation - - - - — -	Parenthesis Pn
Semicolon Si	Quotation Qn	Bracket Br
Colon Ko	Paragraph - - - - —	Dollar Marks Sx
Period - - - - - - -	Exclamation - - - - —	Dash Dx
Hyphen Hx	Underline Ux	

NOTE.—A fraction is made by inserting a dot between the numerator and denominator. Example: 7/8, — - - - . — - - -

SIGNALS AND ABBREVIATIONS.

1. Wait a moment.
4. Start me.
5. Have you anything for me?
7. Are you ready?
8. Busy on other wires (or stations).
9. Train order (or important military message) give way.
13. Do you understand?
18. What is the matter?
27. Adjust your magnet (or flash).
30. Circuit closed (or close station).
44. Answer quick.
73. Accept compliments.
92. Deliver (ed)
134. Who is at the key (flag or torch)?

Abr. Another.
Ans. Answer.
Ck. Check.
Col. Collect.
D H. Dead head.
G A. Go ahead.
G E. Good evening.
G M. Good morning.
G N. Good night.
G R. Government rate.
N M. No more.
O B. Official business.
O K. All right.
Opr. Operator.
Pd. Paid.
Qk. Quick.
Sig. Signature.

TO SIGNAL WITH FLAG OR TORCH.

The flagman faces exactly toward the communicating station; flag vertical in front of center of body, butt at height of waist. The *dot* (-) is represented by a motion to the right, and the *dash* (—) by a motion to the left of the sender. The *space*, whether separating elements of *spaced characters* (C, O, R, Y, Z, and "&") or separating words, will be represented by a "front" motion. Thus, the motions:

Right, right, front, right represent C
Right, front, right represent ..... O
Right, front, right, right represent ..... R
Right, right, front, right, right represent ..... Y
Right, right, right, front, right represent ..... Z
Right, front, right, right, right represent ..... &

Each motion will embrace an arc of 90°, starting from the vertical and returning to it.

The *long dash* (letter "L" and numeral "naught") is distinguished from the "T" dash by a slight pause at the lowest point of dip, and with this exception there will be no pause whatever between the motions required for any single letter

A slight pause will be made between letters.

At the end of each word, abbreviation, or conventional signal, the space signal, or "front" motion, is made, *preceded and followed by a pause* equivalent to that made between letters.

CONVENTIONAL SIGNALS FOR FLAG OR TORCH.

To call a station.—Signal the "call letter" of the station required or, if the call letter be not known, signal "A" without pause until acknowledged; then proceed with the message.

To acknowledge a call.—Signal "I" three times followed by "front" and the call letter of the acknowledging station.

To break or stop the signals from the sending station.—Signal "A" without pause until acknowledged.

To start the sending station after breaking.—Signal "G A" followed by "front" and the last word correctly received; the sender will immediately resume his message, beginning with the word indicated by the receiver. If nothing has been received, signal "R R." The sender will then repeat all.

Error in sending.—Signal seven dots (- - - - - - -) rapidly, followed by "front," and resume the message, beginning with the last word correctly sent.

End of address.—Signal the period (- - - - - - -), followed by "front."

Signature follows.—Signal "Sig" followed by "front."

To acknowledge receipt of a message.—Signal "O K" followed by "front" and personal signal or initial of receiver.

CONVENTIONAL SIGNALS FOR HELIOGRAPH OR FLASH LANTERN.

To call a station.—Turn a steady flash on the station and keep it there until answered by a steady flash. Both stations will then adjust, each on the other's flash. When adjustments are satisfactory, the station called will acknowledge and cut off its flash and the calling station will proceed with the message.

To acknowledge a call.—Signal "I" three times, followed by the "call letter" of the acknowledging station.

To break or stop the signals from the sending station.—Signal "A" without pause until answered by a steady flash.

To start the sending station after breaking.—Signal "G A" followed by the last word correctly received: the sender will immediately resume his message, beginning with the word indicated by the receiver. If nothing has been received, signal "R R," the sender will then repeat all.

Error in Sending.—Signal seven dots (- - - - - - -) rapidly and resume the message, beginning with the last word correctly sent.

Adjustment.—If the receiver sees the sender's mirror needs adjusting, he will turn on a steady flash until answered by a steady flash. When the adjustment is satisfactory, the receiver will acknowledge and the sender will resume his message.

End of address.—Signal the period (- - - - - - -).

Signature follows.—Signal "Sig."

To acknowledge the receipt of message.—Signal "O K," followed by personal signal or initial of receiver.

CONVERSATIONAL SIGNALS FOR TELEGRAPH.

To call a station.—Signal the "call letter" of the station required until acknowledged signing at intervals the "call letter" of the station calling.

To acknowledge a call.—Signal "I" three times followed by "call letter" of acknowledging station.

To break or stop the signals from the sending station.—Open the key.

To start the sending station after breaking.—Signal "G A," followed by the last word correctly received; the sender will immediately resume his message, beginnig with the word indicated by the receiver. If nothing has been received signal "R R," the sender will then repeat all.

Error in sending.—Signal seven dots (- - - - - - -) rapidly and resume the message, beginning with the last word correctly sent.

End of address.—Signal the period (- - - - - - -).

Signature follows.—Signal "Sig."

To acknowledge receipt of message.—Signal "O K," followed by personal signature or initial of receiver.

MESSAGES BY FLAG, HELIOGRAPH, TELEGRAPH, ETC.

The following will be the order of transmitting the several parts of a message: 1st, number of message and "call letter" of sending station: 2d. operator's personal signal: 3d. the check: 4th, place from and date; 5th, address in full; 6th, period (address complete): 7th. body or message; 8th, Sig. (signature follows): 9th. signature.

The "call letter," operator's personal signal, and check can be used only when previously agreed upon.

EXAMPLE.

The message:—

"WASHINGTON, D. C., January 1, 1889.
John Smith,
50 State Street, Boston, Mass.
Sent goods by express.
Thomas Adams."

Would be sent—

No. 2 W 4 pd WASHINGTON D C 1 To John Smith, 50 State Street, Boston, Mass. Sent goods by express Sig. Thomas Adams.

Abbreviations should not be used in the body of the message; numbers occurring therein must be spelled out in full.

This change of code does not affect the method of enciphering signal messages now in use in and between the army and navy.

THE FERRANTI UNDERTAKING IN LONDON.—Electricians in America and Europe are watching with great interest the outcome of the Ferranti undertaking in London. In our last issue we gave an illustrated description of the great London plant now in course of construction. The Ferranti dynamos are to produce a current of 10,000 volts, and the action of this intense current is naturally a subject of great interest among every one interested in electricity. There is a difference of opinion as to the success of this system. Some think it will certainly fail, while others hold to as strong an opinion in the opposite sense.

TO INCREASE ITS STOCK.—At the annual meeting of the Edison Electric Illuminating Company, held on Jan. 28, these gentlemen were elected Directors: John I. Biggs, R. R. Bowker, C. E. Crowell, C. H. Coster, T. A. Edison, J. B. Henry E. H. Johnson, J. P. Marquand, George F. Peabody, T. S. Smithers, Spencer Trask, Henry Villard, and J. Hood Wright. It was voted to authorize the increase of the capital stock from $2,500,000 to $4,500,000. The issue of $2,000,000 bonds, to bear 5 per cent. interest, was also authorized.

TO OVERCOME ELECTRO-STATIC INDUCTION.—Mr. Gorham Gray has discovered a method of preventing the baneful influences of electro static induction from making themselves obnoxious to telephone users. Mr. Gray says that the shape of the wire, as well as its molecular structure, has to do with its susceptibility to induction from neighboring currents. The common wire is manufactured with a hard surface, and a comparatively soft interior. The hard surface he says, is a thousand times more active in reproducing sound than the sluggish interior. Now Mr. Gray suggests that the interior be hard, and the exterior soft. The current would then, he claims, travel through the centre, and be free from induction. He also suggests that the outside of the wire be corrugated in spiral fashion, his theory being that a current will seek the most direct route, which will be the core. He states that wires of this description are in use in Europe, and several in this country.

INSTRUCTION IN ELECTRICITY.—The electrical department in the Massachusetts Institute of Technology is constantly adding to its experimental equipment by the acquisition of new and useful appliances. There are now to be found in this department many of the finest electrical instruments made.

IMPROVING WINES BY ELECTRICITY.—Experiments are now being made in Italy upon this year's vintage in the electrification of wine. Fifty different sorts of wine have already been experimented upon, and the results have been very satisfactory. The wine is clarified, acquires a "bouquet," and is said to stand equally well transport by land or long journeys by sea.

MAGNETISM.

Dr. J. Hopkinson recently delivered an address before the Institution of Electrical Engineers, in London, on the subject of magnetism, and gave a very interesting and able account of the state of our present knowledge of this wonderful force. The following extracts were taken from his address:

As old as any part of electrical science is the knowledge that a needle or bar of steel which has been touched with a loadstone will point to the north. Long before the first experiments of Galvani and Volta the general properties of steel magnets had been observed—how like poles repelled each other, and unlike attracted each other; how the parts of a broken magnet were each complete magnets with a pair of poles. The general character of the earth's magnetism has long been known—that the earth behaves with regard to magnets as though it had two magnetic poles respectively near the rotative poles, and that these poles have a slow secular motion. For many years the earth's magnetism has been the subject of careful study by the most powerful minds. Gauss organized a staff of voluntary observers, and applied his unsurpassed powers of mathematical analysis to obtaining from their results all that could be learned.

Of late years the development of the dynamo machine has directed attention to the magnetization of iron from a different point of view, and a very great deal has been done by many workers to ascertain the facts regarding the magnetic properties of iron. The upshot of these many years of study by practical men interested in the mariner's compass or in dynamo machines by theoretical men interested in looking into the nature of things is that, although we know a great many facts about magnetism, and a great deal about the relation of these facts to each other, we are as ignorant as ever we were as to any reason why the earth is a magnet, as to why its magnetic poles are in slow motion in relation to its substance, or as to why iron, nickel, and cobalt are magnetic, and nothing else, so far as we know, is to any practical extent. In most branches of science the more facts we know the more fully we recognize a continuity in virtue of which we see the same property running through all the various forms of matter. It is not so in magnetism; here the more we know the more remarkably exceptional does the property appear, the less chance does there seem to be of resolving it into anything else.

What explanations have been offered of the phenomena of magnetism? That the explanation must be molecular was early apparent. Poisson's hypothesis was that each molecule of a magnet contained two magnetic fluids, which were separated from each other under the influence of magnetic force. His theory explained the fact of magnetism induced by proximity to magnets, but beyond this it could not go. It gave no hint that there was a limit to the magnetization of iron—a point of saturation; none of hysteresis; no hint of any connection between the magnetism of iron and any other property of the substance; no hint why magnetism disappears at a high temperature. It does, however, give more than a hint that the permeability of iron could not exceed a limit much less than its actual value, and that it should be constant for the material, and independent of the force applied. Poisson gave his theory a beautiful mathematical development, still useful in magnetism and electrostatics.

Weber's theory is a very distinct advance on Poisson's. He supposed that each molecule of iron was a magnet with axes arranged at random in the body; that under the influence of magnetizing force the axes of the little magnets were directed to parallelism in a greater degree as the force was greater. Weber's theory thoroughly explains the limiting value of magnetization, since nothing more can be done than to direct all the molecular axes in the same direction. As modified by Maxwell, or with some similar modification, it gives an account of hysteresis, and of the general form of the ascending curve of magnetization. It is also very convenient for stating some of the facts. For example, what we know regarding the effect of temperature may be expressed by saying that the magnetic moment of the molecule diminishes as the temperature rises, hence that the limiting moment of a magnet will also diminish; but that the facility with which the molecules follow the magnetizing force is also increased, hence the great increase of μ for small forces, and its almost instantaneous extinction as the temperature rises. Again, in terms of Weber's theory, we can state that rise of temperature enough to render iron non-magnetic will not clear it of residual magnetism. The axes of the molecules are brought to parallelism by the force which is impressed before and during the time that the magnetic property is disappearing; they remain parallel when the force ceases, though, being now non-magnetic, their effect is nil. When the temperature falling, they become again magnetic, the effect of the direction of their axes is apparent. But Weber's theory does not touch the root of the matter by connecting the magnetic property with any other property of iron, nor does it give any hint as to why the moment of the molecule disappears so rapidly at a certain temperature.

Ampère's theory may be said to be a development of Weber's: it purports to state in what the magnetism of the molecule consists. Associated with each molecule is a closed electric current in a circuit of no resistance; each such molecule, with its current, constitute Weber's magnetic molecule, and all that it can do they can do. But the great merit of the theory—and a very great one it is—is that it brings magnetism in as a branch of electricity; it explains why a current makes a magnetizing body magnetic. It also gives, as extended by Weber, an explanation of diamagnetism. It, however, gives no hint of connecting the magnetic properties of iron with any other property Another difficulty is this: When iron ceases to be magnetizable, we must assume that the molecular currents cease. These currents represent energy. We should therefore expect that, when iron ceased to be magnetic by rise of temperature, heat would be liberated; the reverse is the fact.

So far as I know, nothing that has ever been proposed even attempts to explain the fundamental anomaly: Why do iron, nickel, and cobalt possess a property which we have found nowhere else in nature? It may be that at lower temperatures other metals would be magnetic, but of this we have at present no indication. It may be that, as has been found to be the case with the permanent gases, we only require a greater degree of cold to extend the rule to cover the exception. For the present, the magnetic properties of iron, nickel, and cobalt stand as exceptional as a breaeh of that continuity which we are in the habit of regarding as a well-proved law of nature.

SEALED PROPOSALS.

The trustees of the village of Bath, Steuben County, N. Y., request sealed proposals for a system of lighting the streets of said village by electricity by 20 arc lights of 2,000 c. p. each, and 15 incandescent lights of at least 25 c. p. each. Said lights to be located within the corporate limits of said village, at such points and places as may be directed by the said board of trustees in accordance with a map and specifications filed for said purpose with the clerk of said village. Said proposals are to contain bids or proposals for additional arc or incandescent lights in excess of the number hereinbefore specified to be placed and located at any and all times, at such points or places, as may hereafter be determined by said board of trustees Proposals are to be indorsed "Proposals for the electric lighting of the village of Bath, Steuben County, N. Y.," and filed with the clerk of said village on or before Feb. 10, 1890 The said trustees reserve the right to reject any or all bids or proposals for said purpose.

Dated BATH, Jan. 22, 1890.

INSURANCE COMPANY'S ELECTRIC LIGHTING RULES.

The following are the rules of the Boston Manufacturers' Mutual Fire Insurance Company for guarding insured property against the hazard of stray currents of electricity generated outside of mill yards:

1. No foreign wires of any kind shall be attached to buildings insured by this company, for the purpose of carrying electric currents across the yard to any point.

2. All electric wires which may be required by the insured shall enter the premises at one point near the headquarters of the night watchman, where they can be kept under supervision; each of said wires shall be guarded by a protector against strong currents, operating by opening the circuit, and by a lightning arrester.

3. Such protectors against strong currents shall be located in a dry, accessible place inside the building, and as near the point of entrance of wires as possible, and shall be without ground connections; such protectors shall be mounted on non-combustible and insulated supports, which shall be provided with a receptacle for the burning of melted parts of such apparatus.

4 The lightning arresters on all wires must be placed between the protector against strong currents and the electrical portion of the apparatus within the building to which such wires are connected. No ground wires for such lightning arrester shall be attached to gas pipes within the premises of the insured.

5. All electric wires which may enter the premises of the insured must be isulated between the line wires on the insulator attached to the building outside and the protection device within, with the best quality of waterproof insulation. Moreover, such wires must enter at a distance of not less than three inches from any other wire or any conducting material.

6. If any wires carrying high tenison or strong currents are to be carried over or under other wires on the property of the insured, they shall be attached to the poles so near to each other, with one wire so far above the other, that if a break should occur, the pendent wire between these poles may not be long enough to come in contact with the wire below, or, if not carried on poles, these wires shall be so placed or protected with guard wires as to render a contact between different wires impossible.

7. If the high and low tension systems are in use in the same yard, even when developed within the works, the wires must be kept separate, and so wide apart that no contact or cross arc can be made.

THE NEW EDISON BATTERY.—Some inquiries having been made in regard to the adaptability of the new Edison battery to doing light work, such as running sewing machines, etc., Mr. James F. Kelly, the general sales agent for the Edison machine works, says a ⅛ horse power C. & C. motor, with six of the new cells will run a sewing machine, but that 8 cells would be required if the machine was doing heavy work. If the motor takes 10 ampères this battery will operate it for 30 hours continuously without any attention. If a 20 ampère motor is used the battery will run 15 hours. Such a performance cannot be equalled by any battery on the market. The Perrett motor, we understand, can be operated with a current of 6 amperes. The battery would, therefore, operate this motor for 50 hours continuously.

THE FRANKFORT EXHIBITION.—It is said that the opening of the proposed Electrical Exhibition at Frankfort-on-the-Main has been postponed until May, 1891.

ELECTRICAL MACHINE ROOM OF THE HALLES-CENTRALES, PARIS—Our engraving shows a view of a part of the great machine room of the municipal central station at the Halles-Centrales, Paris. It is one of the most complete and effective electrical establishments on the Continent. We are indebted to *L'Illustration* for our engraving. On the left are seen the Edison dynamos, and on the right alternating current machines. This is probably one of the most perfectly equipped stations in the world, and the substantial and artistic manner in which the plant is laid out may be considered as a monument to the faith of the French people in electric lighting.

BRITISH TELEGRAPH MONEY ORDERS.—The telegraph money order system in conneciion with the British telegraphs has not been in operation long enough for the annual statement of the head of the department to give an opinion as to its success. Our English cousins are very slow in this matter. For lessons in progress they should pattern after America, but that would not be quite H'Inglish.

PATENTS IN HOLLAND.—Some years ago the patent laws in the Netherlands were abolished, and at the present time no patents are granted. There is now, however, some agitation in favor of the re-enactment of the old laws. It is urged that Holland would soon be excluded from the family of industrial nations if she does not re-introduce a patent system.

An electric light employé at Louisville, Ky., recently cut 24 fire alarm wires and was arrested. He said he thought the wires were "dead."

THE ELECTRO-MECHANIC'S ENTERPRISE.—*The Electro Mechanic*, of Kansas City, began the new year in a manner that indicates prosperity. At that time it was made a weekly, and there is no doubt it will enlarge and make itself more and more necessary to electrical interests in the Southwest. It has a large field practically all to itself and we trust it will receive a full measure of prosperity. During the National Electric Lighting Convention at Kansas City *The Electro Mechanic* will be issued daily, and will faithfully record everything that transpires during the sessions and matters in general in connection with the convention. We hope that the enterprise will be amply rewarded.

SAFETY RAILROAD SIGNALS.—By an ingenious signalling device, which has lately been put into operation, a "shunt" circuit is formed, so connecting the semaphore signal and the operator's key, that when the safety signal is displayed the key cannot be used. The result is that the signal man must keep his signal at the normal danger point when a call distracts his attention.

THE ELECTRIC LIGHT IN MEDICAL EXAMINATIONS.—In the recent medical experiments on horses in Vienna, the incandescent lamp played an important part. The subject under investigation was disease of the nostrils, and by inserting the lamp with mirrors very successful results were obtained. The apparatus was provided with a cooling arrangement, allowing cold water to circulate round the lamp.

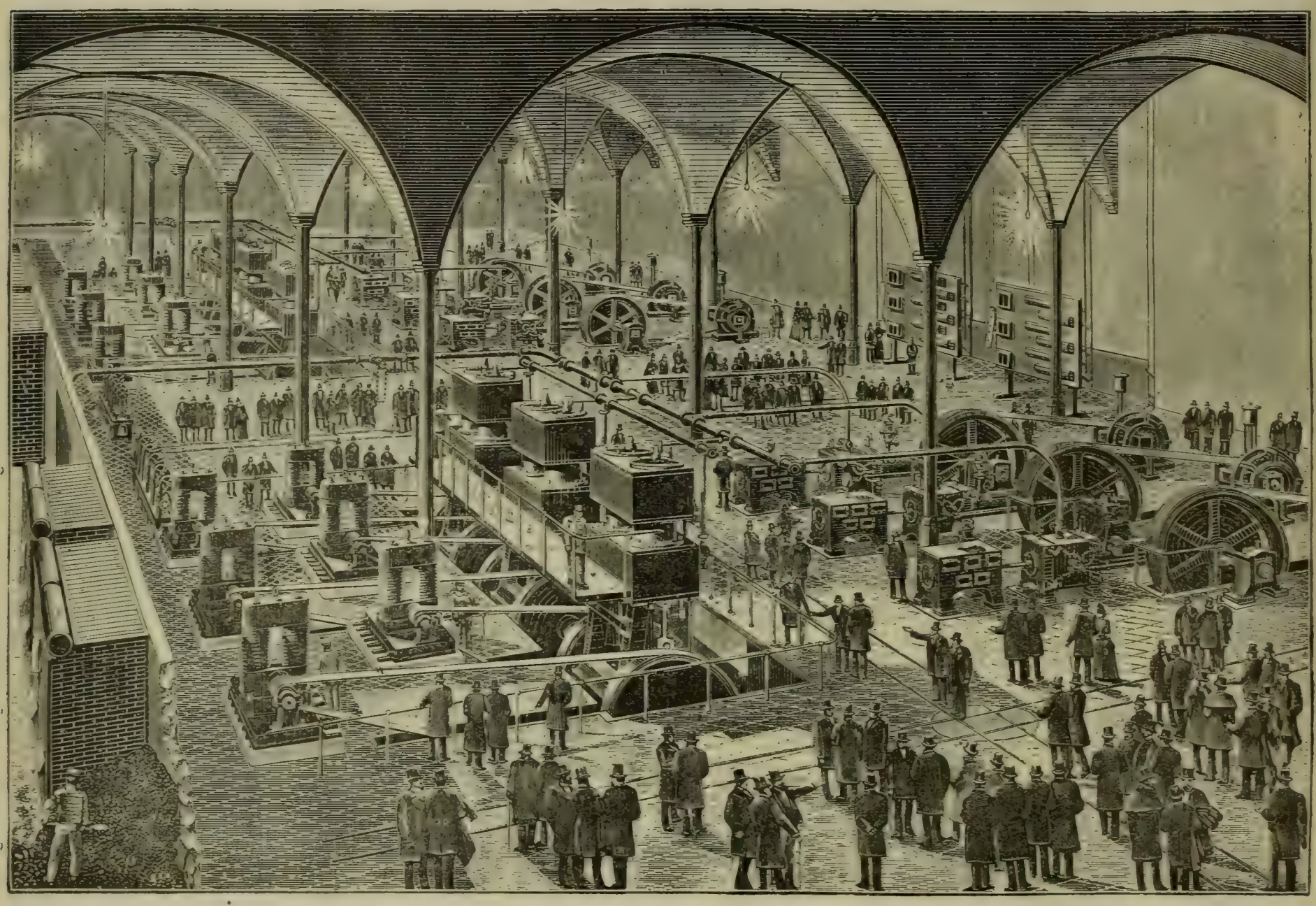
Fort Worth, Texas, has decided to operate an electric light plant of its own. The Wood and Edison Companies will install a $27,000 plant.

THE PHONOGRAPH COMPANY.— During the last six months the North American Phonograph Company has distributed through the agency of sub-companies 6,275 phonographs. The parent company owns all the machines, and they are leased to sub companies at a rental of $20 per year each. The sub-companies rent them to the public at $40 per annum, and keep them in good order. Over 100 phonographs are already being used by prominent government officials in Washington. The manufacturers are delivering on an average 60 machines a day. The North American Phonograph Company owns the Edison patents, and is licensee of the American Graphophone company, and thus enjoys a monopoly of the phonograph business.

CONSOLIDATION. — The Keystone Construction Company, the Marr Construction Company and the Washington Carbon Company of Pittsburgh, have consolidated under the name of the North American Construction Company. The office of the new concern is in the Westinghouse building, and the company will do exploiting and electric construction both for central stations and railway work, and also build, lease and operate central station plants.

POSTAL TELEGRAPH EXTENSION.—The Postal Telegraph Company are making rapid progress in the extension of their lines. They have just completed a new line to Boston, and in the South their lines have reached Wilmington, N. C. The work, it is said, is done in a first-class manner. Two wires are being strung to Wilmington.

A company has been organized for the purpose of constructing an electric railway between Champaign and Urbana, Illinois. The capital stock of the company is $150,000.



DYNAMO ROOM OF THE CENTRAL ELECTRIC LIGHTING STATION, PARIS, FRANCE.

A RECEPTION TO THE CONVENTION DELEGATES.

The Commercial Club of Kansas City has unanimously decided to give a reception to the delegates to the National Electric Light Convention. The reception will take place on the evening of the first day of the convention, February 11th. The object is to give the visitors an opportunity to meet Kansas City's representative men.

In thanking the club, President Weeks, of the National Electric Light Association, said:

"When you remember how much the commerce of the world owes to electricity, the resolulution just passed by the Commercial Club of Kansas City seems most appropriate. In view of the fact that the press is now teeming with what are often sensational reports of our shortcomings, and in view of the fact that the public seems disposed, like Brutus, to set all our faults in a book to be learned and 'conned over by rote,' and seems inclined to either forget or ignore our past services and present usefulness, your action is most timely and will be fully appreciated by the electrical fraternity of the whole country. In the National Electric Light Association both the scientific and commercial elements are represented. The Association may be said to be like the shield in the fable—both gold and silver. We have the gold of pure science and the silver of practical application. There are men like Prof. Rowland who, without a commercial consideration, devote their lives to study and experimental researches. There are also men of affairs who have put hundreds of millions of dollars into applied electricity and who lose sight of no commercial consideration. Kansas City is now throughout the civilized world a synonym for enterprise and progress, and Kansas City, Mr. President, bids fair soon to become as generally recognized as a synonym for hospitality. By your action you have honored the National Electric Light Association, and have done that which will redound to the honor and profit of the commercial interests of Kansas City. On behalf of the National Electric Light Association I thank you."

THEFTS OF WIRE. — The removal of electric light wires from the poles in this city has given plenty of opportunity for the wholesale theft of valuable material. The latest trick to steal this expensive wire was that perpetrated on Courtland street a few days ago. Three young men climbed a pole of the U. S. Illuminating Company, and commenced to take down some of the wires. Supposing, of course, that they were the company's own workmen, nothing wrong was suspected, even by the Superintendent, who chanced to pass by. He gave them orders touching their work, to which they replied, "All right, sir." It was afterwards discovered that they were audacious thieves. They carried off $40 worth of wire. One of the thieves, James McAlloon, was arrested. He refused to give the names of his accomplices.

A NEW USE FOR ELECTRICITY.—Electricity promises to become an important factor in deep seam coal mining. On the basis of both American and English experience the cost of the electrical plant is computed at something like 75 per cent. of that of compressed air plants of similar effective power, whilst they will give something like double the efficiency. Having regard to the ease with which energy can be conducted by the copper conductors into parts now inaccessible except to hand and horse labor, it is thought not improbable that in some colliery centres, where a number of pits are worked within a comparatively small area, large power stations will be erected on similar lines to the central lighting stations, and from them power distributed to motors below ground. The cables in many cases will be run on the surface and carried below through special bore holes of small diameter, by which means the cost of insulation would be much reduced. Assuming that such machines are used in non-gaseous seams, the cost of coal should be very considerably reduced.

THE BOARD OF ELECTRICAL CONTROL.—An important meeting of the Board of Electrical Control was held on January 31st. It was called for the purpose of determining what streets were to be opened for conduits. Engineer Kearney submitted a list authorizing subways for telegraph and telephone companies only in the following named streets:

Greene street, from Spring to Canal; Eighteenth street, between Seventh and Eighth avenues; Eighth avenue, from Eighteenth street to Thirty-fourth street; Twenty-third street, from Second avenue to Madison avenue; Fifty-eighth street, from Tenth avenue to the Hudson river; Seventy-ninth street, from First avenue to Avenue A; One Hundred and Twenty-fourth street, from Lexington to St. Nicholas avenue; Twenty first street, from Lexington to Fourth avenue; Lexington avenue, from Seventy-ninth street to one Hundred and twenty-ninth street; Third avenue, from One Hundred and Twenty-ninth street to the Hudson river

Then a long list of streets through which the subway company proposes to put subways for electric light wires was taken up for consideration. In some instances, where a street was included that had already been repaved, permission to build the subways was refused. Fifth avenue from Fourteenth to Thirty-fourth street was one of these. The same action was taken in reference to Chambers street from West street to Park Row, and Franklin street from Greenwich street to Broadway.

One of the features of the meeting was the announcement by Mr. Lauterbach, of the Subway Company, that his company was willing to divide the work with the Standard Company. At previous meetings his contention had been that no contracts for subway construction could be awarded to any other corporation.

The Mayor did not want any action taken on the Subway Company's proposition until he had time to look into matters a little. He had heard that the Subway and Standard Companies had formed a combination, and he suspects that a monopoly will be the result.

What is behind the change of front made by Mr. Lauterbach's company toward the Standard Company is an interesting matter of speculation. The Standard Company is credited with being a Westinghouse concern. The Westinghouse people control the United States Illuminating Company and the local Brush Company, and these companies want to put their own wires under ground.

EXTENDING TELEGRAPHS. — The Commercial Union Telegraph Company are putting up eight new wires—one from Boston to Newburyport, along the line of the eastern division of the Boston and Maine Railroad, through Salem, Lynn and other towns, and one from Albany, N. Y., to Boston. A third wire is being run from Portland to Lewiston, which will connect the Commercial Union with the Canadian Pacific, and gives them two lines to New York, St. Louis, Chicago and Minneapolis, one by the way of Halifax, the other by the way of Portland.

THE INTERIOR CONDUIT AND INSULATION COMPANY.—The operations of the Interior Electrical Conduit Company have been enlarging so rapidly and the application of its insulating processes become so general and diverse as to render the present organization wholly inadequate. A new company has in consequence been organized, and will not only acquire the stock and property of the Interior Electrical Conduit Company, but as well certain new and valuable inventions in the same general line.

The new company is called "Interior Conduit and Insulation Company;" capital, one million dollars. The incorporators are Edward H. Johnson, Edwin T. Greenfield, Sigmund Bergmann, J. H. McClement and Ph. H. Klein. It is anticipated that the operations of this company will excite a lively interest among the electrical fraternity.

ELECTRICITY IN CERAMICS.—Electricity is gradually being introduced into ceramic operations for the purpose of purifying quartz and kaolin from oxide of iron. The powder to be operated on is, according to this method, placed in a hopper, whence it falls into a receiver rotating rapidly on a vertical axis, this receiver being also surrounded by powerful magnets of triangular section; the purified powder then falls into a second receiver, and, after undergoing a similar purification in this, it is, as a rule, ready for use. The cost of this process is small, and it is stated that, by means of its employment, substances can now be used which were formerly rejected on account of the quantity of iron contained in them.

AGAINST THE WESTERN UNION.—In the United States Circuit Court at Boston, on January 29th, Judge Colt rendered a rescript in the case of the Attorney General of Massachusetts against the Western Union Telegraph Company, being a claim of the State for the payment of taxes disputed by the company. On the basis of the rescript the taxes for 1886, 1887 and 1888 are to be collected.

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TROUBLES OF AN ELECTRIC RAILROAD.—Application was made in the United States Circuit Court at Topeka, Kansas, on January 25th, for the appointment of a receiver for the Topeka Rapid Transit Railway, and for the foreclosure of a mortgage on that road.

The Electric Company built about twenty miles of electric road for the Rapid Transit Company, the cost being $186,000, which was payable by bonds secured by mortgage By arrangement with the Metropolitan Trust Company, approved by the Thomson-Houston Company, first mortgage bonds in the sum of $600,000 were issued by the railway, and a trust deed of the property as security was issued.

The Thomson-Houston Company accepted $100,000 of these bonds, and it claims a balance of $86,000. It asks for the immediate delivery of the bonds, and in case of default, that the railway be sold or placed in a receiver's hands. The Metropolitan Trust Company of New York is made a party to the suit.

The Rapid Transit Company will oppose the application for a receiver. "The Rapid Transit Company has the $86,000 bonds claimed by the Thomson-Houston Company," it says, "and proposes to keep them until the Thomson-Houston Company complies with the contract with us. Under our contract with the Thomson-Houston Company, the bonds were not to be delivered until the equipment was furnished and the plans completed and occupied by this company. The plans have not been carried out nor the terms of the agreement. They agreed to furnish us with a guarantee protecting us in the patents used by them, and to furnish us with a bond guaranteeing to furnish us with all electrical improvements at a reasonable price, and without royalty charges. That guarantee they have not so far kept."

ELECTRIC ROADS IN SWEDEN—Electricity is being adapted to a very large extent in Sweden. In Christiana the question of an electric tramway is being discussed. A committee appointed to inspect the electric roads of various countries has reported that electric tramways are both the safest and the cheapest and the result is that extensive schemes for electrical tramway installations are being developed.

ELECTRICITY IN SURGERY.—Dr. Thomas Keith in the *British Medical Journal* is a warm advocate of electricity for the treatment of uterine tumors. He considers it preferable to hysterectomy, which gives a high mortality, although the disease itself seldom shortens life, whereas electricity relieves the patient of all troubl some symptoms. However, as this method of treatment is not without danger, even in the hands of experts, Dr Keith insists that the surgeon should not merely "get up" his case, but should be well up in the science of electricity. Two cases re reported in the *Journal* as having been successfully treated by electricity.

A NEW THEORY OF THE CIRCULATION OF THE BLOOD.—According to a physician the motive power of the blood is not the hydraulic action of the heart, but electricity. The lungs are kept continually positive by the oxygen or electricity of the atmosphere, and the impure blood coming from the extremities of the system in a negative condition is made pure and positive; but as the law of electricity is that two positives must repel one another, the blood is forced from the positive lungs to the heart, and thence over the system The heart regulates the system precisely like the pendulum of a clock, but gives no motive power.

THE TELEGRAPH SYSTEM IN INDIA.—According to the *Pioneer* (Allahabad), the advisability of putttng the Indo-European and Indian telegraph systems under separate heads, is once more under consideration.

STANDARD TABLES FOR INCANDESCENT WIRING.—The second edition of the valuable and handy little book of the above named title is out. The author, Mr. Chas. M. Davis, Pueblo, Colo., has compiled a great many important facts, and these together with a good deal of original matter and illustrations go to make up the contents of the book The title of the book, however, is rather narrow in its application. In fact it has a good deal to say on arc lighting, and this addition makes it all the more valuable. Every one interested in electric lighting should possess a copy of this little volume, as it will serve to throw light on important points by a moment's search. It is of a size sufficiently small to carry conveniently in the pocket.

TELEPHONE AND ELECTRIC LIGHTING WIRES.—In Bamberg, Bavaria, the telephone and electric lighting wires do not get on at all well together; so much so that during the hours of lighting the telephone service between that place and Nuremberg comes to a standstill. An official investigation has brought to light that the so-called induction is transmitted by the earth, and largely, by means of the water mains.

A GEOGRAPHICAL ERROR.—The London *Electrical Review* is evidently not very well posted on American geography. It tells its readers how a theatre at "Tremont, New England" is fitted with electric doors, etc. What was undoubtedly meant is the Tremont theatre in Boston.

A ROTARY ARC LAMP.—A rotary arc lamp is soon to be put on the market by a Boston firm. In place of the ordinary pencil carbons, carbon discs are to be used, and as these are consumed they revolve presenting new surfaces for the arc. It is said these lamps will last 40 or 50 hours.

A RE-VOLT IN BOSTON.—The common council of Boston has ordered "that the joint committee appointed to consider the subject of superintendence of electric wires in the city also considers the advisability of reducing the voltage of overhead electric light wires to 500 volts."

BOSTON'S ELECTRIC LIGHTS.—The electric light question in Boston is still as big a muddle as ever. The more the papers try to explain the whys and wherefores for and against electric lighting the more mixed they get. They are doing a good deal of talking but little work.

THE BOSTON FIRE.—The report of the Fire Marshal of Boston throws no light on the cause of the great fire on Thanksgiving Day. The cause has generally been ascribed to the crossing of an electric light wire with a clock wire running into the building in which the fire started, but nothing definite on this point could be determined. This version of the cause is, however, disputed by many, and the fact that all the clocks on the circuit in question are reported to have stopped early on Thanksgiving Day, does not necessarily prove that the stoppage of the current caused the fire. The breaking of the circuit may have been the effect, not the cause of the fire. The real cause of the conflagration probably will never be known.

RECORDING COMPASS.—It has long been recognized that if a permanent record could be kept automatically and continuously of the course travelled by a ship, much information could be gained, and possibly considerable economy effected in the time of the ship's passage, and also in the fuel consumed. A device has been designed by which the compass is under the influence of the current for but the fraction of a second each minute, and at that time is fixed in its position. The records obtained in this way will afford ample means of checking the vigilance of the wheelman, and its adoption will go far towards securing exemption from many accidents from carelessness.

THE ELECTRIC LIGHT AS AN INVESTMENT.—The electric light is becoming recognized as one of the best paying investments in this country. An electric-lighting company in Pennsylvania is an instance of good profits. From the time they started, some three years ago, the company has paid an annual dividend of 17 per cent. to the shareholders.

RAILWAY STATION INDICATOR.—An electric indicator of the names of railway stations is coming into use in England. A magnetic apparatus turning a roller on which are printed the names of stations in good visible letters is fitted over the window of every carriage, with an electric bell to call the attention of passengers to the change. The instruments are connected in series, and are under the control of the guard, who changes the names by a simple touch of a button before the train stops.

NARROW ESCAPE OF A QUEEN.—A press dispatch from Athens says the Queen of Greece had a narrow escape from a frightful death on January 24th. While driving through the streets in an open carriage an electric wire broke. A portion of it fell upon the Queen and tightly enwrapped her. Several officers sprang to her aid and quickly extricated her. Within a minute after the wires were removed from her the current was turned on, so her escape is regarded as almost miraculous.

AN IMMENSE MAGNET.—The members of the American Society of Civil Engineers, which recently held its annual meeting in this city, were shown everything of scientific interest about the town. They were taken to Willett's Point and shown the so called magnetic gun. This gun is wrapped with wire and connected with a dynamo. The magnetism produced is so strong that a ball weighing 300 pounds, and lying some five feet distant, is drawn into its mouth by attraction. Spikes thrown at the gun stood out like bristles, and an iron wheelbarrow once in contact, the strength of a man was not sufficient to pull it away.

ELECTRIC CLUBS.—Electric clubs are all the fashion these days. Atlanta, Georgia, is organizing one.

WHO INVENTED THE LIGHTNING ROD?—Everbody believes that Franklin was the inventor and constructor of the first lightning rod. It now appears that the first lightning rod was invented by a poor monk of Scuttenberg, Bohemia, who put it up on the palace of the Curator of Preditz, Moravia, June 15, 1754.

THE NEW ENGLAND ELECTRIC EXCHANGE.—The New England Electric Exchange held its regular quarterly meeting in Boston on the 13th of January, President P. H. Alexander in the chair. The report of the committee on examinations showed that 247 applicants had been granted licenses, and 14 had been promoted to higher grades.

Mr. Ridlon suggested the advisability of educating newspaper reporters in electrical matters, so that facts would be more closely adhered to in describing electrical events.

Canvasser (representing an electric time service)—I would like, sir, to put into your superbly furnished office one of our synchronizing or electric clocks.

President (of the Neverbust Bank)—How strong is the current that runs it?

Canvasser—One volt advances its hands one second.

President—So it is one volt after another all day long, or the same volt over and over again, eh? Well, sir, we want nothing revolting in here. Good day!—*Ex.*

It is reported that the Edison company is to erect immense central stations in Buffalo, Montreal and San Francisco.

THE ELECTRICAL TRAIN TO THE CONVENTION.

President E. R. Weeks, of the National Electric Light Association, has written a letter to H. Hubert Humphrey, principal member of the Woodward Electrical Company of Detroit, requesting that the electrical train which that company proposes running from Detroit through to Kansas City precede the "Electric limited" from New York. The Detroit train consists of two special cars and a motor car, and they will be manned by competent electricians all the way. Storage batteries will be used in connection with the electric motor. There will be no smoke, no cinders, and no coughing from an unshapely smoke stack, but the train will move along steadily and easily with little or no noise, at a rate of speed equal to that attained by ordinary passenger trains. The motor car will resemble an ordinary cable grip-car more than anything else.

This train will stop only at Chicago and Quincy, as is thus far known. In these two cities the cars will be transferred from the railroad tracks to the street car tracks, as the gauge is adjustable to any width, from the broadest railroad gauge to the narrowest country hamlet bob-tail street car track. Exhibitions will be given in the two cities named and in Kansas City also. Here the train will be tried on the several cable tracks and the citizens given an opportunity to see something that will astonish them more than the cable system did four years ago. These special cars will be handsomely fitted up with reference to both ease, portability and convenience. They will be much lighter than the ordinary day or sleeping car and smaller in every way. Berths will be fitted up that will be as comfortable to repose upon as those of the most luxurious Pullman or Mann boudoir palace. The cars will be stocked with a handsome outlay of provisions, so that the train may be said to have its dining car with it all the time. When it is found necessary to restock with motive power the train will stop at a town where there is an electric light station and recharge its storage batteries.

Aboard this electrical flyer will be a party of electrical experts and newspaper men, who have been invited by Mr. Humphrey to ride on the first long distance electric motor trip.

There will be ample power to propel the three cars and to spare in case of unusually steep grades or when a burst of speed is desired.

GAS AND WATER PIPES AS LIGHTNING CONDUCTORS.—Very recently the Electro-Technical Union, Berlin, has been investigating many cases of stroke by lightning, and considered it important to obtain as many reports as possible of instances where lightning had struck and was conducted away by gas or water pipes, whether inside or outside of buildings. There is no doubt this has occurred oftener than generally supposed; that such cases are not more known is because they have usually been without much damage—the pipes being good conductors of electricity. There will generally be freedom from injury when lightning passes to such pipes even through combustible substances in a building, excepting if passing through wood. From lightning thus striking and conducted, usually but slight traces remain, and may therefore be not noticed or considered worthy of mention. On the contrary, a knowledge of the slightest circumstances appertaining to this subject is of considerable importance, for determining what influence gas and water pipes have as conductors of lightning.

NEW BUILDING FOR THE EDISON COMPANY.—The Edison Electric Light Company has filled plans for a new ten-story structure, to be built of marble and iron, at Nos. 38 and 40 New street, running through to Broad street, and to cost $250,000.

THE SCOPE OF THE ELECTRIC AGE

It is our purpose to make THE ELECTRIC AGE a journal that can be read with profit and pleasure by students of the science of electricity as well as by experts. We intend to publish in each issue one article at least in explanation of the construction of the innumerable instruments used in the various branches of electrical industry, and of the various uses to which they are put, etc. In these days of rapid advancement in electrical development and in the eagerness to keep up with the times, it is easy to overlook the fact that there is constantly coming into electrical service, in one line or another, young men who need some rudimentary instruction in their particular branch of the service. In our own rapid progress, we will not be unmindful of those who are to follow; and it is our purpose to devote some of our space to doing what lies in our power to help along and instruct all young men who are battling with the perplexities which beset all newcomers into the field of electricity. To these it is discouraging to read in the electrical papers, columns and columns of matter that is just as intelligible to the young student as so much Hebrew. What those less advanced in electrical knowledge want is to read something that they can understand and be instructive to them. They want to know how electrical instruments are made and all about them; why they are made thus and so, and how to use them. Something practical is the thing, and that is what we are going to give them. We will keep right to the front and record everything of note and value that transpires in the highest planes of electrical development, so that when the student steps into the field of practical work, he will find THE ELECTRICAL AGE just as valuable to him as it was when he began his studies and investigations into the greatest of sciences. Our articles will be on diverse subjects. We will cover the entire field of electrical industry. In accordance with this policy, we publish in this issue an article of this character, viz.: "Voltmeters," In appreciation of our efforts in this direction, Mr. J. M. Lennon, inventor of the Lennon Dynamo, Minneapolis, Minn., writes: "Having had the great pleasure of reading and examining various copies of your publication, I write to let you know of my hearty appreciation of so able an effort to furnish a cheap and practical paper for the uninstructed. * * * Your paper fills a great gap."

STAMP CANCELLING MACHINE.—The post-office authorities at Washington have found the stamp cancelling machines, now on trial in several of the larger post offices, very useful, and there is a probability that many of them will be put in operation during the year. The plan of driving them with ¼ horse-power electric motors has not proved as successful as desired, for the reason that, in a number of places, the current supplied from central stations has been too unsteady and intermittent. Post-offices provided with independent lighting plants have less trouble than those dependent upon outside plants. The service demands some motive power that will be reliable and available at all times, day and night, and a motor that does not make much noise. One of these machines has been in use in the New York post office for the past seven months, and does very excellent work. It is claimed that it will cancel, postmark, count and stack the letters and postal cards at the rate of 30,000 per hour. It has actually cancelled 24,000 postal cards in one hour.

The big guns now being made in the English arsenals are fitted with a device to facilitate firing at night. The ordinary sights are illuminated by a small incandescent lamp, the rays from which, passing through a lens, are converged, so that only a minute point or line of sight, is obtained.

THE KANSAS CITY CONVENTION.—The arrangements for the convention of the National Electric Light Convention to be held on the 11th, 12th, 13th and 14th instant, are about completed. The Coates House will be the headquarters of the delegates during their stay in the city. The rooms of the officers will be on the second floor of the hotel. The convention will be held in the Coates Opera House, which is within convenient distance of the hotel. The Casino, in which the electrical exhibits will be located, is in the same block. The Kansas City electric light companies have agreed to furnish the necessary current. Every effort is being made to make the visit to the metropolis of Kansas one which will never be forgotten. The committee in charge of the entertainment of guests are hard at work perfecting their plans for the thorough enjoyment of the delegates. A large exhibition of electrical apparatus is expected, and it is possible that the Music Hall may have to be utilized as an annex to the Casino. The latter hall has a total area of 6,000 square feet, and the way applications are coming in it looks as though this space will be insufficient.

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Built for Direct Two-Wire, Three-Wire, Five-Wire to Nine-Wire, and all Alternating Systems, in sizes from 15 up to any number of ampères. Every counter measures correctly the amount of current consumed from a fraction of an ampère up to its full capacity.



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In use by European Central Stations measuring over 60 million watts. Unquestioned superiority. Indispensable for Central Station work. Amount of current consumed may be ascertained at a glance, the dials being constructed on the same principle as the gas meter dials.

OPINIONS OF AMERICAN ELECTRIC LIGHT COMPANIES.

DOVER, N. H.

We have tested the Aron Counter and have no reason to doubt its reliability. We beg to enclose check for a few counters at $75 to be supplied.

H. W. BURGETT,
Treasurer Dover Electric Light Co.

SAN FRANCISCO, CAL.

The Aron Counter is the best instrument we have ever seen. We have thoroughly tested that Counter for alternating current and are satisfied that it will work correctly.

GEO. H. ROE,
Secretary San Francisco Electric Light Co.

BROOKLYN, N. Y.

We have four Aron Counters in use for some months, during which time no trouble has been experienced in regard to [illegible] of same, and satisfactory readings have been obtained. Yours very truly,

C. J. FIELD,
General Manager Edison Illuminating Light Co.

MANCHESTER, CONN.

We find that the Aron Counters register as accurately as is necessary for the purpose to which such meters would be applied. We have perfectly satisfied ourselves of their adaptability.

WM. A. ANTHONY,
Mather Electric Light Co.

LYNN, MASS.

Dear Sir:—The Aron Electric Counter works very satisfactorily. Yours, etc.,

THOMSON-HOUSTON CO.

FOR PRICES AND PARTICULARS, ADDRESS:

W. HACKENTHAL, Sole Manufacturer and Importer, 21 BEEKMAN STREET, NEW YORK.

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THE ELECTRIC LIGHT CONVENTION.

To each and every member of the Electric Light Convention we extend our compliments.

We trust that this visit to Kansas City will be one of profit and pleasure, and that when the delegates return to their respective homes they will feel that their time and money were well spent.

This convention is an important one. The advances made in the improvement of electric lighting are rapid and great.

By a general meeting means are provided for a free interchange of experiences and opinions, and every person in attendance knows that he will learn a good many things he did not know before, however expert he may be in his particular line.

Every individual's experience is, in one sense, narrow and limited, in itself. Men's experiences are as varied as are their minds.

Each person sees many things and brings out many points that others overlook.

No finite mind is capable of attaining a perfect knowledge on any subject.

Every man's experience added to the general fund of knowledge means another step forward toward perfection.

It is so in electric lighting as in everything else.

The difference between electric lighting and other industries is that there is always a great deal to learn, hence the importance of a convention such as this.

Every delegate present will, we are sure, profit by his attendance, and we hope that electric lighting will receive such an impetus as a result of this convention that it will soon become, in a physical sense, the light of the world.

To paraphrase the utterance of a great man of nearly twenty centuries ago, let your light so shine that it may reveal the good work of man in overpowering darkness.

THE BILL TO REGULATE INTERSTATE COMMERCE BY TELEGRAPH.

The bill recently introduced in the United States Senate to regulate interstate commerce carried on by telegraph has been reported favorably by the Committee on Commerce.

The bill provides that it shall be unlawful to make unreasonable charges for the service; to give any unreasonable preference or advantage to any person or firm; to enter into any pool for the division of receipts; to give any rebate or reduction in price to any person, firm or corporation not given to others. It is further provided that every telegraph company shall publish its rules from time to time as prescribed by the Commission, and shall file with said Commission a sworn schedule of rates.

Failure to perform any of the requirements of the act makes the company liable to the person injured thereby for the full amount of damages sustained, together with costs and attorney's fee. Persons claiming to be damaged may make complaint to the Commission or sue in the United States court. Any officer of a telegraph company violating the provisions of the act, or who willingly suffers or permits any violation, shall be deemed guilty of a misdemeanor and upon conviction in a district court of the United States be subject to a fine not exceeding $5,000 for each offense.

The Interstate Commerce Commission, created by the act of Feb. 4, 1887, is given jurisdiction over telegraph companies and the business transacted by them, and is authorized to enforce the provisions of the act.

THE AMERICAN PATENT SYSTEM.

In his annual report to Congress, Commissioner of Patents Mitchell calls attention to the fact that this is the one-hundredth year of the American patent system. In 1790 President Washington recommended that steps be taken with a view to encouraging and protecting inventions. The result was that in April of the same year the first American patent law authorizing the granting of patents was signed by the president. Since that time a marvelous growth has attended the system. During the year ending December 31, 1889, nearly 24,000 patents were granted. The number for the entire century approximates 437,000. During the past year the number of applications for patents was 40,575. The revenue from patents during the same period was $1,281,728 and the expenses of the department, $1,052,955.

The report shows that Connecticut is the most inventive State, the number of patents granted during the past year being one to every 700 of the population. Mississippi is the least inventive, only one in every 23,500 of her population having received a patent.

Citizens of foreign countries took out 2,000 American patents. Of these 739 were English; 440 Germans; 299 Canadians and 156 French. One patent was granted to a citizen of South Africa.

The Commissioner dwells upon the urgent necessity for more room and better facilities for carrying on the business of the department. He says the present situation is most deplorable. He also asks for a small increase of the force.

The most important feature of the report is the section devoted to the limitation of patents. The Commissioner says:

"Section 4,887 of the Revised Statutes provides that every patent granted for an invention that has been previously granted in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term. In some countries a patent is liable to become forfeited for non-payment of fees, and in some forfeiture is liable to take place for other reasons. For many years it was understood that the original term of the foreign patent controlled the duration of the American patent subsequently granted for the same invention, and that the American patent would neither be extended by the extension of a foreign patent nor shortened by its forfeiture. So long as the law was thus understood no considerable difficulty was experienced in ascertaining the duration of the term of the American patent. In a recent decision of the Supreme Court of the United States, however, it was decided that where the foreign patent for the same invention which was subsequently patented in the United States had been extended, and the foreign act under which the extension was granted was in force when the United States patent was applied for and issued, and the foreign extension was a matter of right at the option of the patentee on the payment of the required fee, and the original and extended terms of the foreign patent had been continuous and without interruption, the United States patent did not expire with the original term of the foreign patent. And still more recently it has been held by some of the circuit courts of the United States that forfeiture of the foreign patent, even during its original term, terminates the American patent also.

"Under these circumstances it is manifestly impossible for the Commissioner of Patents in granting a patent for an invention previously patented abroad to prescribe in terms the period of exclusive use. * * * In all cases where patents have previously been granted for the same invention in foreign countries, the present practice is to insert a provision in the grant stating that the term is subject to the limitation prescribed by Section 4,887 of the Revised Statutes, by reason of certain foreign patents (specifying them) which have been granted for the same invention. * * * The law, which is believed to have been originally enacted for the purpose of putting a limit to the privileges conferred upon foreign patentees, has in its operation become a standing menace to American inventors. I believe that all competent persons who have given attention to the subject agree that further patents for American inventions should be granted for the full term of seventeen years provided by statute, whether or not a patent has been previously obtained in a foreign country. I most earnestly recommend that, at least to American inventions patented hereafter, Section 4,887 of the Revised Statutes be modified so as to prevent a foreign patent previously obtained from affecting the duration of the American grant."

In conclusion, the Commissioner says: "I verily believe that no law or legal system in any age or any land has ever wrought so much wealth, furnished so much labor for human hands, or bestowed so much material blessing in every way as the American patent system."

STANLEY'S TALK IN A PHONOGRAPH.—A special messenger took a phonograph from London to Egypt and paid Mr. Stanley a good round sum for talking into the instrument for an hour. Stanley gave the little machine a humorous lecture, apologizing for not confiding to it the details of his recent explorations.

A POWERFUL LIGHT.—What is said to be the most powerful electric light in existence has recently been put into operation in a lighthouse at Houstholm, on the dangerous coast of Jutland. It is of two million candle power, mounted on a tower about two hundred feet high and can be seen at a distance of thirty-five miles even in rainy weather.

WAY LIGHTSHIPS ON THE OCEAN.—A project for establishing a line of lightships across the ocean, each having steam engine and dynamo aboard so as to show a powerful electric light, has been laid before the international conference, now sitting at Washington.

OHIO LEADS.—It is said that Ohio has the greatest number of miles of electric street railway of any State, 93¼, and runs 161 cars.

THE WHEATSTONE BRIDGE OR BALANCE.

This well-known apparatus is considered to be the most accurate, efficient and best adapted instrument extant for determining the locality of faults, and for ascertaining generally the electrical condition of all apparatus and circuits pertainining to a practical system of telegraphy. It is simple in its operation, does not require any special form of galvanometer (so long as it is sufficiently sensitive), is independent of variations in the testing battery, and possesses considerable range of measurement.

A theoretical representation of the bridge is shown in Fig. 2. It was originally constructed in this manner, but now usually bears the more compact and convenient form shown in plan by Fig. 1. The conductors *B C F G* (Fig. 2) are called the arms or sides of the bridge. The line to be measured usually forms part of the arm *F*, whilst the balancing resistances, comprising a series of coils from 1 to 4,000 units are placed in *G*. The arms *B* and *C* consist each of three coils of 10, 100, and 1,000 ohms respectively. A galvanometer and key are inserted between *D* and *E* for the purpose of determining when these two points are at the

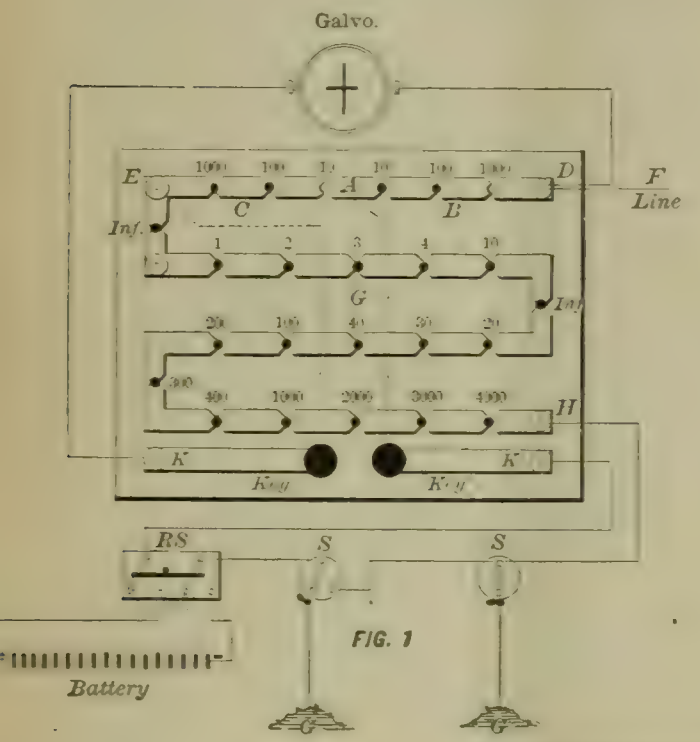


FIG. 1

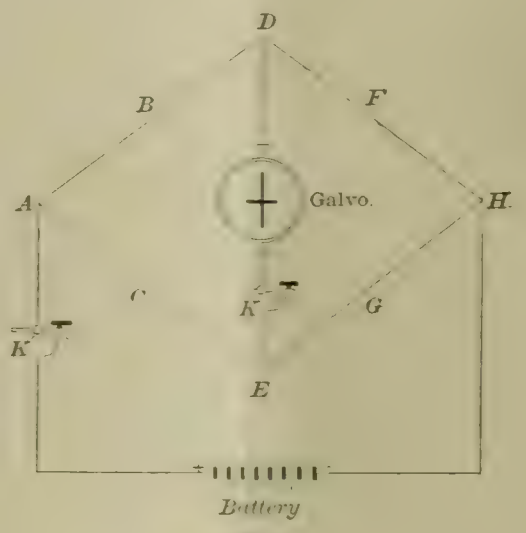


FIG. 2

WHEATSTONE BRIDGE.

same potential, for it is in securing an equality of potentials by balancing one against the other that the principle of this system depends. A battery and key are inserted between *A* and *H*. When the key *K'* is depressed the current leaving the battery divides into two parts when it arrives at *A*. One part goes via *B D F*, and the other via *C E G* to *H*, where they reunite and flow back to the battery. Upon examining these two branches it is found that the electric potential falls along either branch in exact proportion to the resistances encountered. If, therefore, the two routes are of equal resistance the fall of potential at all points along the upper route *B D F* will correspond with those points in resistance exactly opposite in the lower route *C E G*. Now, as a current cannot flow between two points where no difference of potential exists, it follows that under such circumstances no current will flow in the cross wire and galvanometer between *D* and *E*, or between any other points, such as *B* and *C*, or *F* and *G* equidistant in resistance from *A*. This will always happen when the four conductors *B C F G* hold among themselves the elements of a rule-of-three sum, or when *B : C :: F : G*, or *B : F :: C : G*.

To measure resistances :

(1.) Within the range of the coils in *G* : the arms *B* and *C* are made equal and approximating as nearly as possible the resistance to be measured.

(2.) Greater than that of the coils in *G* : the arm *C* is made less in resistance than *B*, and, conversely, when

(3.) The resistance to be measured is less than that in *G* : the resistance in *C* is made greater than that in *B*.

If the resistances in *B* and *C* are equal (Case 1), then by varying the resistance in *G* until a balance is obtained the resistance to be measured in *F* will be the same as that inserted in *G*. If *B* and *C* hold a known proportion to each other, such as 10 to 1, or 100 to 1, the resistance unplugged in *G* must either be multiplied or divided by that ratio as required, in order to find the value of the unknown resistance in *F*. Thus, in Case 2, *G* would have to be multiplied, and, in Case 3, divided by the ratios employed.

All parts of the practical arrangement of Fig. 1 will be found to correspond exactly with the theoretical arrangement of Fig. 2, and to be lettered homologously. The reversing switch *RS* and buttons *S* and *S'* are inserted for the purpose of illustrating and of facilitating the several changes to be made during the operation of testing. The present arrangement of the apparatus shows the necessary connections requisite for an insulation test. The balancing rheostat *G* is connected at the post *H* with the ground through button *S'*. The positive end of the battery is also grounded through *RS* and *S*. The negative pole of the battery is led through *RS* to the right hand key *K'*, and thence through the dotted connection to *A*, when the key is depressed.

The battery current divides at this point. one portion going to ground by way of *C G H* and button *S'*, the other portion passing via *B D* to line *F*, the further extremity of which is open. It is absolutely necessary to have some resistance inserted in the arms *B C*, otherwise the galvanometer would not be effected ; and it is usual in this test to make the proportions 1,000 on the line side as against 10 on the rheostat side, and multiply the reading of the rheostat by 100. By turning *RS* to the right the battery is reversed with regard to line and ground. When the buttons *S* and *S'* are moved to the right the rheostat is disconnected from the ground and placed in connection with one pole of the battery.

Some of the methods adopted and connections required for insulation and conductivity tests, and for the localization of faults, will be described in a future issue.

THE CLARK AUTOMATIC SAFETY DEVICE FOR HIGH TENSION WIRES.

The Clark Electric Company of this city have brought out a most ingenious automatic safety device for use on electric light wires. It is well known that when an electric light wire breaks the current continues to flow from the dynamos, and so long as it does the broken wire is a menace to life and property. Should the wire fall on a telegraph or telephone wire the instruments on such wire are burned out. Danger of fire is also a necessary accompaniment of an accident of this sort. If the wire falls into the street it is liable to cause serious, if not fatal injury to whoever happens to come in contact with it. Obviously any device calculated to remove these dangers in case of breakage of a wire would be of great value. Such is the object of the Clark device, and while it is very simple, mechanically and electrically considered, it is absolutely reliable and effective in its action.

The invention is of Ernest P. Clark, the electrician for the company, and that gentleman gave a practical exhibition of the working of the device recently to the representative of THE ELECTRIC AGE.

The Automatic Safety Device is made in three separate forms, to be applied to either series-wound arc lighting dynamos, shunt-wound arc lighting dynamos, or high tension alternating machines. In either case the action of the device and effect are the same. It is so constructed that at the instant the line wire breaks or is cut, the dynamo is rendered powerless, in which condition it remains until the circuit is repaired and the safety device is once more set.

Another valuable feature of this arrangement is that it works automatically every time the dynamo is stopped or put out of action, and it must be re-set by hand, as the last thing to be done when starting the machine on its load. This in a measure insures its action, when it is called upon, for should it get damaged or out of order, the attention of the person in charge is called to it, as he must operate it every night in starting up.

The device is so quick in its action that before a broken wire has had time to pass through the space of one inch the current is cut off at the dynamo. The value of this feature can be readily appreciated when it is remembered that in many places electric light, telegraph and telephone wires are mixed indiscriminately on the same poles, and in case of the breakage of an electric light wire it does not have to fall far before it comes in contact with some other wire. But before the contact is made all the danger has passed away if the wire is equipped with this device.

The operation of the invention is absolutely reliable under all conditions, as was practically demonstrated on the occasion mentioned.

Taking it altogether, the Clark system of electric lighting is a very efficient one, and with the addition of this latest invention the company are placed in a position where they can say, "we have an absolutely safe system." To make this claim without qualification means a good deal.

In the Maryland State Senate on the 15th inst., a bill was introduced to regulate charges of telephone companies and to prevent discrimination. The bill fixes the rates to be charged between cities at fifteen cents for the first five minutes, and five cents for each five minutes thereafter. It also fixes the rental for one telephone at $3 per month ; for two or more, at $2.50 per month.

BELTING FOR DYNAMOS.

BY CHAS. A. SCHIEREN, JR.

While electric lighting was yet in its infancy, it was found that the ordinary run of belting was unsuited for dynamo transmission. Belt makers began to study the requirements of electric light machinery, and found that a belt was needed which should be of a perfectly even substance throughout, combined with pliability and strength.

Many experiments were made in preparing these belts, both as to the quality of the leather used and improvements in the currying process. It was found that in consequence of the high rate of speed at which dynamos were run, and being exposed to mineral oil which penetrates the leather and rots the fibre, that the life of the belt was materially lessened. To overcome this difficulty a dressing or composition was invented, which, if put on the surface of the belt after it was made up, renders it impervious to all oils or any liquids of any kind, and makes the belt as near waterproof as leather can be made. This dressing is what makes the life of Shieren's "electric" belt at least four times that of an ordinary belt.

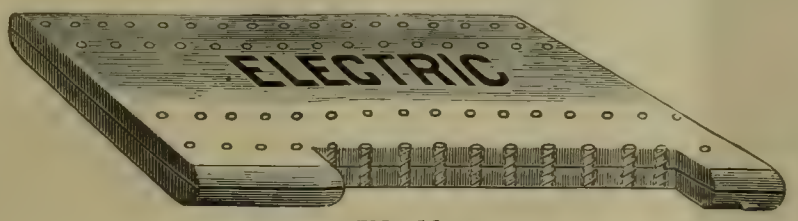
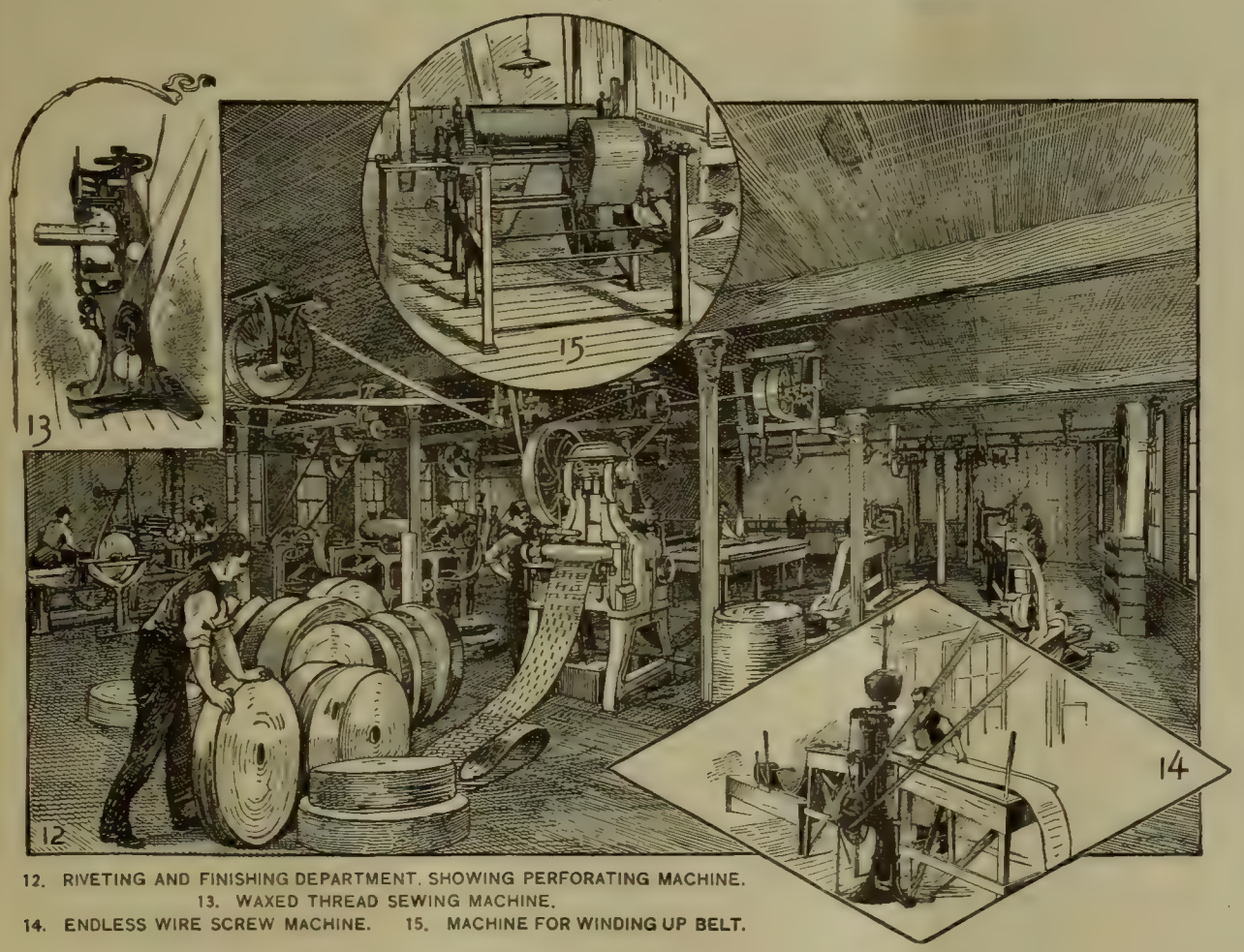


FIG. 11.



12. RIVETING AND FINISHING DEPARTMENT, SHOWING PERFORATING MACHINE.
13. WAXED THREAD SEWING MACHINE.
14. ENDLESS WIRE SCREW MACHINE. 15. MACHINE FOR WINDING UP BELT.

It was also found that the rivets or fastenings generally used were too cumbersome, and injured the running of a dynamo belt. To overcome this, the house adopted the method of using *endless copper wire screws*, which are screwed into the belt and cut off short at both ends, leaving the surface perfectly smooth and at the same time holding the leather firmly together. (See figs. 11 and 14.)

When the alternating current system made its appearance and belts had to be run as high as ten thousand feet per minute, it was found that many belts would not stay on the pulleys at all, and if they did stay on would run with a sort of waving, vibrating motion, and form air cushions between the belt and pulley, consequently the dynamos could not be held up to their speed. After many experiments Mr. Schieren conceived the idea of simply perforating the belts with holes in a systematic manner, so as to produce a perfect tension and even strain all over the surface of the belt. A large machine was constructed which can perforate a belt of any width whatever, at the rate of one thousand feet per hour. (See fig. 12.)

This invention proved to be a great success, and during the past two years, thousands of these belts have been made by this firm, and are running in all parts of the country. They have been tested in various ways, and in the most difficult positions, and been subjected to the greatest strain, but have withstood all tests.

The Denver (Col.) Light, Heat & Power Company have twenty-one (21) perforated belts in operation. Some of them (sixteen inch) are running eight thousand feet per minute, developing one hundred and sixty horse power. They were put on the pulleys two and a half years ago, and are apparently as good to-day as when put on. The perforations in these belts besides preventing air cushions from forming between belt and pulley, allow them to be run looser than ordinary belts with less strain on dynamo bearings and the consequent use of less oil.

In order to insure success and avoid any possible cause for failure, the firm uses nothing but the centre part of prime steer hides in making up these belts. The leather is all pure oak tanned, stretched on the latest and most improved plan, and anything that can be done to still further improve the quality of these belts, is done irrespective of expense, in order to retain the high standing which they now have in the market, and to make the quality still better if possible.

To all those who are interested and desire to see how electric belts are made, and what care is given in selecting the stock, we cheerfully extend an invitation to call and see our facilities.

OUR TELEGRAPH AND TELEPHONE SYSTEMS.

MM. de la Touanne and Seligman Lui, the two eminent French engineers sent to this country by their government to investigate the American telegraph and telephone systems, are astonished to see how extensive these means of communication are. In a recent interview Mr. Seligman Lui said: "The manner in which the telegraph and telephone, especially the former, is extended all over this country is astonishing. I regard the Western Union system as the best in the world, considering the difficulty it has to encounter. In Europe we only have telegraph stations where they are required, and many villages are without them. But here I have not seen a hamlet without a telegraph station, and in many instances I have seen stations on railroads where there was not a house for miles. Instead of waiting for a demand, the policy of the American telegraph seems to be to create it. The rates for long distances are low, but for shorter distances high, probably because of the indifference of Americans for small savings. Some points might be criticised; for instance, the mass of wires and unsightly poles in the streets of the largest cities. These would not be tolerated in Europe. I find that there is a strong feeling against underground conduits. As regard their danger, I can only say that they are used on the continent and that no bad results have followed."

MAKING ELECTRICITY SAFE.—The proper application of electricity to lighting and power purposes actually reduces the danger, both to property and life, concentrating as it does the primary force in one particular spot—the power station where the boilers and dynamos are located. If danger arises through its transmission, that is the fault primarily of the authorities in not regulating the manner of its distribution, and, in perhaps no less a degree, it is also the fault of the companies in not providing the safeguards with which they are perfectly familiar, and the necessity of which they well know. Explosions of illuminating gas and the ordinary hand lamp cause fires and death in far greater proportion to their use than does electricity. There was a time when electric railways were vigorously opposed because of the element of danger that accompanied them. Uncontrovertible statistics will show—taking street railways alone—that the cable system has caused more deaths in one week than has the more modern system in the whole period that it has been established. In fact there is no case on record, so far as known, where any one has been killed as a direct result of the application of electricity to street railways. In order to make electricity the safest form of force, it is only necessary to compel by law the use of safeguards that are amply provided. This is done in the use of steam and other forms of energy, and should be in the application of electricity, which is the most pliant, easily handled power that we possess.

ELECTRIC LOCOMOTIVES FOR LONDON.—The electric locomotives now being built for the City and Southwark Subway have, on trial, proved to be capable of moving the loaded trains at a speed of 25 miles an hour with ease, and a higher speed could be attained if desired.

LONDON'S POOR GAS.—There is great complaint in London of the poor quality of gas furnished to consumers, and the sentiment in favor of the electric light grows in inverse proportion.

The city trustees of Alameda, Cal., have decided to issue $25,000 worth of electric light bonds.

THE SHORT ELECTRIC RAILWAY COMPANY.

This company, which has its headquarters in Cleveland, Ohio, is prepared to construct and equip electric street railways with the most perfect and substantial appliances ever offered. The company has equipped many lines throughout the country, and they are giving the best of satisfaction in their work. These lines include the systems in Cleveland, St. Louis, Ensign, W. Va., Huntington, W. Va., and Columbus, Ohio. Where there is a double track, with many cars and heavy street traffic, the series system with two overhead wires and no rail return is in almost every case the most desirable system to use. The first cost is less; small motors are used and cannot be burned out; and the voltage is low. The cost of operating the cars is less than in any other system, and in every other respect the system is most efficient. Where but few cars and a single track with turnouts are desired, the parallel system is used, with single overhead wire and rail return. For this system the company claim to have the most perfect motor and generator ever offered to the public. In every case the company uses the very best of appliances to insure the best service for the least possible investment, and lightness and neatness, with absolute safety, are additional features of their construction. The company has utilized every means to establish a strictly first-class system, and with close attention to the strength of materials and careful study of the best and most graceful forms, every detail has been worked out, all combining in a perfect whole.

Various styles of poles are used by the company, according to taste and municipal regulations. They are placed from 100 to 150 feet apart and firmly set in a bed of concrete. The trolley wire supports are new devices, and many defects in other systems are entirely overcome by the methods employed in this. A very ingenious and effective method is employed in the construction of curves on the trolley wire. It is simple and artistic in appearance. The trolley is a great improvement on the ordinary styles, and is both substantial and efficient.



FIG. 1.

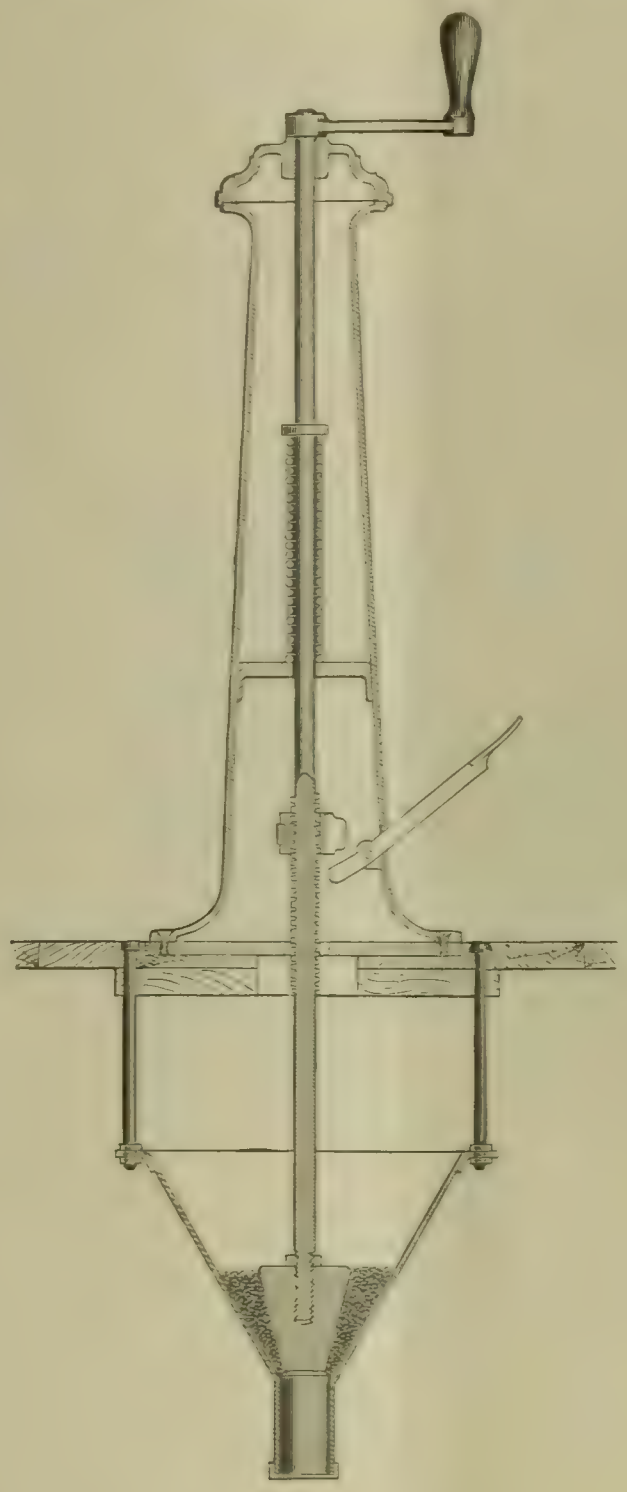


FIG. 2.

The contact is "sliding," and there is no wear on the trolley wire. The motors embrace every improvement, and are in every way free from the ordinary imperfections. Two motors are ordinarily carried on a truck frame, one attached to each axle. The motor frame and all the electrical parts are thoroughly insulated from each other and from the car wheels. All parts are interchangeable, and repairs are effected in a most simple manner.

In the two overhead wire system no resistance devices are necessary to control the current. Changes in speed and direction are made from either platform by a single movement of the lever of the controlling stand. Where a single wire is used an additional resistance is placed under the platform of the car. Fig. 1 shows the controlling stand complete, and Fig. 2 the internal mechanism. Trail cars are lighted by electricity. Each car has 5 incandescent lamps of 16 c.p. Fig. 3 shows the organization ot the single overhead wire system with rail and earth return, and Fig. 4 that of the double overhead wire without rail return-series system.

Fig. 5 shows the safety guard wire used in connection with the single wire rail return system. This insures freedom from damage in case a telegraph or telephone wire breaks and falls across the trolley wires. A device is used which renders any wire crossed with the circuit perfectly harmless.

All roads operated by this system are giving satisfaction, both to the companies operating the same and to the public, and the freedom from danger is a great point in its favor.

ELECTRICITY IN COAL MINES.—The use of electricity in coal mines is meeting with no small amount of favor in Pennsylvania, and that it will be the motive power of the future is becoming recognized in that quarter. The Hillside Coal & Iron Company, whose mine is situated near Scranton, has electricity now in use. The dynamo is in the engine house, and the wire running to the bottom of the shaft is incased in a pipe. The wire then runs along the main heading for 2,000 feet, about six feet from the rail. The motor car is much like a street car, except that the trolly usually on the top of the car is on the left side of it. The cable will carry 200 volts of electricity, and is supposed to pull or shove twenty loaded cars. This will do away with from seven to ten mules in this heading, but the use of this long-eared animal cannot be dispensed with in hauling from the chambers. The wire which will furnish motive power to the car will also feed a number of incandescent lamps. It is claimed that the use of electricity will give the mine greater tonnage capacity, and the miner will be able to do more work, in that he will not have to wait so long for the return of the cars. Should the trial prove a success in the mine it will be introduced in a number of the other collieries owned by the Hillside. The Hercules Mining Machine Company of Pittsburg, has contracted for installing electric mining machines in several mines of Pool No. 1 on the Monongahela river.

INTERNATIONAL MEMORIAL TO DR. JOULE.—It is proposed to raise a fund for the erection of an international memorial to the late Dr. Joule, the discoverer of the law of the conservation of energy. This, it is said, is to have for its chief object the encouragement of research in physical science, though it is also intended to erect a tablet or bust of the deceased in London. In a circular issued by the Royal Society the importance of the law discovered by Dr. Joule is compared to that of the laws of gravitation and chemical combination in extending the beneficent influence of science throughout the world.

BREAKDOWN OF A CABLE.—Telegraphic communication between the Hebrides and the mainland has lately been discontinued owing to the breaking of the cable in deep water. It is believed that more than one break exists. The cable was laid down some fifteen years ago, and has been twice repaired.

LIGHTING OF THE TAY BRIDGE.—It is said that the fourteen large spans of the Tay Bridge, as well as the piers of the old bridge, are to be lighted with electricity, which will make the traffic on the river much safer than hitherto.

THE INCANDESCENT LIGHT IN SPAIN.—The Cadiz corporation has signed a contract to light the public thoroughfares of the town with 1,000 incandescent lights of 16 candle power. Each light is to be used on an average of seven hours per day.

ELECTRIC STREET CARS IN ROME.—The Roman Tramways Society has concluded a contract with the English Electrical Traction Syndicate to make experiments upon the line on the Via Flaminia outside the Porta del Popolo. This line runs to the Ponte Molle, a spot much frequented by the Romans in summer and on all holidays, and there are numerous restaurants and pleasure grounds skirting the Tiber there. The mode of working is kept entirely secret at present.

AN ASSOCIATION FOR THE PROMOTION OF ELECTRICAL INTERESTS.—A meeting, at which representatives of several leading electric lighting companies were present, was recently held in London under the presidency of Sir John Pender. The desirability of establishing an association of the statutory electric lighting companies within the metropolis, in order to promote the consideration of, and combined action upon, matters of general interest relating to electric lighting, was considered.

ELECTRIC LIGHT IN THE KANSAS CAPITOL.—The work of equipping the capitol at Topeka with electric lights has been completed. Over 40,000 feet of wire was employed. There are 150 burners in the House and 110 in the Senate, and the cost of the fixtures was $4,500.

FORESTS AND THUNDERSTORMS.—It seems that there exists some relationship between the extent of forests and the corresponding amount of damage effected by lightning. Some Swiss statistics show that in certain regions which have been gradually deforested, the fires due to lightning is steadily increasing. The evidence at hand is considered sufficient to prove that, as forests are cut down, so the frequency and violence of thunderstorms increase, and that forests afford a large amount of protection against the various consequences of lightning.

TELEPHONE BETWEEN VIENNA AND BERLIN.—There is a project on foot for the establishment of a telephonic service between Vienna and Berlin. The negotiations between the German and Austrian governments have been so satisfactory that there is every prospect that the work will shortly be commenced.

CABLE CODES.—At a recent meeting in London of the directors of one of the English Altantic Cable Companies, the chairman, in the course of his remarks, said that people when out on pleasure found many ways of spending money without spending it on telegrams. Americans away from home never lose sight of the main point; they were all men of business. They generally arranged a little code in which one word gave all the information that was necessary. He had been astonished at the amount of ingenuity shown by them in making codes and getting an amount of matter into very small compass; and he was sorry to say they were growing so fast in that direction that it prevented the submarine telegraph companies from growing in the direction of larger dividends.

Three miles of conduit are to be built in New York by the American Conduit Company, of Boston.

The Rapidan Water & Electric Power Company, with a capital of $100,000, has been organized at Rapidan, Mich.

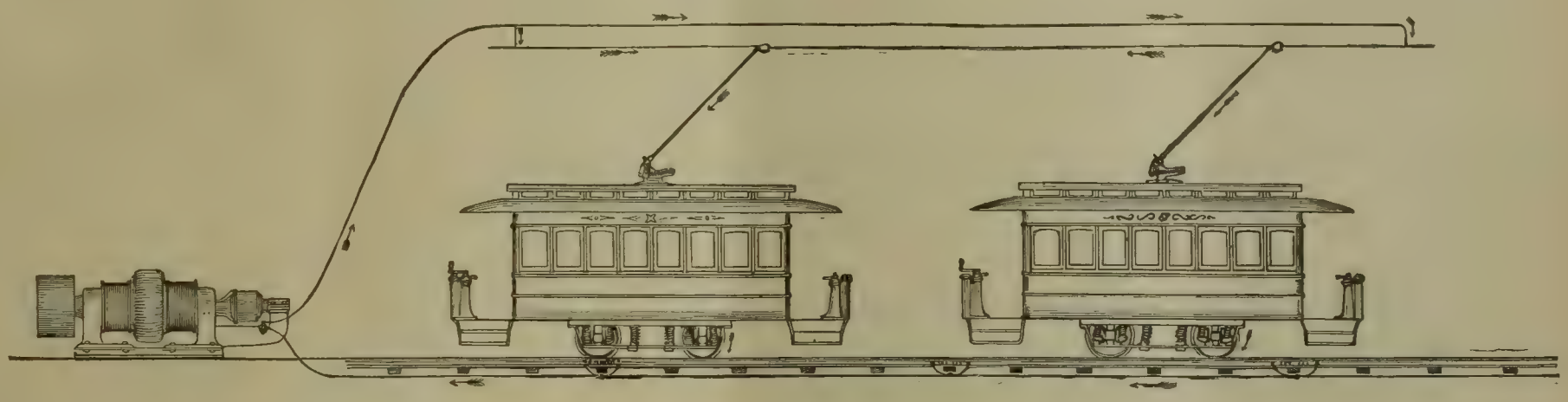


FIG. 3.

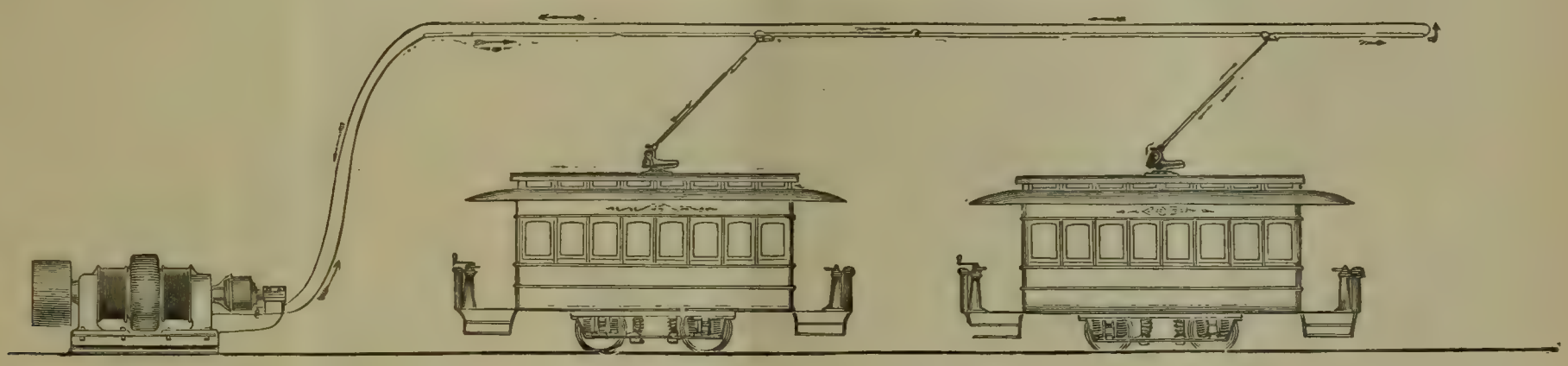


FIG. 4.

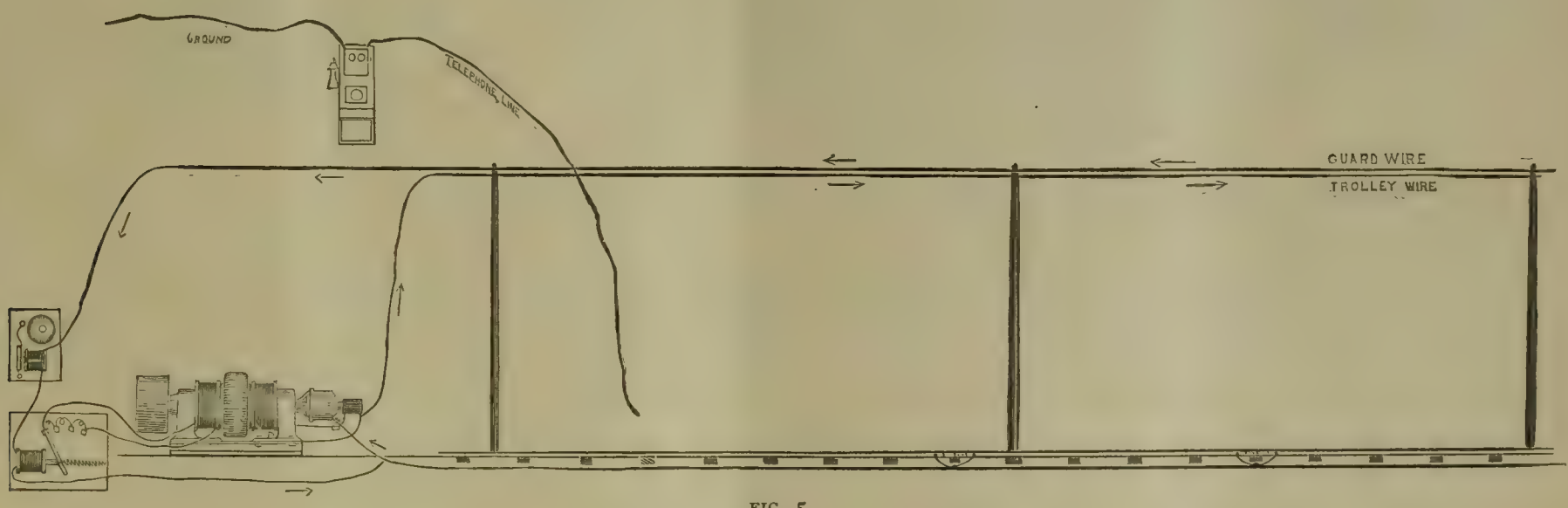


FIG. 5.

THE SHORT ELECTRIC RAILWAY ILLUSTRATIONS.

NEW APPLICATIONS OF THE C. & C. MOTOR.

New uses and applications are daily being found for the electric motor. It is five years since the first electric motor was introduced into New York City, and now there are between 25,000 and 30,000 in daily use on the various electric light circuits throughout the country. Their applications are divided into three principal heads: that of traction service, mining, and for distributing power in small units in populous districts. There is also a fourth, which, although as yet developed to a very small extent will, we think, before long become one of the chief and most profitable uses for electric power. We mean electric motors as applied to factory buildings and generally as a substitute for belting and shafting.

Last year at this time the C. & C. Electric Motor Company opened their new building in Greenwich street for the manufacture of their motors, and at first found it necessary to occupy only two floors of their six story building. As the building was fire proof throughout, the floors being of brick and stone, they placed a dynamo in the basement, and ran their machinery in the two upper floors by means of motors, running their wires to the motors in conduits which were already provided in the walls of the building, and thus avoided the necessity of defacing their floors by cutting holes in them for belting and shafting. With their greatly increased facilities they began at once the construction of large motors and dynamos, and at the present time are occupying the entire six floors of their factory.

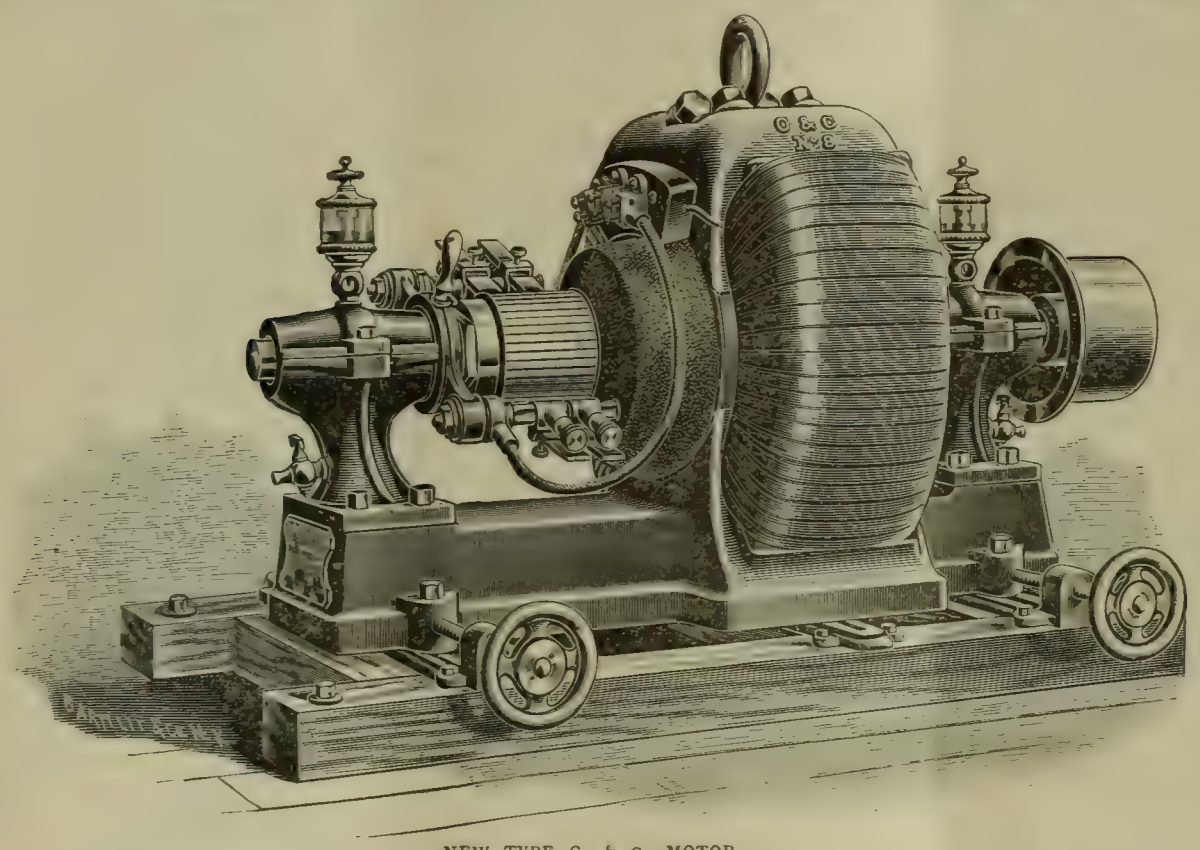
The new machine which they put on the market last year is now built in the various larger sizes from one horse-power to fifty horse-power. Its most striking characteristics are a saving of superfluous metal, the large diameter of the armature, allowing ample wire space, long bearings, large shafts and generally the combination of great strength and durability with symmetry of form. About one hundred of these motors of one horse-power and over have been placed on circuits of different incandescent light companies, and they have been received with an approbation which has proved very gratifying to the manufacturers.

The installation of 75 horse-power motors in the new factory of the Hickok Mfg. Company of Harrisburg, Pa., and 70 horse power in Huyler's factory on 18th street, New York City, and the plant at the Chicago Printing Company's office in Chicago; the *Star* newspaper in Washington, and the Auditorium Building, Chicago, are among the largest electric power plants that were installed last year, and the plant of the Hickok Mfg. Company and Huyler's are the first of a new class of power plants which will bring about great changes in our present methods of furnishing power for factories.

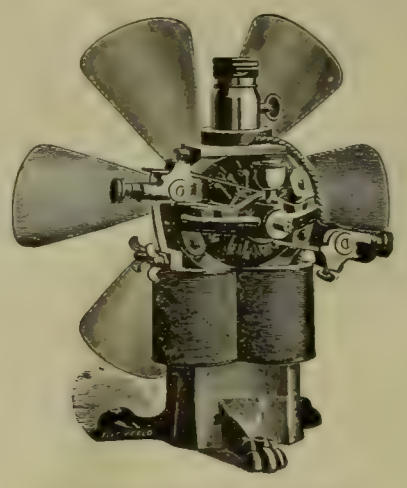
This company made its name in the field of little motors and fan outfits long before it became known as the maker of large machines. In the Summers of 1888-89 over a thousand of these fan outfits were distributed among the offices and restaurants of New York City, more than a hundred being placed in the Equitable building alone. The new White Star steamship "Teutonic," as well as the "Celtic," the United States cruisers "Chicago" and "Charleston" are making use of a number of them for ventilating their interior state rooms and hallways. They were placed in the vestibule trains running between New York and Boston, and the air in the Mikado's palace in Japan is kept in circulation by several of these C. & C. fan outfits.

A two horse-power motor in the new form has been made up in combination with the Sturtevant blower to ventilate the dynamo room of the crusier "Baltimore," and two more have been recently finished for the new crusier "San Francisco." The small space occupied by the motor in this combination, and the neatness and beauty of the design, cannot fail to strike observers.

The application of these motors to pumps, hoists, drills and tram cars is revolutionizing the old systems of mining, and although this field for electric power is perhaps less developed than any other, it is likely during the coming year to make a very noticeable advance.



NEW TYPE C. & C. MOTOR.



C. & C. FAN AND MOTOR OUTFIT.

PHONOGRAPHIC TYPEWRITING.—There is a "new departure" in typewriting in connection with the use of the phonograph that many firms are beginning to avail themselves of. A banker has a quiet talk with his phonograph in his private office, and sends the cylinder around to a "phonographic typewriting" office. Here the talk is reproduced, and the typewritten work sent back to the business man. This method is considered by those who use it to be far preferable to stenographic dictation.

NEW TELEPHONE LINE IN SCOTLAND.—A new telephone line is being erected between Glasgow and Edinburgh.

MORE SPRAGUE ELECTRIC RAILWAYS.

The mid-winter is not generally considered by street railway construction companies to be the most active and busy time of the year. The conditions of soil and weather are unfavorable for outside work, and the amount of business to be performed by the street railway companies is not so great as in the summer months, and does not encourage extensions. But with the prominent electric railway supply companies the season seems to have no effect upon the amount of business contracted for and under construction, unless it is to increase it. We are advised by the Sprague Electric Railway & Motor Company that winter makes no difference with its business, and that during the last few months an unusually large number of contracts have been closed for electrical apparatus, and that construction work will go on right through the winter.

A list of the roads which have ordered equipments from this company illustrates in a striking way the remarkable confidence which street railway managers feel in the electric system, and is indicative of a widespread adoption throughout the country by street railway companies of electrical apparatus. Among the most recent contracts of the Sprague Company may be mentioned the following:

Salem, Ohio, Capital City Street R'way,	2 cars.
Davenport, Ia., Davenport Electric St. R'way Co.	4 "
Dubuque, Ia., Electric Light & Power Co.,	10 "
Chicago, Ill., Cicero & Proviso St. R'way,	12 "

and the following additional orders from street railway companies already equipped by Sprague or other systems.

Sioux City, Ia., Sioux City Electric R'way,	3 cars.
Milwaukee, Wis., West Side Street R'way,	9 "
Des Moines, Ia., Des Moines Electric R'way,	2 "

MEASURING POTENTIALS.—A patent has recently been granted in England to Sir Wm. Thomson for "Electro-static apparatus for measuring potentials." The inventor uses an electro-static arrangement of which the part whose potential differs most from the earth is a smooth insulated conductor, which may be of a cellular or multicellular form. The movable body may be a metal plate, or an arm, or a group of metal plates or vanes. The electro-static force acting upon the movable body may be equilibrated by torsion, or by torsion and gravity, as in the well known bifilar balance: or by gravity as in an ordinary balance; and may be read by inspection on a scale, or may be determined by a balancing operation. For checking the vibration of the index, the inventor uses a rigid or elastic piece of solid material which may be brought momentarily and gently to touch upon the index itself or other connected moving part of the apparatus. To prevent all other motion of the checker than the one desired motion he mounts it on a geometrical slide.

The South Brunswick Telegraph, Telephone Electric Light & Power Company has been incorporated at Brunswick, Ga., with a capital of $50,000.

THE LUMINOUS INTENSITY OF ARC LAMPS.

Some interesting trials relative to the luminous power of arc lamps have just been carried out at the Berlin High School in accordance with certain exigencies of the civil authorities. The latter had stipulated in their forms of contract that arc lamps should give, with a current of 12 ampères, 2,000 candles, and, in some cases, 5,000 candles. Herr Elston called all the parties interested together and raised a lively discussion by affirming that the lamps at present in use did not give more than 500 candles. After this meeting the Berlin Allgemeine Elektricitäts Gesellschaft instituted a series of experiments at the electro-technical laboratory of the High School under the direction of Prof. Slaby. Dr. Wedding, in giving an account of these trials, started a sharp debate *apropos* of what was to be understood by the expression "A 2,000-candle arc lamp." Was this with or without globe? Was it under a given angle, or was it the total intensity?

The measure of luminous intensity must not be taken from any particular angle, since it varies according to the angle. If the lamp be intended to light open spaces, it is necessary to determine the different values of this intensity from the horizontal direction to the verticle direction downwards; if, on the contrary, the lamp is to light a covered space, it is as well to take into account also the luminous rays comprised between the horizontal position and the vertical position upwards. Measurements in these different azimuths were made by the aid of mirrors. The experiments were made on differential lamps of the Siemens type in Unter den Linden. The intensity of the current was from 14 to 15 ampères, and the difference of potential from 48 to 52 volts. The place where these measurements were made being very high, the luminous intensity could be measured at different angles without having recourse to mirrors; the photometer used was one of Elster's, which is a modification of Bunsen's. The carbons seldom burnt badly, but the two sides were not so brilliant, so that two photometers had to be used, one on each side, to collate the results and take the means. The unit adopted was that of the German candle, which corresponds nearly with the decimal candle. The intermediary light chosen was that of an Albert gasburner.

The intensity following the horizontal direction was weak (without globe, total intensity=196 candles); then it increased rapidly, and attained about 1,150 candles at 20° and a maximum of 2,014 candles at 42°; then it rapidly decreased, and at 60° the light was sensibly null. From this it results that the average luminous intensity of the surface lighted was 1,228 candles, without globe. With globes, the division of the light was quite different.

Three globes were used in the experiments which showed the average horizontal intensity to be 478; average maximum intensity 925, and the average mean 692.

From these figures it appears that the mean intensity is only from 40 to 53 per cent. of the intensity of the lamp without a globe. By adding a reflector, the loss due to the globe may be reduced to 32 per cent. By tracing, in the streets to be lighted, the lighting curves at different points, corresponding to a height a little less than that of the head of a man, and the lamps being placed at 8·90 metres from the ground, the light necessary to read (or 10 candles at 1 metre) is obtained for a distance from the lamp of 25 metres; the lamps should therefore be 50 metres apart. Dr. Wedding finds, also, that the actual luminous power of Siemens differential lamps with globes like those used in Berlin, varies from 510 candles following the vertical direction downwards to 1,183 at an angle of 40° with the horizontal and 640 at an inclination of 5°. In short, with the most transparent globes, which have been supplied and with reflectors freshly painted, the mean luminous intensity was 834 candles. Herr Elster, in his experiments on the lighting of the present streets, obtained a maximum of 640 candles; more recent experiments only gave 500 candles.

These experiments, carefully executed as they were, throw great light on the practical conditions of public lighting, and justify the disappointments which have often been experienced with arc lighting, despite the high nominal luminous intensity of 2,000 to 3,000 candles of lamps which had been announced by the makers.—*Le Moniteur Industriel.*

The French Government and the Eastern Telegraph Company.—An official decree of the French Government has been published, approving the renewal of two telegraph conventions with the Eastern Telegraph Company. The Government have compelled the company to make some concessions in the public interest. The company have to pay a largely increased price for their special line from London to Marseilles, and they are bound to land at Marseilles a third cable, running by way of Malta and Bona, in Africa. The company will also have to reduce their rates for telegrams in plain language to the French Press in the extreme East, and the rates must, furtherefore, never exceed those for the English Press telegrams to Cochin China, Annam and Tonking, viz.: three francs a word.

Zinc.—The destruction by rust of two of our great ironclad ships which were recently found with their hulls corroded entirely through, calls to mind an ingenious application of voltaic electricity, by which the English ironclads are now successfully protected. Taking advantage of the fact that when a battery is formed of iron or zinc in a corroding solution, the zinc is most readily acted upon, many of the later ships have their iron hulls cased with boards, over which are nailed sheets of zinc. At intervals, through holes in the boards, connection is made between the two metals. On exposure to the action of sea-water, it is found that the zinc is dissolved away, and must be periodically replaced, but so long as any zinc remains, the iron under it is perfectly protected against rust, by the transfer of the chemical action to the zinc.

Electric Railways.—F. J. Sprague gives it as his opinion that the electric railway has nothing to fear from the cable system. In fact, he remarked that since the cable conduits were usually well constructed by competent engineers, they would prove a first-class receptacle for the electric conductors which will be certain to follow, and hence, whenever he heard of the laying of a new cable conduit he was well pleased.

Dangerous Lamps.—Complaint is made by the Boston papers of the careless manner in which some of the lamps on commercial circuits are hung. It is claimed they are lower than is consistent with safety, and the companies are urged to investigate the matter before some one comes into accidental contact with them and gets hurt, if not killed.

In Berlin electric lights of standard power, with great and steady brilliancy, light the city at a cost of less than fifteen cents per night, about $55 per year.



C. & C. MOTOR AND STURTEVANT BLOWER.

Do Not Invest in This Scheme.—England has its cranks as well as we. The following story comes from London, and as a "wild cat" scheme, it equals anything ever gotten up anywhere to fool the unsuspecting public:

A peculiar formation exists in one of the lead mines in Derbyshire. Not only is there a marked stratification of almost pure lead in the form of thick plates, but by a natural chemical action not easily explainable, the plates are coated evenly with peroxide of lead. Several enterprising capitalists have, it is said, taken advantage of this remarkable arrangement, and have succeeded in making a case of insulating and acid proof material around and under the whole. The next step will be to erect a large number of lightning conductors in the vicinity of the mine to charge the vast "accumulator," and the supply to be obtained from one electrical storm of ordinary severity will, it is expected, be sufficient to light the entire country, yielding at least 10,000 ampére hours.

The Flushing Electric Light & Power Company has been incorporated at Flushing, N. Y.; capital $30,000.

GALVANOMETERS.

At the meeting of the Physical Society of London, on January 17th, a paper "on Galvanometers," was read by Prof. W. E. Ayrton.

The question as to whether fairly sensitive galvanometers should be astatic or non-astatic was answered in favor of the former system, from the fact of its being less affected by external magnetic disturbances, and the greater ease with which great sensibility may be obtained.

The usual method of placing the mirror inside the coil was shown to be undesirable, and in the newer forms of instruments, Mudford's improvement of placing the mirror outside the coils has been adopted, the space near the axis of the coil being nearly filled with wire. It was also shown that if wire be wound in a certain approximately spheroidal space near the magnets, then these convolutions will tend to oppose the more distant portions of the coil; however, by winding the two parts in opposite directions, they conspire to deflect the magnet.

Details as to the methods of supporting the coils were then discussed, and the importance of fitting them in boxes mounted on hinges, or otherwise, so as to be readily removable, was pointed out.

A galvanometer devised for teaching purposes, and provided with variable damping arrangements, was described, in which the damping is effected by enclosing the mirror in a glass cell, whose sides can be caused to approach or recede by turning a milled head outside the instrument. This arrangement enables the damping to be varied between wide limits, and its effect on the swing produced by a given discharge can be determined. The instrument is also serviceable, both as an ordinary damped galvanometer or as a fairly ballistic one.

In measuring quantities of electricity by the first swing of a galvanometer needle, a correction has usually to be introduced for damping; this correcting factor is simple enough when the damping is small, but becomes more complicated as the damping increases, and to facilitate the calculations a table of values of the factor for various values of Γ (the logarithmic decrement) has been calculated. From this it appears that for values of Γ less than 0·5 the value of the factor is very nearly $(1 + \frac{1}{2}\Gamma)$, the correction usually employed.

Improvements in methods of insulating the coils and terminals of galvanometers required for insulation tests were next described. A special form of instrument for high insulation work was exhibited, in which the copper resistance of the coils is nearly 400,000 ohms, and the shortest path along which surface leakage can take place from the coils to the base of the instrument is between 30 and 40 inches of ebonite artificially dried by sulphuric acid. This is attained by supporting the coils from two corrugated ebonite rods which depend from a brass ring carried on the top of three corrugated pillars fixed to the base plate.

With reference to the proportionality of deflection to current in reflecting galvanometers, it was pointed out that ordinary instruments may differ as much as 2 per cent. within the limits of the scale, hence showing the necessity for calibration when any approach to accuracy is desired. Galvanometers of the d'Arsonval type sometimes differ from proportionality quite as much as the one above referred to, but by fitting such instruments with curved pole pieces, and allowing the coil to hang freely from the top suspension, a proportionality true to less than 0·15 per cent. has been attained over a scale about 30 inches long.

Coming to the question of sensitiveness, the importance of keeping the wire as close as possible to the magnets was brought prominently forward, as well as the necessity of reducing the "figures of merit" of various instruments to the same standard, in comparing their sensibilities. The standard adopted as most convenient and closely approximating to practical usage is arrived at by supposing the distance of the mirror from the scale to be equal to 2,000 scale divisions, and the sensibilities for current and quantity are given as *scale divisions per micro-ampère* and *scale divisions per micro-coulomb* respectively. The period of oscillation is also taken into account.

A table showing the resistances, sensibilities, coefficients of self-induction, and volumes of the coils of various instruments, together with the relations existing between them, accompanies the paper and from this it appears that in the best astatic double coil instruments of from 10,000 to 30,000 ohms resistance the number of scale divisions per micro-ampère may reach 400 times the resistance to the 2-5th power (400 R 2-5th), when the period is 10 seconds.

Electric Traction in England.—The Series Electrical Traction Syndicate, Limited, of London, has concluded a contract to work the North Western and Midland District Auxiliary Railway Company's line, 7¼ miles in length, by electricity. It has also contracted for the equipment of a further 15 miles of tramroads at present under construction.

Dr. Werner Siemens.—A Berlin correspondent writes: "Herr Werner von Siemens has announced his intention to retire from the firm of Siemens and Halske, in order to devote himself to scientific research. Another member of the firm, Herr von Hefner-Alteneck, has also retired."

Electric Lighting in England.—There seems to be as much activity in electric lighting in England as there is in this country. In small towns the light is being introduced with as much vigor as anywhere else. "Give us the Electric Light" seems to be the universal cry.

Electrical Power vs. Steam.—A three-horse power electric motor and a four-horse power steam plant were recently compared as to cost of running. The result of the test shows that the electric motor could be run at a saving of 35 per cent. of the cost of maintaining the steam plant.

The Elgin (Ill.) Electro-hydraulic Company has been organized with a capital of $250,000, to generate electricity for power and lighting by the Gray inventions.

THE GETHINS BATTERY.

The enterprising promoters of this establishment in Boston have made public a comparative statement bearing on the cost of maintaining a "Gethins" and an ordinary "Crowfoot" battery. It is stated that the annual cost of running a Gethins battery is 39 cents per cell, against $1.03 per cell of Crowfoot battery, showing a difference of 64 cents in favor of the former.

Taking all the cells of battery in the United States, estimated at 40,000,000, a saving of $25,600,000 would be effected were they of the Gethins type, as compared with the cost of the Crowfoot type.

This excellent showing in favor of the Gethins battery is attracting considerable attention on account of its superior qualities. Its economy in maintenance, its constancy and reliability are its main features. It is a combination of the Gravity and Daniell cells, with certain improvements made by Mr. J. L. Gethins of Boston. It requires only one-half of the material used in the ordinary cells. This new battery has been in use on the police department wires in Boston, and the electrician reports that it has given excellent satisfaction, and that it has been recharged with copper sulphate but once during the year.

THE OKONITE COMPANY.

Oh, yes! the Okonite Company always "get there." Have you seen their "Adv." in this issue? The popularity of Okonite insulated wires and cables, not forgetting their celebrated tapes, is increasing at a furious rate. The demand last year for these goods was something enormous and came from all parts of the globe, compelling the manufacturers to erect a new and larger factory, so that they might supply more conveniently the wants of their numerous customers. Always progressive and pushing a good article, they have merited and won the confidence and patronage of the people. Will be at the convention as usual.

The Interior Conduit and Insulation Company.—On the 7th instant the Interior Conduit and Insulation Company gave a test exhibition of their conduit system at the factory of Bergmann & Co., on 34th street, which was witnessed by a large party of invited guests. These included Mayors Hart, of Boston, and Newhall, of Lynn, Mass., and representatives of the Board of Fire Underwriters of Boston, Philadelphia, Newark and other cities. The test was a perfect success, and all the persons present were very favorably impressed with the valuable features of the system. After the exhibition a banquet was given at the Hoffman House, at which several speeches were made. All the speakers spoke in flattering terms of the system and predicted a great future for it. Mr. E. H. Johnson, President of the Company, was heartily congratulated on his success in bringing out a safe system of wiring.

METALLIC TELEPHONE CIRCUITS.

General Barney, in his last news-letter, writes the following, which is from a St. Louis paper: "Recognizing the fact that induction from the wires of the Missouri Electric Lighting & Power Company is impairing the public service of the Bell Telephone Company, Mr. Guido Pantaconi, general Western representative for the Westinghouse Company, a few days ago arranged with Manager George F. Durant to provide metallic circuits, that is to say, return wires for the Bell telephone main lines wherever the latter run near the wires of the Missouri Company. This will in a measure mitigate the distracting humming now heard in the receiver. Mr. Pantaleoni stated that this humming results from the imperfect adjustment of the electric lighting circuits, and gave assurance that it would entirely disappear as the circuits become balanced.

Patents for Sale.—Mr. H. D. Rogers, who was at one time actively engaged in the development of electricity, offers, in another column, to dispose of seven different patents, covering electrical conductors for high and low tension currents, printing, telegraph instrument and circuits therefor, self-sustaining electric battery and secondary battery, and means for transporting the same. In later years Mr. Rogers finds his time pretty well occupied in other channels, and is therefore unable to give the necessary labor to the development of his patents. The number of the patents are given, so that interested parties can examine them among patent files. Mr. Rogers is prepared to negotiate for the sale of his patents, or furnish information and details relating to their objects and merits. Mr. Rogers is on record as being the pioneer in uuderground work, he having made application to put the circuits underground in Cincinnat eleven years ago.

In an electric road the power the engine develops is directly in proportion to the work being done whether one or a dozen care are in the circuit.

ELECTRIC LIGHTING AND PUBLIC SAFETY.*

BY SIR WILLIAM THOMSON.

England and America are the freest countries in the world. Hence a remarkable feature of almost every city in the United Kingdom and the United States, which strikes with wonder all visitors from the continent of Europe—cirrus clouds of electric wire hovering perennially over the streets and houses. These clouds do not, to any sensible degree, diminish such light of heaven as the liberty-loving owners of domestic fire-places and steam-boilers allow to reach their fellow-citizens through the volumes of black smoke pouring from their chimneys. Some persons of taste object to the aërial wires as diminishing the beauty of our cities. The same people would complain of a forest of ships' masts seen from London Bridge, or completing the vista of some broad avenue of New York, or relieving the dullness or the squalor of some little old city by the sea, if ships were an invention of this century and shipping industry not fifty years old.

Ruskin eloquently admires ships with their masts and sails as the most beautiful and picturesque of the works of man. Some future Ruskin will no doubt be equally enthusiastic about the beauty of the gossamer lines of telephone wire, with their gentle curves stretching away by hundreds from stately standards fixed aloft over our houses, or from high cathedral domes, or from future Eiffel towers, and ornamenting whatever they touch. Hitherto, however, conservative æstheticism has barred many cities of the continent of Europe from the larger benefit of electricity in the service of man already enjoyed by America and England; and would, in England, if it were permitted, sweep all electric cobwebs from the sky, and not concern itself with the question of expense involved in banishing all telegraphic, telephonic, and electric light wires to below ground.

Public work in most cities of Europe is tremendously under authority, and, as a rule, authority, except in America and England, is very timid, even in respect to matters of taste. The more serious questions of public safety which the large development of the high-pressure alternate-current system with transformers for electric lighting has forced upon us, in the last four years, have scarcely hitherto come into account in determining the rules and usages of continental cities as to overhead and underground wiring.

In Paris, the electric-lighting companies, bound under stringent regulations of the city authorities, have all their conductors underground. There are no exceptions to this; nor are there any overhead telegraph wires. Both telegraph and telephone wires are insulated in electric cables, and are placed underground in the excellent sewer system of Paris, except in some very rare cases where a subscriber lives in the outskirts of the town, and has an air-line to the nearest point of a cable-carrying sewer.

In Berlin. all the electric light wires are underground, and the lighting is all done by continuous currents at low potential, much of it for out-of-doors, by arc lights in bridges of pairs, between conductors for the supply of indoor lighting, by Edison 100-volt lamps. No rules have been laid down in Germany to provide against personal danger, there being practically none to provide against with 100-volts' potential; but rules to prevent danger from fire are imposed on makers and users of electric-light installations.

In Belgium, the telegraphic department issued, in 1887. a careful code of rules for the establishment and use of electric-light wires above ground in all parts of the Belgian dominion, and especially in the neighborhood of telegraphic and telephone lines. Not one of these rules has reference to possible danger from conductors at high potential, because, in fact, in Belgium, as in Germany, there have been hardly any high-pressure electric installations of alternate currents with transformers, and electric-lighting work has been done chiefly by continuous currents at 100 volts or other low potential.

In Italy there is no law restricting electric industry. In Milan and many other towns of Italy there are small stations for electric light, supplied through underground wires at low potential. In Milan and Turin there are installations of aërial wires at 2,500 volts for forty arc lights in series. These isolated installations have no doubt been put up with great care, and do not seem to have been hitherto found dangerous to the public. A grand installation for electric light in Rome, by water-power of the Tivoli Falls, at thirty-seven kilometres' distance, is now projected and will no doubt be realized before long. It is designed to use 2,500 horse-power at the falls, which is to be transmitted by alternate current at 5,000 volts, through aërial conductors over the country to the city gate. There, by a transformer, it is to be first reduced to 1,000 volts, and distributed by underground supply conductors to numerous transformers in different parts of the city, by which it is to be further reduced to the safe 100 volts for use.

In passing, I may remark that 100 volts in the house is perfectly safe to the user, whether the current be alternating or continuous, as is proved by large and varied experience in England.

There is, so far as I know, just one city in the world, outside of England or America or Italy, in which high-pressure overhead wires are used, and that is Temesvar, in Hungary, which has been thus supplied with electric light for many years.

In England, any individual or company wishing to carry wires above the houses and streets of our towns, or anywhere over the country, and having obtained permission from the proprietors to place the requisite bearing poles on roofs or other parts of buildings, or on unoccupied ground, has perfect liberty to do as he pleases in the air over town and country; provided that he comply with whatever conditions may be prescribed to protect the public safety and the convenience of previous occupants of the air.

Two years ago the Board of Trade issued, under the Electric-Lighting Act of 1888, very stringent regulations for safety, to be observed throughout the United Kingdom, in every case of placing an electric conductor otherwise than wholly enclosed within a building. Tney have been approved by the Institution of Electrical Engineers in consultation with the officials of the Board of Trade. If they are thoroughly *and permanently* fulfilled in every case, I believe their object—"the protection of the public safety and of the lines and works of the Postmaster-General, and of other electric lines and works"—will be effectually secured. So much being admitted—and I believe so much will be generally admitted—the question remains, Can these regulations of the Board of Trade be thoroughly and permanently fulfilled?

The fulfilment of these rules can, indeed, be made practically certain. *But at what cost?* What of the cost for permanent maintenance of standards, suspending wires, "non-metallic ligaments"? And what of the "durable and efficient material" required as an insulating coating for the copper conductor, when we consider that every hitherto known insulating material that could be used for coating the wire experiences destructive deterioration in the course of years, especially if kept exposed to light and to the variations of outside atmosphere in our climate?

We are forced to conclude that in laying down these regulations, and in arranging for careful inspection to secure their fulfilment as far as practicable, the advisers of the Board of Trade felt that the danger from high-pressure overhead wires could not be absolutely annulled. This view is confirmed by the fact that in most or all cases in which provisional orders under the Electric-Lighting Act of 1888 have been granted to companies for the electric lighting of cities or districts of cities, it has been stipulated that the conductors shall be altogether underground, except in cases in which aërial wires have already been placed and brought into action; and that even in these cases the conductors. if for high-pressure supply, shall be removed from the air and replaced by underground conductors within two years.

It may be considered, indeed, as now definitely resolved that the distribution of electric energy for light and power in towns of the United Kingdom shall be by underground conductors, and plans for carrying this into effect safely and economically are engaging the anxious consideration of electrical engineers. The telegraphic department of the post-office has already replaced nearly all the aërial telegraph wires of the larger cities by underground conductors.

The telephone wires alone remain in the air. Long may they hold their place there: they are perfectly harmless to the general public, and they are enormously less expensive where they are than they could be if placed underground.

As for the country, telegraph, telephone and electric-light conductors must all be in the air. The cost of placing them underground would be absolutely prohibitory of the great public benefit to be obtained by placing more and more of them in the air. The Board of Trade rules are amply sufficient guarantees against danger to man or beast in country districts, from aërial electric-light conductors, whether for high or low pressure; high pressure they must generally be for long ranges over country. Indeed, I believe these regulations may be largely relaxed for electric-light wires in the country. Provided only that strong enough and sufficiently well-engineered standards or well-stayed poles be placed for carrying the wires, and provided the spans from standard to standard be short enough, it will, I believe, be found quite unnecessary in respect to public safety to have any coat of insulating material on the copper of conductors for electric light or power along a country road. Fifty years may well pass, with all their gales and snowstorms, without a single break-down, and there are no telegraph or telephone wires to fall upon the deadly copper with its 10,000 volts. Until, however, the security of the poles and wires, which I believe to be attainable, is satisfactorily demonstrated, and until it is also proved that this security can be attained at moderate enough cost, I would not suggest the slightest relaxation of any of our Board of Trade regulations for the protection of the public safety, whether in town or country.

*From the *North American Review*.

THE TELEPHONE IN THE WEST OF ENGLAND.—There are now in connection with the Western Counties and South Wales Telephone Company, throughout the Southwestern district, 2,204 exchange subscribers and 671 private wires. There are 39 exchanges in the whole of the district. The longest speaking connection of the company is from Bath to Llanelly, a distance of 142½ miles.

ELECTRIC RAILWAYS IN WASHINGTON.—Senator Harris, of Tennessee, in advocating the granting of an electric street railroad charter in the South, recently, said he expected to see every street railroad in the District of Columbia operated by electricity within the next three years. He expressed the opinion that the road to Eckington, a suburb of Washington, was the most complete in the world, and as free from danger as any horse railroad.

EDISON'S START IN LIFE.

HOW THE GREAT ELECTRICIAN MADE HIS FIRST HIT IN BUSINESS AND REALIZED THE IMPORTANCE OF THE TELEGRAPH.

The following is one of the "Talks with Edison," which George Parsons Lathrop reports in *Harper's Magazine* for February: "At the beginning of the Civil War," said Mr. Edison, "I was slaving late and early at selling papers; but, to tell the truth, I was not making a fortune. I worked on so small a margin that I had to be mighty careful not to overload myself with papers that I couldn't sell. On the other hand, I could not afford to carry so few that I should find myself sold out long before the end of my trip. To enable myself to hit the happy mean, I formed a plan which turned out admirably. I made a friend of one of the compositors in the *Free Press* office, and persuaded him to show me every day a 'galley proof' of the most important news article. From a study of its headlines I soon learned to gauge the value of the day's news and its selling capacity, so that I could form a tolerably correct estimate of the number of papers I should need. As a rule, I could dispose of about 200; but if there was any special news from the seat of war, the sale ran up to 300 or over. Well, one day my compositor brought me a proof slip of which nearly the whole was taken up with a gigantic display head. It was the first report of the battle of Pittsburg Landing—afterward called Shiloh, you know—and it gave the number of killed and wounded as 60,000 men!

"I grasped the situation at once. Here was a chance for enormous sales, if only the people along the line could know what had happened; if only they could see the proof slip I was then reading! Suddenly an idea occurred to me. I rushed off to the telegraph operator and gravely made a proposition to him, which he received just as gravely. He, on his part, was to wire to each of the principal stations on our route, asking the station master to chalk up on the black bulletin-board—used for announcing the time of arrival and departure of trains—the news of the great battle, with its accompanying slaughter. This he was to do at once; while I agreed, in return, to supply him 'free, gratis, for nothing,' a *Harper's Weekly*, a *Harper's Monthly*, and a daily evening paper during the next six months from that date.

"This bargain struck, I began to bethink me how I was to get enough papers to make the grand *coup* I intended. I had very little cash, and, I feared, still less credit. I went to the superintendent of the delivery department and proffered a modest request for one thousand copies of the *Free Press* on trust. But I was not much surprised when my request was curtly and gruffly refused. In those days, though, I was a pretty cheeky boy, and I felt desperate, for I saw a small fortune in prospect if my telegraph operator had kept his word—a point on which I was still a trifle doubtful. Nerving myself for a great stroke, I marched upstairs into the office of Wilbur F. Storey himself, and asked to see him. A few minutes later I was shown in to him. I told him who I was, and that I wanted fifteen hundred copies of the paper on credit. The tall, thin, dark-eyed, ascetic-looking man stared at me for a moment, and then scratched a few words on a slip of paper. 'Take that down stairs,' said he, 'and you will get what you want.' And so I did. Then I felt happier than I have ever felt since.

"I took my fifteen hundred papers, got three boys to help me fold them, and mounted the train, all agog to find out whether the telegraph operator had kept his word. At the town where our first stop was made I usually sold two papers. As the train swung into the station I looked ahead, and thought there must be a riot going on. A big crowd filled the platform, and as the train drew up I began to realize that they wanted my papers. Before we left I had sold a hundred or two at five cents apiece. At the next station the place was fairly black with people. I raised the ante, and sold three hundred papers at ten cents each. So it went on until Port Huron was reached. Then I transferred my remaining stock to the wagon which always waited for me there, hired a small box to sit on the pile of papers in the back of the wagon, so as to discount any pilfering, and sold out every paper I had at a quarter of a dollar or more per copy. I remembered I passed a church full of worshippers and stopped to yell out my news. In ten seconds there was not a soul left in meeting. All of them, including the parson, were clustered around me, bidding against each other for copies of the precious paper.

"You can understand why it struck me then that the telegraph must be about the best thing going, for it was the telegraphic notices on the bulletin boards that had done the trick. I determined at once to become a telegraph operator. But if it hadn't been for Wilbur F. Storey I should never have fully appreciated the wonders of electrical science."

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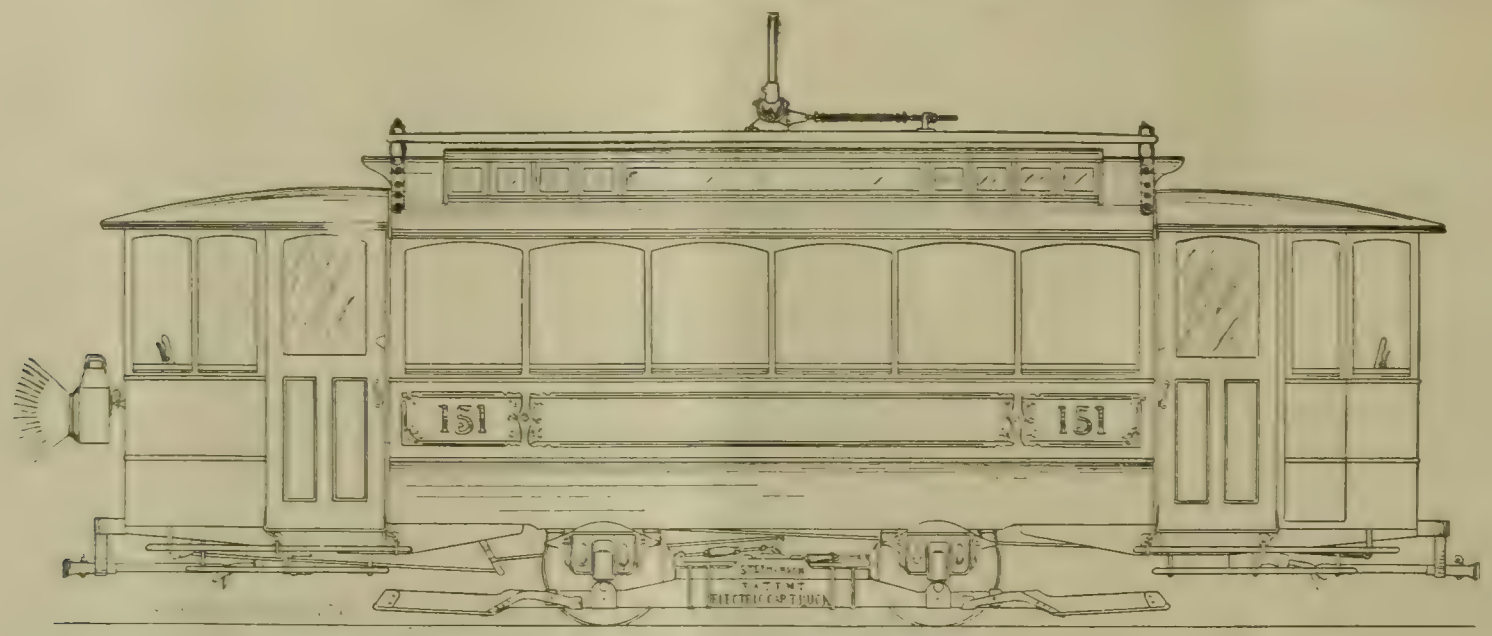
To meet this demand, the Stephenson Company is manufacturing a vestibule electric street car, of which an illustration is given herewith. The car is elegant in appearance and is finished in a superb manner in every particular. There are many features in this new style of car that are worth noting. The unusual height of the windows is one of the first things to attract the attention. The sash stiles are of bronze, and the glass is imbedded in rubber cushions, thus allowing a fully open view out of the windows, and preventing the rattling that is so common and disagreeable. In the cab, or vestibule, the driver is isolated from contact with passengers entering or leaving the car, and he is completely protected in stormy weather. The trolley bridge on the roof of the car is worthy special mention. It is of sufficient strength to bear its own weight and that of the trolley stand and arm. It is supported at the ends by plates of iron securely fastened to the end wall of the car, and rests between rubber cushions at each end. It is thus free from contact with the car roof, and is a protection against possible damage to the latter. On account of its being insulated by means of the rubber cushions already mentioned no ill results to passengers or car can follow any derangement of the wires, etc.

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THE ELECTRIC LIGHT CONVENTION.

The National Electric Light Association held its eleventh semi-annual convention at Kansas City, Mo., last week. It was a success. The papers read were timely and interesting, and the exhibition of electrical machinery was the best ever made at conventions.

The papers submitted contained information of great value to the electrical profession.

The important question of harmonizing insurance interests remains in pretty much the same condition as before the meeting, although the discussion which took place on the subject brought out many valuable points.

The next meeting of the association will be held at Cape May, N. J., in August.

The convention made a mistake in not placing a resident of Chicago on the Executive Board. With one exception the members belong in the East. We believe this oversight was wholly due to the nominating committee, which should have exercised better judgment in its selections. The Eastern members are, no doubt, willing to have the apparent injustice to Chicago rectified. If it is necessary for one of the New York members to resign to make room for a Chicago representative, it would be preferable to the indifference that will be certainly manifested by the Chicago members in the future welfare of the association. Chicago interests must be recognized and encouraged; not ignored.

THE EDISON PHONOPLEX,—Twenty six stations in the Kansas City, Fort Scott and Memphis Railway are equipped with the Edison Phonoplex system. The superintendent of telegraphs of the company has constructed 250 miles of circuits along the line of the road.

GOOD EFFECTS OF ELECTRIC ROADS.—It is a significant fact that in almost every case where electric railways have been laid in cities one of the first results of the innovation has been the erection by city people of residences in the adjacent country. This is something for street car companies and real estate dealers to think about. For both parties to combine in the introduction of electricity as motive power means a large increase of business and corresponding increase of revenue. The potent factor here is the fact that electricity is a rapid method of transit, and all large cities are discussing the question of rapid transit. Electricity, too, is a safe, convenient and reliable method of propulsion, and is free from all of the objections of other systems. That the tendency is to rapidly build up along the line of an electric railway is an incontrovertible fact. Rapid transit is the secret of it. Take the experience of New York City as an example. Before the elevated roads were established, Harlem and adjacent sections were considered altogether too far for a business man to go to live. As soon as these roads began operations, however, property in Harlem began to increase in value, and now there is very little land that has not been covered by a building. The increase in the value in property at the northern end of the city has been phenomenal, and all because of the possibility to reach the outlying districts quickly.

GAS IN THE SUBWAYS.—The accumulation in subway manholes of gas from leaking gas mains is what causes the explosions that occur now and then in this city. The question naturally arises, why do the gas companies not use pipes that are gas-tight. It looks like a simple matter to confine gas so it will not escape, but in practice it is evidently not so easy as it appears. It is said that there is nothing that can be practically utilized in the manufacture of gas pipes that will absolutely prevent escape. Take, for instance, a gun barrel, which is as tough and dense as iron can be made, fill it full of gas and plug the ends perfectly tight. After it has stood for a while, on removing the plugs, no trace of the gas is found. If this happens in an experiment of this sort, it is not to be wondered at that the gas finds its way out of the ordinary iron mains. It is said that the gas lost by leakage in the mains is equal to 30 per cent. Here is a chance for some inventor to exercise his ingenuity. A fortune awaits any one who invents a perfectly gas-proof pipe. Such an invention would be valuable not only to gas companies, but also to the electrical industries using subways.

POLITICS AND ELECTRIC LIGHT IN OHIO.—A bill has been introduced in the Ohio Legislature to compel all electric light companies operating plants in Ohio to place their wires underground. All wires must be under ground in six months after the passage of the act. Failure to comply will subject any delinquent company to a fine. It is said that the author of this bill is from a county that never had an electric light within its borders. Politicians have tried to regulate electric lights in New York and have dismally failed. Ohio will suffer likewise if her citizens submit to interference of this sort by so-called legislators, who think they must do something smart in their capacity as law-makers.

A CHINESE ELECTRICIAN.—Mr. Bert C. Lee, a native of China, is employed at the Westinghouse Company's works in Pittsburgh. Mr. Lee is here in the interest of Chinese capitalists to study the Westinghouse system. After his apprenticeship he will return to his native land and take charge of the central stations in China.

ELECTRIC STREET RAILWAYS.—The Buffalo Railway Company are considering the advisability of substituting electric power on its lines.

WHIPPLE'S ELECTRIC REPORTS.

"Whipple's Electric Reports" for February are out. This work is of great value to electric light, electric street railway and gas interests. Each monthly number contains a revised list of central stations in the United States, by States, and is corrected to date. A similar list of electric street railways is given, and all changes in both industries are accurately recorded.

The February report shows that there are in the United States 1,338 central light stations; 80 in Canada; 2 in Cuba, and 7 in Mexico. Of the gas companies in the United States, 249 operate electric lights. There were 164 electric roads in operation in the United States at the end of January, and 4 in Canada.

JOINT OWNERSHIP OF POLES NOT SATISFACTORY.—A novel rule has been adopted by the Cincinnati Board of Public Affairs. Hereafter but one line of poles will be allowed to be erected on any one street, and if more than one company wishes to run wires through the same street, provisions are made whereby all wires are carried on the one line of poles. The first company must erect the poles and pay the cost, and if a second company wishes to use the poles, it must pay the first company one-half of their cost. A third company is required to pay the first and second companies each one-sixth the value of the poles. In this way each company will own an equal share in the line. The Board of Public Affairs is to act as arbitrator in fixing the value of poles. There is great opposition to the order, and several injunctions have been filed as a result. The outcome of the present state of affairs will be watched with much interest.

FIRE WIRES INVITED DOWN.—Mayor Grant has sent to the Fire Commissioners a long list of the telegraph poles that now bear only fire wires and police wires. The Mayor says:

"You will readily see that the above together with a few others, which will be furnished to you by Mr. Wheeler, would make nearly 1,000 poles which could be cleared from the streets if your department and the Police Department could remove their wires. I wish you would take up the matter and facilitate its disposal as much as possible. The representatives of the telegraph and telephone companies frequently make the excuse that their wires are down long before those belonging to the city."

THE RUBBER TAX QUESTION.—According to latest advices from Brazil, the Governor of Para seeks to shift the responsibility for the increase of the rubber tax from his own shoulders to some body else's. In revoking the tax he explained that the duty was abolished at the request of those who asked that it be established, the tax not having produced the desired result. The decree also provides that the amounts received from the duty shall be refunded to the contributors.

THE CARNEGIE LIBRARY AT ALLEGHENY CITY.—The Carnegie library building in Allegheny City, Pa., is to be lighted by 900 incandescent lamps supplied by the Westinghouse alternating current system. This is the edifice which was erected by Mr. Carnegie, and presented to the citizens of Allegheny. The total cost was about half a million dollars.

AN ELECTRICAL EXCHANGE PROPOSED.—It is proposed to establish an association in London for the interchange of useful information pertaining to electric lighting. There is some opposition, but it is thought that a majority of those engaged in the electrical trade will fall in line. The advantage of such an exchange would be great. Comparing one's coal bill with our neighbor's, might teach economy and lead us to inquire if there was waste, thus enabling one to effect a saving. Then there is the question of the cost of distribution, which to suppliers of electric current is a most important item.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

THE ELEVENTH SEMI-ANNUAL CONVENTION HELD AT KANSAS CITY, MO., A GREAT SUCCESS.

FIRST DAY'S PROCEEDINGS.

The eleventh semi-annual convention of the National Electric Light Association began proceedings February 11th at 1 o'clock, in the Coates Opera House, President E. R. Weeks presiding.

Mayor Davenport of Kansas City was introduced, and he delivered an interesting address of welcome. He said:

"MR. PRESIDENT, LADIES AND GENTLEMEN OF THE CONVENTION.—To me has been assigned the pleasant and agreeable duty of welcoming you to our city, where many of the most important and interesting conventions that have been held throughout the United States during the years of 1889–90 have sat in deliberation. To none, however, have I extended, in behalf of our citizens a more cordial and heartfelt greeting than it is now my pleasure and privilege to offer you, whose coming has been a source of pleasant anticipations, mingled, perhaps, with the hope that here, in the center of this great American Union, the verge or margin of that border land of science, which Mr. Thurston so graphically depicts, may some day find its beginning, a land where it is said, the portrait of the sender of each telegraphic despatch will accompany the message, where submarine and aerial navigation will be carried on successfully by the power derived from stored electricity, where the soft light of the firefly or glow-worm will be produced by man, and the direct conversion of heat into electricity will be solved. The result of your deliberations will be anxiously awaited by the whole commercial world, as well as the scientific, because electricity has given an impetus to the former that has driven and impelled it forward with wonderful rapidity and signal success to its present high state of perfection. Its civilizing influences have extended the confines of education, refinement and culture to the uttermost parts of the earth. You, gentlemen, are the exponents of laws which govern one of the most powerful forces of nature, under the action of which energy becomes appreciable. You teach us that like heat, light or work, it is measurable and can be produced or converted into other forms of energy. By means of this marvelous agency, you have already presented to science most wonderful aids by which she has been able to make visible what has hitherto been invisible; to make audible what has been inaudible, and to discover what has not been dreamed of in the philosophy of mankind, for whether its manifestations be considered under the head of static, galvanic, or faradic, it is all electricity—it is all witchcraft with its future possibilities entirely inconceivable, except to such research as may result from distinguished and able gentlemen as compose this assembly. As we hear of these mysterious currents measured by Ampères, and of the power by which various bodies resist these currents, measured by Ohms, we seem to be attaining the condition of life of which Mr. Thurston speaks, or that so cleverly portrayed by Bulwer in his 'Coming Race,' in which all are happy and harmonious, seeming to have reached the millennium. Evil, being held in bondage by the potent 'Vril' wand which gives to all alike motive, defensive and creative power—with also the perfect knowledge of how to use it for the greatest and best good for all. Electricity is our magic 'Vril' wand, and you are teaching us its capabilities. Six years ago it had not been used upon the broad ocean, that difficult and dangerous field of warfare. When the navy department fitted out the frigate Trenton with an electric incandescent plant, the eyes of the world were upon her, eager to see the mooted question settled, as to how the glass bulbs and carbon filaments would bear the firing of the frigate's guns. The three years' successful cruise proved so much to the United States and to those foreign countries, who are learning to follow in her footsteps, that now a man-of-war is not equipped without the incandescent lighting plant and the 'arc' for the 'search,' which reveals, not only the dangers of the surface of the mighty ocean, but pierces the briny deeps, detecting the death-dealing torpedoes that have been laid for destruction. This faithful servant of man not only guards the vessel from the inventions of the enemy, but aims and fires the gun, illuminates the sights that the aim may be sure, discharges torpedoes, measures her speed, is the most successful motor for submarine boats and renders possible a system of telegraphy by which communications may be flashed against the clouds and understood at a distance of sixty miles.

"We welcome you as true benefactors of mankind, the emancipators of the human race from darkness. What you and those of your profession have accomplished within the past few years reflects credit upon your country—borders close upon the miraculous and entitles you to imperishable honor and renown. I will not detain you in enumerating your achievements, gained by the most faithful and unremitting labor. Cost, or dollars and cents, is the great obstacle in the way of the speedy and universal adoption of many of your most important discoveries and perfected inventions. Electricity today is at its highest cost, and we look forward to the time when, being cheaper, it will accomplish for humanity all that it now promises. It is estimated that at the beginning of the year 1890 $600,000,000 was invested in the electrical industry in the United States, and that 250,000 persons depended upon it for their means of living. That 150,000 miles of telegraph wires are in operation—enough, it is said, to encircle the globe forty times. Three hundred thousand telephones are constantly talking, and an average of 1,255,000 messages are sent daily, requiring the use of 170,000 miles of wire.

"The longest distance over which conversation is maintained is 750 miles, i. e., from Portland, Me., to Buffalo, N. Y. Just how many of the musical kind, that Mr. Bellamy speaks of, I do not know. Four hundred miles of electric railways are in active operation in America. The fastest speed attained in the transportation of passengers has been twenty miles an hour. I believe Mr. Weems has quite recently at Laurel, Md., upon an experimental track, made two miles a minute, or 120 miles per hour. There were no passengers upon that train, however, it being used exclusively for baggage, which is hereafter to be sent in advance. At your annual meeting at Niagara Falls the statement was made that there are in use in the United States 237,917 arc lamps and 2,704,760 incandescent. I hope that the increase will be so great within the next few years that the various companies will find it possible to furnish light and motive power at much lower rates. Electric light is certainly the only form of artificial illumination not injurious to health, and therefore it is our hope that all classes may soon, in consequence of its cheapness, be enabled to enjoy its benefits. The mystery which seemingly surrounds electric service will, in time be dissipated, and it will come to be regarded with less suspicion and fear.

Perfection cannot be expected in the use and distribution of such force and power immediately. Danger to human life and property interests are questions in which we are all concerned, but it will not do to condemn without comparison and investigation, else we may deprive ourselves of valuable agencies and servants, whom to understand is to bring us health, wealth and prosperity. Immense poles, that make unsightly our most beautiful thoroughfares over which hang a dense mass of wires to obstruct access to our buildings in case of fire, and almost shuts out the light of day, will in time disappear. It was necessary that they should precede the subways now coming into use, but not yet, I believe, admitted to be universally successful, though the Bell Telephone Company had in 1877, 6,338 miles of wire under ground; in 1888, 8,009 miles, and in 1889 have increased it to 17,138 miles. Taking into consideration, however, the service performed and work done through the means of this unseen power, it is pleasing to note that the casualities resulting from its use are less than from any other source.

"To the future we can only look with wondering eyes and bated breath and to you as the workers of miracles. May your deliberations, gentlemen, while here, be as harmonious as the laws which govern the marvelous and wonderful philosophy of electricity."

Mayor Davenport was frequently interrupted by applause, and after the last round had subsided President Weeks replied as follows:

"At our first convention, held in February, 1885, there were eighty-seven delegates, full of enthusiasm for the good to be accomplished. I believe, gentlemen, that they have not been disappointed in the work of this association. As one of the original eighty-seven, I point with pride to five years of broadening and harmonizing influence; and I believe that every central station, every factory, every supply company in the country has felt its impulse towards improvement. To-day, gentlemen, we number 304, representing not only a wider extent of territory than ever before, but all the leading systems of the United States. A more fraternal spirit now prevails between the electric light and power men and our elder brothers of the telegraph and telephone interests, a pleasant proof of which has been given by the hearty co-operation of their representatives in this city in preparing for the entertainment of the convention. [Applause.]

"The past work of the association speaks for itself; but our number has so increased and our sphere of usefulness has so advanced, that we must look for work of a better character than was possible in earlier days, when most of our members were new to the duties which they had undertaken. We now need work of more direct practical value to central station men, and theoretical work of a higher grade than that of the past, good as that has been. With this in view, we have endeavored to prepare a programme of such importance, both practically and theoretically, that you will find it good to be here.

"The committee on state and municipal legislation will report the organization of state associations with a view to developing among legislators a full appreciation of the importance and needs of the electrical industries and to present these industries in their true light. The urgent need is for organization along the lines of legislation and popular education. This can be best accomplished by state associations, whose conventions could advantageously take the place of the semi-annual meetings of this association. Ten of these state associations have been formed, and I hope that before the close of this convention steps will be taken toward the organization of many more.

"The increasing interest in railroad work and the immense field for future development in the motor department will render especially pertinent the discussion by Mr. Sprague, and also the work of the committee on standardization of potential on electric street railways, the report of which will be submitted through its chairman, Mr. Lynch.

"As the growth of our industry must be chiefly in the direction of incandescent light and power, the discussion to be presented by Mr. Field is of the greatest importance, both to central station men and to all who desire electric service in their homes.

"The watchwords of the future are certainly economy of fuel and perfect insulation, and while there may be improvements in designs for apparatus, and in methods and means of distribution, and while we still hope for the direct conversion of the energy of coal, the advance of the immediate future should be in the direction of economizing present waste, rather than in the discovery of new facts or principles. [Applause.] Americans are proverbially prodigal, and there is an absolute and growing need that waste and loss should be arrested. While the demand for the necessary elements is increasing with the population, the supply of many of those elements are steadily diminishing. Messrs. Babcock and Sickles will doubtless point out lines of economy in the department of steam engineering, and Mr. Smith will present for our consideration another phase of the same question—'A Universal System of Central Station Accounts.' The many problems arising in the electrical and mechanical departments of the operation of central stations have left this question to general neglect. But now that we are becoming passably familiar with the tricks of our apparatus attention is more and more directed to data for comparisons with a view to economic methods.

"The topic of the hour is certainly safety. It would seem that in view of the relatively small number of serious accidents connected with electrical industries, we have grounds for some impatience with the present outcry against electricity as a dangerous servant. It is true that compared with those which have accompanied the introduction and use of steam and gas, the number of accidents in the use of electrical apparatus is very small. But in this age comparative rates will not be accepted as answers; the people have a right to demand that devices for public safety keep pace with developments in other directions. The discussions of Professor Thomson and Messrs. Haskins and Harber will present this current topic in its various phases. I trust that each speaker will enforce the importance of good construction and maintenance on the part of producers, and proper inspection on the part of the municipality.

"It is hoped that the committee on underground conduits and conductors will be able to report some facts regarding the actual operation of high pressure currents under ground. Thus far discussion of this topic abounds in theory and speculation, but contains little experience.

"During the past twelve months there has not been only a greatly increased activity in the electrical industries abroad, but many millions of foreign money have been invested in the electrical properties of America. It is also worthy of note that our brethren in Great Britain have set the example of adjusting differences amicably, instead of carrying litigation to the court of last resort. Such a policy in America would not only have saved hundreds of thousands of dollars now charged to profit and loss, but would have greatly enhanced the value of electrical securities. The past year has furnished instances in which the value of local electrical properties has been greatly depreciated through the invasion of territory already fully occupied. This policy is short-sighted. Prices in most cities are fair and just, both to consumer and producer. To depreciate them will not only ruin the business of pioneer companies who have invested large sums, and borne the brunt of introducing a new and valuable industry, but cannot fail to result in great loss to the invader.

"Although electric lighting in this country has seemed to receive a check, a look ahead would not be discouraging. The law that 'action and reaction are equal and in opposite directions,' applies not only to mechanics, but to public opinion. As America is the birth-place of the commercially successful electric light, and as Americans are the foremost people of the world to recognize improvements, we may we believe that with proper attention on our part to our duties to the public, the present popular and largely sensational agitation against us will give place to a feeling of confidence. In the meantime, let the outcry teach its proper lesson to all engaged in the electrical business."

After Mr. Weeks had concluded, Secretary Allan V. Garratt called the roll of the members and those present responded to their names. The financial report was then read showing a most favorable condition of affairs, and this was succeeded by communications from the Commercial Club, offering any hospitality possible and asking President Weeks for suggestions; from the Engineers' Club, offering the use of its room; from the Chicago, Milwaukee & St. Paul railroad, offering the members' transportation to the "life-giving" waters of Excelsior Springs; from the Excelsior Springs Hotel Company, offering the hospitality of the house, and from the Missouri & Kansas Telephone Company, offering free service to any members desiring it. These were all accepted. Invitations from John A. Martin to visit the Soldiers' home, and from George W. Warder to visit the Warder opera house, were referred to the executive committee, as it was doubtful if time could be spared for the excursions.

A motion was made by Mr. F. E. Degenhardt and carried, that a committee be appointed to draft resolutions of respect to the memories of Messrs. C. E McIntire, and Miles W. Goodyear, who died since the last meeting.

The convention then adjourned to 9 o'clock February 12th.

After adjournment the delegates were grouped in front of the opera house and photographed by a member of the association.

The informal reception tendered the association by the Commercial Club was one of the pleasantest affairs ever held in Kansas City. The spacious rooms of the Commercial Club were filled by the members of the association and their hosts, while in a corner convenient for observation a few ladies occupied seats. The intention to have the meeting informal in every way was carried out to the letter. In an anteroom coffee and punch were served, and cigars were passed every few minutes.

President Faxon, of the club, welcomed the visitors in an appropriate address.

A special train on the "L" road was tendered, the electricians and a pleasant ride was had by many of them to Chelsea Park. The Board of Trade committee on reception accompanied them on their trip. The visitors, one and all, seemed astonished that two such magnificent cities should repose so peacefully side by side.

SECOND DAY'S PROCEEDINGS.

The second day's deliberations were begun in Music Hall, the atmosphere of which was for two hours quite chilly. Everybody was warmed up by the handsome thing done by the Metropolitan street railway company. It extended the courtesy of all its lines to the delegates and said that conductors had been directed to recognize badges in lieu of fare. It also tendered a special excursion over the Armourdale electric line. The offers were accepted with applause.

The state association of architects in session at the Midland invited the delegates to inspect the display of architectural drawings in parlor S of the Midland. The executive committee was directed to answer the communication and reciprocate courtesies.

The following was then read:

Sorry to be debarred from attending the convention. The association has our heartiest good wishes and will always have our best endeavor. May its deliberations be marked by Western breadth and Southern generosity, and may it grow as fast as Kansas City.

T. C. MARTIN, and
JOSEPH WETZLER.

Mr. George M. Phelps of New York, presented the report of the committee on the abolition of the duties on copper wire—something of interest to every citizen of the United States. The report, which was very attentively listened to, was received and accepted. As the reading was finished President Weeks remarked with emphasis:

"This is a matter of great moment—a matter of moment not only to the electrical men here assembled and all over the country, but it comes home to everyone. Whatever affects the manufacturer of an apparatus affects the user of that apparatus, and whatever affects the user of an apparatus affects the consumer."

Then Mr. Phelps, facing the delegates, said: "I wish to suggest further that members who feel deeply interested in this matter would, I think, contribute to the success of the petition by addressing communications to their several representatives in the national Congress. It is somewhat problematical, I think, whether any discussion of the subject of revenue at all will be permitted to take place on the floors of Congress this season. But, if such a discussion can be brought about there, it is the opinion of your committee that the success of their petition is exceedingly probable. There is practically nothing to be said in favor of retaining the duties on copper. I have not heard a word in defense of it. The only persons who have been at all disinclined to sign the petition have been those who have said substantially: "Yes, it is all right; the duty on copper ought to go; but we make something else, and our friends make something else that are protected by tariff duties, and we do not want this thing 'stirred up.'" We feel that the greatest difficulty will be in getting the thing 'stirred up.' If it can be 'stirred up' and brought to the attention of the national Congress on the floors of the house of representatives, it is my individual opinion and I think the belief of the rest of the committee that the copper tariff will not last long. All those who are in sympathy with the measure will contribute to its

successful issue by addressing their members in Congress, or any congressmen or senators to whom they have access in any way. [Applause.] I ought to say I am but one member of the committee present; Mr. Brown, the chairman, is unable to attend and Mr. Morrison, we all know, is unfortunately prevented from being here. I have made out this report after conference with Mr. Brown, but have not been able to see Mr. Morrison.

"I ought to say further, perhaps, as a matter of record, that there was no appropriation made for the work of this committee. Your committee has expended a considerable sum of money and a great deal of printing and postage was required. In due time when we are through with our work we may present, for the information of the association, a record of this matter."

President Weeks said: "Gentlemen, this subject is a matter of great moment. Aside from its national, I might say international interest, it is a matter that comes right home to everyone engaged in the electrical business; and it illustrates very nicely the community of interests that prevails, and we should all appreciate and understand it, whatever affects the manufacturer of electrical apparatus affects the user of that apparatus, and what affects the user of that apparatus must necessarily come right down to the user of the product of that apparatus—the general public. I repeat, gentlemen, that this is a very important question. The report is now before you; what is your pleasure?"

Mr. A. J. DeCamp moved that the report be received and the committee continued. This was carried.

THE COMMITTEE'S REPORT.

The committee appointed at the last meeting of the National Electric Light Association to petition the proper committee of Congress for the abolition of duty on copper, appeared at Washington January 16, through Mr. Phelps, who presented the following petition to the committee on ways and means with the subjoined address:

Petition to the Honorable Committee on Ways and Means, House of Representatives, U. S. A.

The subscribers were appointed a committee to petition your honorable body for the abolition of duty on copper ingot, plate bars, rod and wire. We represent the National Electric Light Association, a body composed of representatives of electric lighting companies throughout the United States and also of manufacturers of and dealers in electric lighting apparatus and supplies.

The resolution appointing this committee was passed without a dissenting voice. We therefore have the honor to present this petition, earnestly requesting that the action asked to be taken as a measure which will be approved by the great body of users and manufacturers of copper.

CHARLES A. BROWN,
GEORGE M. PHELPS,
J. F. MORRISON.

The National Electric Light Association consists of corporations, firms and individuals owning and operating stations and plants for the distribution of light and power by electricity.

At the time of the last convention of the association, August 6, 1889, the capital then invested in the industries above named was estimated, from statistics collected by the secretary of the association, to be not less than $275,000,000. This sum represented mainly electrical apparatus and electrical conductors for the supply of 238,000 arc lamps and 2,700,000 incandescent lamps, in all which apparatus and conductors copper is an indispensable and chief material. In the total cost of electric plant for light and power distribution, it is estimated by competent experts that from one-fourth to one-third is expended for copper.

The foregoing figures and statements sufficiently indicate the magnitude of the interest of electric light and power companies in the price of copper.

In the opinion of the petitioners, the proposed abolition of the copper tariff does not touch the question of protection to the American industry. The duty on copper appears to be wholly superfluous as a protection to American producers of that metal. The United States not only produces more copper than it consumes and consequently exports that metal, but it possesses the richest and most easily worked copper mines in the world, and its mining companies produce the metal and put it in the market at a lower cost than is possible to the Spanish or Chilian miners. Obviously the American producers of copper require no duty to protect their domestic market and their exports of copper furnish sufficient evidence of their ability to meet competition in foreign markets.

The existing duty is of no appreciable value to the national treasury, because copper is not imported in any considerable quantity. As a source of national revenue the copper tariff is practically useless and the returns from it could not be increased materially under the conditions of production throughout the world by any modification of the rate of duty if the government needed increased revenue, which it confessedly does not.

It would appear, therefore, that the duty on copper can only be efficient in enabling the mining companies and dealers in copper to establish and maintain excessive prices through combination for that purpose. It is believed that the United States duty of 4 cents per pound was a considerable factor in the operations of the syndicate, established in France in the autumn of 1887, and which syndicate, aided by its agreements and contracts with copper mining companies in this country, succeeded in controlling the copper production and markets of the world for more than a year, doubling, for a considerable period, in London and New York, the price existing just previous to the beginning of its operations. This was effected, moreover, in the face of an abundant supply of the metal. For some months after the break-down of the French speculation the American companies maintained the price in this country considerably in excess of that of European markets.

Touching the relation of the duty on copper to combinations for maintaining excessive prices, the following quotation is subjoined:

Extracts from editorial in New York *Tribune*, May 15th, 1889:

The mine owners have publicly stated that they are able to produce more than all the copper this country consumes, and a large part of it at a cost not exceeding 6 cents per pound, and that they propose to the French bankers, who hold an enormous unsold stock, to fix the selling price at about 13 cents per pound—more than double the cost. Nothing need be said about the right of the producer to get a profit of more than 100 per cent. on his copper, provided he is not a beneficiary of a national policy intended to protect and encourage American productions. But the mine owners are beneficiaries of that policy and owe to the public a certain consideration and service in return. If they enter into a combination for the benefit of foreign speculators and bankers against the interests of American producers, the duty on copper may not last long. * * * There will in all probability be a revision of the tariff next winter. The party in power being anxious to defend all industries that need and merit defense, or where it appears to be needed or where it seems to be deserved. Combinations of speculators to corner the markets of the world are not highly popular and will not appear to members of Congress to merit particularly favorable consideration. Under such circumstances the demand for a removal of the duties on copper ores, pig and bars will be difficult to resist. It is safe to say that, had the Mills bill proposed no change more unpopular or unobjectionable than that, its public support would have been incomparably greater.

In short, and to recapitulate, in the opening of the National Electric Light Association the duty on copper, being useless for revenue and unnecessary for protection, should not be suffered to remain on the statute books of the United States, since its only remaining function is to serve as an ally to the promoters of combinations for putting up prices, a process to which the government should not lend its assistance.

The committee has circulated an auxiliary in support of the petition presented in behalf of the association. It has been intended to solicit the signatures of all companies, firms or individuals engaged in electrical industry and to offer opportunity for signing to all other persons accessible to the committee who are in sympathy with the proposed measure.

On February 8,440 signatures to such auxiliary petitions were forwarded to the committee on ways and means of the house of representatives.

Your committee is still engaged in circulating copies of the auxiliary petition and hope to collect several hundred more signatures.

The committee would earnestly request any members of the association or others inclined to sign the petition who have not received a copy to address either members of the committee, viz: Charles A. Brown, 227 South Clinton street, Chicago; George M. Phelps, 150 Broadway, New York; J. F. Morrison, 15 South street. Baltimore.

Mr. Frederick E. Sickles, who is renowned as an inventor, read a paper on the "Steam Engine," in which the latest inventions in this direction were treated in a way that caused the delegates to listen eagerly to every word that fell from the speaker's lips.

Secretary Garratt read the report of the committee on underground conduits and conductors. It was in the form of a letter to President Weeks, stating that no quorum had come together. Mr. Lynch, chairman of the committee, suggested a new committee containing fresh blood. The committee was discharged and a new one ordered appointed.

The committee on the standardizing and potential of street railways presented a report of some length.

Mr. P. H. Alexander, of New York, presented the report of the committee on harmonizing insurance and electric interests. The committee had had a great deal of correspondence and it repeated the recommendation of last year.

An amendment to the report was offered in effect that the institution known as the New England Electrical Exchange should be extended throughout the country and divided up as follows: The southwestern and a middle state, the northwestern and Pacific coast, these organizations in return to be controlled by a central body to be denoted the National Electrical Exchange. The objections offered to this plan were that inasmuch as the insurance companies themselves assumed the risk and were paid for doing so, it remained with them to inspect all interior wiring or installations whether operated from isolated plants or central stations; that insurance companies in the past had been negligent in not availing themselves of the ample opportunities offered them for obtaining a thorough knowledge of everything necessary to enable them to do this work for themselves; that the time had come when this business with 75 investment of $2,000,000 capital and operating 238,000 arc lamps and more than 2,500,000 incandescent lamps should be better known and its progress no more hampered by numerous restrictions which are not common to other businesses; that the electric light business should not be singled out and made the sole exception to the ordinary policy of insurance offices. Inspectors of these offices it was urged should be instructed by associating themselves with first-class electrical engineers, such as can be found in any fair sized community. They would thus put themselves in a position to judge accurately of the safety of any installation.

Mr. George Cutter, of Chicago, opened the discussion. He felt a hesitancy, he said, in speaking for the electric light men of the West, but in this section there was a demand for harmonizing the two interests—insurance and electric light—and he advocated it warmly in a long speech.

Mr. Smith, of Philadelphia, followed, holding that the insurance companies should be made to look after the safety of electric wires and not electric light companies.

Mr. M. J. Francisco, of Rutland, Vt., advocated combining the two interests and forming a national exchange, which should be divided into sectional associations on the plan of the New England Insurance Exchange, which employs an expert to determine risks. This association would take the place, or be on a par with the National Board of Underwriters.

Mr. Lockwood, of Detroit, Mich., Vice-President De Camp, Mr. Perry, of Providence, R. I.; Mr. Armstrong, of Camden, N. J.; Mr. Alexander, Mr. S. E. Barton, of Boston; Mr. Williams, of Ohio, and others spoke at length. Finally the report was accepted, the amendment being lost.

Following this Mr. C. J. H. Woodbury, of Boston, read a paper on the "Construction of Central Stations." He submitted a number of general suggestions for stations which embodied the merits of convenience, slight need of repairs and resistance to fire. The convention then adjourned.

THIRD DAY'S PROCEEDINGS.

Immediately after calling the convention to order President Weeks announced that the Interstate Rapid Transit Company had tendered the use of all its lines to delegates who desired to ride over them, and the association badge was a pass over the entire system yesterday, and will be until the convention adjourns.

The actual business of the convention was opened by George E. Palmer, of Chicago, who read an exhaustive paper prepared by George E. Babcock, of New York, on "The Economical Generation of Steam for Electric Light Stations." The paper illustrated the difference in the construction of boilers to be used in generating steam for electric light stations as compared with those for ordinary manufacturing plants. For electric light power the work of the boiler is crowded into a few hours' time, and boilers to be economical should be so constructed as to admit of crowding for a short period. The theory was backed up by statistics and practical illustrations.

At the conclusion of the reading of the paper President Weeks announced that the subjects brought before the convention by the papers of Mr. Babcock on the "Economic Generation of Steam," and J. H. Woodbury on "Central Station Construction," read at Wednesday's session, were open for general discussion. Mr. Sickles spoke of the advantages afforded by flat stayed surface boilers.

T. Carpenter Smith, of Philadelphia, took issue with him and maintained that cylindrical surfaces were far preferable for practical use.

C. J. Field, of Brooklyn, also took part in the discussion and made some excellent points in regard to boiler construction.

M. D. Law, of Philadelphia, thought that Mr. Woodbury, in his paper, had neglected to treat of the dangers from fire by the use of waste beneath dynamos on floors necessarily made of wood. He argued that electric light stations were constantly in danger of fire from this source, and his point was followed up by S. E. Barton, of Boston, who called attention to the oil-soaked floors of the electric light stations adding increased hazard to the fire risk. J. A. Seely, of New York, and M. J. Francisco, of Rutland, Vt., also took part in the discussion.

C. J. Field read a paper entitled "Development of Generating Stations for Incandescent Light Power." Before commencing to treat of his subject Mr. Field caused to be circulated printed copies of his paper with illustrations intended to aid the listener in following his theory. He treated his subject exhaustively and was followed closely by the electricians present. At the conclusion of Mr. Field's treatise, a short discussion, taking the form of questions and answers, took place, in which A. J. De Camp, of Philadelphia; E. A. Armstrong, of Camden, N. J., and P. H. Alexander, of New York, participated.

T. Carpenter Smith, of Philadelphia, read the last paper introduced in the morning session. It was entitled "A Universal System of Central Station Accounts," and as its title implies, contained many practical suggestions regarding a system of accurate bookkeeping for electric light stations.

Before adjourning the secretary announced that Frederick H. Whipple, superintendent of the electric display at the St. Louis exposition to be held this year, had requested the convention to elect a judge of awards to witness the display and decide who was entitled to the premiums offered. E. R. Weeks was at once chosen for the position, and the convention took a recess until 2:30 P. M.

Most of the afternoon session was devoted to a discussion of a paper prepared by Mr. De Camp, of Philadelphia, on the subject of keeping central station accounts. The paper was discussed by Messrs. Francisco, Field and others.

A telegram was read from Mr. R. W. Pope, who is at Richmond, Va., announcing the defeat of the bill which was introduced in the legislature to restrict the voltage used in Virginia with a view to lessening the number of casualties.

There were no papers read in the afternoon, but all had been printed and copies circulated among those present at the convention. Five minutes was allowed the writer of each paper to call attention to any particular features and then discussion was invited. The first paper to which attention was called was "Prodigality in Economy," by C. C. Haskins, of Chicago. Mr. Haskins spoke of the great losses that had been entailed by the purchasing of inferior articles merely because the price was low, of engines that would not run and of generators that would not generate; of wire that was of no use except to get people into trouble, and of oils that would not lubricate.

The paper by Professor Thomson, on "Safety and Safety Devices in Electric Installations," had been read with great interest, and was discussed at some length. Professor Thomson is one of the ablest electrical engineers in the country, and is peculiarly qualified to speak on the subject he chose. He says: The development of the electrical arts, particularly in the direction of lighting and motive power transmission, has been very great in the past few years. It has brought with it a demand for very much work of a novel character, as regards the details of plant and methods of installation. It has also entailed in many cases elements of risk to life and danger of fire. There can be no doubt, however, that electricity, as an agent in itself, is not to be charged with bringing about the results for which recklessness in its use is sufficient to account. That under favorable conditions for discharge through a person's body electric currents of comparatively high pressure may injure or kill is not to be questioned for a moment, and I have no sympathy with any effort tending to give the impression that they are absent when, in reality they exist. Nor have I any sympathy with efforts to exaggerate such risks, efforts that have not been wanting, as is well known. There can be no question that the risk to life from shocks, even with bad insulation, would be removed by using high potential currents, and there can be no question that the shock from certain kinds of currents, as the alternating, is much less safe than from continuous currents of the same pressure. Nevertheless I am just as firmly convinced that the fire risk is very much less with the alternating than with the direct currents. Would it be possible to work successfully, using only low potential currents of either character? Would we, for instance, be able to utilize water powers for lighting without employing pressure of potential sufficient to convey the energy to a distance over a conductor of moderate cost or non-prohibitive cost? In most cases we would certainly not be so able. If the great natural resources in water powers are to be developed, if ever we are to accomplish the great saving in fuel that results from the use of one large instead of several small steam plants it will be by the employment of comparatively great electrical pressures for the conveyance of energy to distant points. And in this connection it must not be forgotten that even with the very low pressure currents safety from fire risk is only to be secured by careful construction and supervision and that fire involves personal risk."

Professor Thomson then discussed the alternating system and statesd that the outside wiring in that system undoubtedly carried a current that will give a fatal shock, but states that the outside and inside wiring can be certainly separated so that no possible shock can be obtained by those using the light and that it is impracticable to furnish the incandescent light at great distances on any other system.

The next paper discussed was by H. W. Pope, of Elizabeth, N. J., entitled, "How Our Paths May be Made Paths of Peace." He closes his paper by saying:

"It should be the aim and policy of all electrical corpora-

tions to constantly improve the condition of the poles and lines, giving as much attention to their strength and beauty as to their perfection electrically. Every day you delay these improvements you encourage adverse criticism and hasten adverse legislation, and subways and underground conduits are not pleasant things for the strongest of us to contemplate. A policy such as this and a vigorous state organization of electric lighting companies will protect our interests from any severe measures at the hands of the general public."

After a brief discussion of the paper the convention adjourned.

Cape May, N. J., was then selected as the next place of meeting.

FOURTH DAY'S PROCEEDINGS.

It was within a few minutes of 10 o'clock when President E. R. Weeks called the electric light convention to order for the election of officers for 1890–91.

The secretary read the report of the committee on nominations, which was as follows:

Marsden J. Perry of Providence for president. Edward W. Mahar of Albany, first vice president, C. L. Edgar of Boston, second vice president.

Executive Committee—C. R. Huntley of Buffalo, chairman; E. R. Weeks, Kansas City, Mo., J. E. English, New Haven, Conn., J. J. Burleigh, Camden, N. J., M. D. Law, Philadelphia, M. J. Francisco, Rutland, Vt., A. F. Mason, Boston, J. A. Seely, New York, H. K. Thurber, New York.

At the conclusion of this report Dr. A. F. Mason of Boston in a hearty speech nominated the present president, E. R. Weeks of this city. Vice President De Camp seconded this nomination and in so doing paid a glowing tribute to Mr. Weeks's administration. The president was deeply grateful for these kindly remarks and sincerely thanked the gentlemen for their approval of the retiring administration, but said that he must decline with thanks the honor of a second nomination.

The president then declared the foregoing nominees the officers for the ensuing year, with the exception of A. E. Armstrong of Camden, N. J., of the executive committee who declined to accept. John J. Burleigh was appointed in his place.

SPRAGUE ON ELECTRIC RAILWAYS.

The first paper of the day was on "Electricity as Applied to Street Railways," by Frank J. Sprague. Mr. Sprague, who is one of the most prominent men in the association, took the stage and was greeted by continued applause. He described as briefly and concisely as possible the different modes of applying electricity to street railway motors. He illustrated at times, by figures on a blackboard, those parts of his address that could best be understood by being seen in black and white. Mr. Sprague proved that a train could be run from New York to Philadelphia cheaper by the use of electric power than by steam, and that a rate of sixty miles an hour could be attained and kept up continuously by means of obtaining the power from power stations at points along the line.

At the close of Mr. Sprague's address he was cheered and applauded, and so enthusiastic was the audience in its approval of the gentleman's address that there was a relapse of the applause after it had first died out. A. E. Armstrong of Camden, N. J., in a very hearty speech thanked Mr. Sprague in behalf of the entire convention for his wonderful and complete and satisfactory address. The audience expressed its approbation of Mr. Armstrong's presumption in thanking him for all by another outburst of applause.

A paper by C. A. Harber of Kansas City discoursed on line insulation, from the standpoint of practical experience. The gentleman reviewed all of the many ways of line insulation and showed how dangers might be averted.

J. D. Lockwood of Detroit read a paper entitled "How to Locate Grounds Upon Arc Lights." This paper was discussed by M. D. Law of Philadelphia, Captain Brophy and Mr. C. E. Gregory of Chicago.

Vice President A. J. De Camp then presented the report of the standing committee. This report first suggested that the name be changed from "The National Committee on State and Municipal Legislation" to "National Committee on Legislation," which was adopted. A list of membership by States of this committee was accepted as presented.

ELECTRIC EXECUTIONS DISCUSSED.

The third section, relative to electric executions, was the subject of more discussion and debate than any other subject of the convention. At the convention held at Niagara Falls last August a resolution was adopted directing the committee to use its efforts to secure the repeal of the electric execution law in New York. Although this has never been acted upon the committee thought it best to make no move in that direction while the question of the constitutionality of the law was undetermined. The committee is still of the belief that the law should be repealed and at the same time believe the law may be enforced, and that it is necessary to amend it so as to require a special apparatus to be devised for the purpose, that shall generate a current of not less than 10,000 volts. The committee recommended the association to instruct it to co-operate with the New York State Association in securing such amendment of the law.

Nearly an hour was consumed in making suggestions as to changes that would benefit this report, but the result was that Dr. Mason's motion to adopt it as read passed unanimously.

The executive committee's report containing a review of the workings of the association during the year and the condition of its several departments showed its progress to be encouraging. The report was adopted as a whole and the convention adjourned for dinner.

At 3.30 o'clock the phonogram from Thomas Edison, the "wizard," was delivered to the audience through the great electrician's latest improved phonograph. The following is the phonogram complete:

Edwin R. Weeks, Esq., Kansas City, Mo.

MY DEAR MR. WEEKS: When I had the pleasure of meeting you at my laboratory in December last, you suggested that I should send to the Kansas City convention, which commences next week, a phonograph discussion upon the subject of my five wire system of distribution, which you were good enough to assure me would prove of interest to the delegates, and ever since that time I have been trying to find an opportunity to prepare the data.

My failure to do so has been through no fault of yours, as your letters have constantly kept the matter before me; nor has it been through want of inclination on my part that I am obliged to substitute this explanation. Certain urgent matters of business which I was unable to anticipate have occupied my attention to such an extent that I have even had to neglect the important work of my experiments.

While I could not have contributed to the success of the convention, which is already assured through its location in your enterprising city, I regret that I am unable to send something which would at least be more interesting than this apology.

Yours, very truly,
THOMAS A. EDISON.

The phonogram is dated February 7, and is sent from Mr. Edison's private laboratory at Orange, N. J.

Before the phonograph had called up the voice of Edison from its depths, Edward Johnson explained the mechanism of the instrument, and a cornet solo by Jules Levy was reproduced. The tones of the cornet as well as the voice of Mr. Edison were distinctly reproduced and were audible throughout the house.

Further discussion of papers took place for one hour, when the convention adjourned *sine die*.

Among those present were:

KANSAS CITY.

G W Johnston
C A Ross
O H Schramm
Jas Scammon
W F Sargent
D K Smith
W Wiley Smith
D A Williams
E R Weeks
Thos Wolf
W B Grimes, Jr
G W Hart
F Howard
C A Harber
F K Hoover
F K Holtzinger
Ira C Hubbel
L S Jenkins
W B Knight
Edw Lassell
C W McDaniels
F A Kettler
W D House
Horace Keefer
W M Yenawine
C H Talmage
C S Gilbert
A M Barron
Louis Kunz
John Boyle
W G McGonnon
R Macmillan
J W Mason
A M Morse
W T Osborn
M S Porter
H M Porter
C H Rusling
T H Reynolds
Paul Bossart
L C Bair
M E Bates
J S Chick
T F Clohesey
J D Cruise
H M Cutler
O W Ditsch
G H Elmore
T F English
C C English
W B Grimes
W H Woodring
G M Myers
Floyd Platt
Ben Friedberg
Bert Ford
Dr R W Brown
L H Camp
H C Sprague
T Mulford

CHICAGO.

C G Armstrong
G C Bailey
W J Buckley
E V Cavell
F W Cushing
Geo Cutter
A C Durburow, Jr
A L Davison
D B Dean
D T Everts
D S Geer
C E Gregory
Ernest Hoefer
W A Kriedler
Alex Kempt
H P Lucas
W W Low
E L Powers
G M Smith
J H Shay
A E Smith
J Stedman
F S Terry
John Young
J B Allan
Geo Atkinson
A H Bauer
S S Badger
C H Cone
A L Cloud
F E Degenhardt
J W Dickinson
Fred DeLand
C W Emery
E D Floyd
H A Glasier
Geo T Hewes
C C Haskins
G A E Kohler
S S Leonard
H T Lockwood
W B Pearson
John Ritchie
B H Schmidt
R J Randolph
C H Wilmerding
H E Longwell
G S Searing
E L Clark
J J Nate

NEW YORK.

G M Phelps
C E Stump
F J Sprague
J A Seeley
S S Wheeler
H W Leonard
H L Lufkin
P H Alexander
C A Benton
W L Candee
E T Greenfield
A V Garratt
J W Godfrey
J B Halstead
J P McQuade
H M Haines
F A Magee
F P Wisner
P H Hover
Luther Stieringer
C W Price
C A Schieren, Jr
G P Toby
B R Western
E H Johnson
A T Mayer
J F Kelly
W S Kelly
W J Johnston
Geo Manson
A H Patterson
J B Taltavall
R J Gray
A J Stott
David Chalmers
W S Turner
C J Field
Wm. Hammond
H M Swetland

J B Darrah

MCPHERSON, KAS.
B A Allison

F E Knight

MERIDEN, CONN.

MILWAUKEE, WIS.

B W Smith

NEWTON, KAS.
W G Oldfield
L McCormick

MONTREAL.

W R Kimball

ALLENTOWN, PA.

Harry E Heller

ATCHISON, KAS.
J A Chisham
W W Wells

BOSTON.

A K Page
Captain Wm. Brophy
H J Conant
D J Flanders
A F Mason
C M Ransom
Dr Robert Amory
F E Barker
S E Barton
D Killicutt
F A Wyman

D E Evans

BALTIMORE.
H C Tudor

BUFFALO.
C R Huntley
F G Raichle

BRIDGEPORT, CONN.

H D Stanley

BOONVILLE, MO.

J F Gwelich

BROOKLYN.
C F Coles
J F Munsie
E J Cook
E F Peck

CAMDEN, N. J.
E A Armstrong
J J Burleigh

CAPE MAY, N. J.

F T Walton

CARROLL, IOWA.
V Hinrichs
E M Parsons

CARROLTON, MO.

James W Lacy

CINCINNATI.
E V Cherry
Emile Kahn
G E Allen
W H Jones
J C Hobart
E H Williams

CLEVELAND.
J B Crouse
W C Hayes
B F Miles
W H Lawrence
Frank A Rogers
C C Curtis

KEARNEY, NEB.

J. G. White

JACKSONVILLE, ILL.

Frank M Doan

LINCOLN, NEB.

M J Bigelow

LOUISIANA, MO.

W T Johnson

NEWARK, N. J.
C O Baker, Jr
M Garver

NORTH EAST, PENN.

A L Daniels

NEW BRITAIN, CONN.

T H Brady

NEW ORLEANS.

E H McFall

OMAHA, NEB.
H A Kinney
L H Korty

PHILADELPHIA.
A J De Camp
M D Law
G F Porter
E G Willyoung
W R Hood
J A Pentz
T C Smith

PINE BLUFF, ARK.

J H Aitkin

PITTSBURGH.
A E Carrier
M W Meade

PEORIA, ILL.
Lafayette Cole
Martin Kingman

PROVIDENCE, R I.
M H Hartwell
M J Perry

PUEBLO, COL.

C M Davis

QUINCY, ILL.

A B Faunce

RED JACKET, MICH.

J D Cuddihy

RICHMOND, MO.

J R Hamacher

RUTLAND, VT.

M J Francisco

SALINA, KAS.
A Hiller
Geo Kruger
J M Jeffres

SPRINGFIELD, ILL.

A L Ide

ST JOE, MO.
T A Chadwick
J A Corby
I T Dyer
F D Rusling
Frank Yenawine

ST. LOUIS.
S P Baird
F E Costello
L M Fishback
H S Graber
C W Hazeltine
G Parker
F H Pond
E Ruebel
J A J Shultz
T J Wilson

SYRACUSE, N. Y.

A P Seymour

TOLEDO, OHIO.

C R Faben

TOPEKA, KAS.
J J Everingham
W W King

VINCENNES, IND.

H W Frund

WINDSOR, CONN.

M E Baird
A D Newton

WASHINGTON, D. C.

Fred W Royce
John Lynch

WASHINGTON COURT HOUSE, O.

Jerome Penn

WICHITA, KAS.

J W O'Neil
E M Reed

WILKESBARRE, PA.

J C Bridgeman

DALLAS, TEX.

D M Clower
W T M Mottram
WM Clower

DAVENPORT, IOWA.

H O Woodruff

DENVER, COL.

C H Smith — E W Rollins
C H Brown — W H Emanuel

DETROIT, MICH.

J A Campbell — J E Lockwood
A A Robinson — Fred H Whipple

EXCELSIOR SPRINGS, MO.

E B Kay

EAU CLAIRE, WIS.

Carl Kammeyer — W K Freeman

FORT SCOTT.

H S Mitchell — N C Thompson
A W Walburn

FORT SMITH, ARK.

R H Browne

FORT WAYNE, IND.

Chas Knight

FREMONT, OHIO.

C T Richmond

FORT WORTH, TEXAS.

E J Jennings

GREELEY, COLO.

B D Sanborn

HARTFORD, CONN.

C E Newton — E B Hatch

HAYS CITY, KAS.

I M Yost

HOUGHTON, MICH.

J R Dee — J T Daniels

HUTCHINSON, KAS.

L A Beebe

INDIANAPOLIS.

Chas D Jenney — Geo C Pyle
L A Boyd — F W Baugher

THE EXHIBITS.

The Okonite Company had an extensive exhibit of their various insulated wires, also submarine cables insulated with Okonite. Manson tape also formed part of the exhibit.

The Fishkill Landing Machine Co., N. Y.

The Hawkeye Electric Mfg. Co., Davenport, Ia., represented by H. O. Woodruff.

The Fred H. Whipple Co., Detroit, Mich., represented by F. H. Whipple.

Southwestern Electrical Supply Co.

Holmes, Booth & Haydens, New York—per H. P. Lucas.

Consolidated Fruit Jar Co, New York—per T. P. Wisner.

The Monitor Electric Co., Chicago—per C. G. Armstrong.

The Sperry Electric Co, Chicago—per C. E. Gregory.

Mr. A. Kempt, of Chicago, and C. C. Curtis, of Cleveland, looked after the interests of the Brush Electric Co.

W. B. Pearson represented the Ball Engine Co. of Erie, Pa.

The Parker-Russell Co., St. Louis, had D Russell, G. Parker and C W. Hazletine at the convention.

The Pond Engineering Co., St. Louis.

The Triumph Compound Engine Co., Cincinnati—per J. C. Hobart

W. K. Freeman and Carl Kammeyer, of Eau Clair, Wis., transformers, etc.

Ernest Hoefer, the Chicago representative, took good care of the interest of the Bishop Gutta Percha Co., of New York.

The Detroit Motor Co. was represented by Mr. A. A. Robinson, of Detroit, who had on exhibition several motors.

Mr. J. W. Godfrey was kept extremely busy talking Grimshaw, and his extensive display made many friends and customers for his goods.

Wm. Baragwanath, of Chicago, exhibited feed water heaters.

Charles S. Rushing represented the Thomson-Houston Electric Co. of Boston.

Mr. D. S. Turner represented Woodbridge & Turner of New York.

M. T. Mulford, resident Kansas City agent, looked after the interests of the Goodyear Rubber Co.

The Johns Pratt Co, Hartford, Conn, exhibited vulcanized asbestos packages and insulations.

Mr. T. J. Wilson represented the Western Electrical Supply Co. of St. Louis.

The Westinghouse Electric Co of Pittsburgh, Pa.

J. A Grant & Co., of Boston—per H. A. Glasier.

Mr. R. J. Randolph, of Chicago, looked after the interests of the Excelsior Electric Co.

Mr. Horace Keefer, of Kansas City, electrical supplies.

A. H. Bauer, electrician of the Pullman Palace Car Co., was a prominent figure at the convention.

The National Electric Headlight Co., of Indianapolis, Ind., distributed photographs showing their apparatus. Mr. L. A. Boyd and Geo. C. Lyle in charge.

The Eddy Electric Mfg. Co., Windsor, Conn., had a large exhibit of motors. M. E. Baird and A. D. Newton from the factory, also their local agent, W. T. Osborn and their New Orleans agent, Mr. E. H. McFall, were all on hand.

The Weston Electrical Instrument Co. of Newark, New Jersey, exhibited their handsome standard electrical instruments.

The Phœnix Glass Co., New York, had a very pretty display of shades, globes, etc., for incandescent fixtures. Mr. A. H. Patterson was in charge.

The Washington Electric Conduit Co., of Washington, D. C., had sample conduits on exhibition in charge of Mr. John Lyuch.

The Fort Wayne Electric Co. was represented by Mr. W. T. Buckley and Charles Knight.

Mr. Gilbert M. Smith, of Chicago, Western manager of the Ansonia Brass & Copper Co. of New York, was on hand with a magnificent display of wire for various electrical purposes. Mr. Smith reported business in his line very good.

Mr Paul W. Bossart, of Kansas City, Mo., had a large space for his exhibits of the Mayo arc and incandescent dynamos, motors and appliances, manufactured under the Mayo system, by the Rockford Electric Mfg. Co.

The Kansas City Electrical Works was well represented during the convention by Mr. W. H. Woodring and Mr. Geo. M. Myers, two of its enterprising officials.

The C. & C. Motor Co. of New York, represented in Kansas City by Floyd Platt, occupied the first space to the left of the door on entrance. They had three, four and fifteen horse-power motors on exhibition. They are made of from three-horse to fifty-horse power capacity, and can be used to run large factories, looms and other machinery.

Charles E. Newton, representing the Jewell Belting Company of Hartford, Conn, had a large exhibition of belting. This article is used for general and special electrical service and is made from the centers of whole hides.

The Jenney Electric Motor Co. of Indianapolis, Ind., was represented by Charles D. Jenney, of the original firm of Jenney & Co., which was formerly in Fort Wayne, Ind.

M. M. Garvey had charge of the standard voltmeters and ammeters used on dynamite cruisers for ascertaining the exact range, and also for direct reading of central stations, both of light and power.

The Electric Supply Company occupied the little room to the right of the entrance to the hall, and had it fitted up with every kind of electric light specialty and appliance imaginable. From the ceiling was suspended an immense Japanese umbrella, over the rib points of which fell varicolored incandescent light globes. F. S. Terry, assisted by G. T. Hewes, was in charge.

The Charles Munson Belting Co., of Chicago, was increasing the patrons of that company by a liberal distribution of highly complimentary testimonials.

Mr. P. H. Alexander, the popular general manager of the Sawyer Man Electric Co., renewed old acquaintances and made many new friends.

H. E. Longwell, of Chicago, represented the Westinghouse Engine Co., of Pittsburgh, Pa.

The India Rubber and Gutta Percha Company of New York had a solid polished mahogany sample board, showing end sections of various cables and conductors having Habirshaw insulation.

The models of conduits exhibited by Mr J. F. Munsey and Mr. C. F. Coles, of Brooklyn, N. Y., attracted attention.

Mr. Frank O. Magee, of New York, with his ever-smiling countenance, was on hand representing the E. S Greeley & Co., the electrical supply house.

Mr. James F. Kelly, general sales agent of the Edison Machine Works, New York, one of the best-looking gentlemen attending the convention, had an extensive display of his various grades of wires, etc., which occupied a prominent place in the gallery.

Mr. R. J. Randolph represented the Electric Excelsior Co.'s Chicago office.

Young's automatic safety cut-out was exhibited by the Royal Electrical Specialty Co. of New York, with Mr. J. B. Halsted in charge.

James F. Munsie, the inventor of underground conduits, had a large display of insulated wires and other electrical appliances.

A. D. Newton, of the Eddy Electric Company of Windsor, Conn., reversed the old order and had at the Casino a steam engine operated by an electric motor.

W. H. McKinloch and F. W. Cushing, of the Central Electric Co. of Chicago, were floating around the Coates house, talking to the boys and always keeping one eye on a future deal.

C. H. Wilmerding, treasurer and general manager of the Arc Light & Pioneer Company of Chicago, and who piloted the party from that city, is making many friends. He says he has learned a thing or two from the papers read.

H J. Conant, of the Evans Friction Cone Company of Boston, has been interesting visitors in the new device which does away with belting, connecting directly with the dynamo by means of the cones.

The largest and most prominent exhibit was that of the Sprague Railway & Motor Company, which occupied quite an amount of space in the gallery, together with the Interior Conduit & Insulation Company. The entire display was under the immediate supervision of E. H. Johnson, of New York, that wide-awake gentleman of business. A map of the United States, marked where the Sprague System is used, showed how widespread was their system. Mr. Johnson was accompanied by F. J. Sprague, E. T. Greenfield and W. S. Kelly.

One of the finest displays at the hall was that of English, Morse & Co., of Kansas City. A novel feature wss the running of a 50 horse-power Ide engine by an Eddy motor. The engine was illuminated with colored incandescent lights and presented a pleasing effect. There were on exhibition a number of appliances which English, Morse & Co., are selling agents for.

The Crocker-Wheeler small motors attracted much attention. Dr. S. S. Wheeler in charge.

The National Carbon company exhibited a fine line of carbons. In keeping with the numerous improvements being made in apparatus, an improved carbon point, adapted to the different currents generated and peculiar requirements of each system of lighting has been demanded. Represented by W. H. Lawrence, W. C. Hayes and B. F. Miles.

Mr. J. A. Shultz exhibited the Shultz Patent Leather Woven Link Belt. It is flexible laterally and lengthwise in all its parts, and is more pliable than a flat belt. It weighs very little more than a flat belt of same width, and the form of the links and pliable rods cause it to adhere closely to the pulley, and being so light can be run wherever belts are used.

George Cutter, consulting electrician from Chicago, made a fine exhibit of weather-proof wires made by Simplex Electrical Co. He is the western representative of Pettingell, Andrews & Co., of Boston, Mass., and also handles many appliances that are a necessity to the electric light business.

The *Electrical World* issued a daily bulletin, as has been its custom for years.

The Empire City Electric Co., N. Y., was represented by Mr. David Chalmers, who saw that the interests of his well-known establishment did not suffer.

Mr. S. S. Leonard, manager, western department of the Hill Clutch Works of Cleveland, Ohio, had an excellent exhibit of his goods.

Mr. Ira C. Hubbell representing Fairbanks, Morse & Co., was a prominent figure everywhere.

Mr. P. H. Hover sustained the reputation of the Standard Paint Co., of New York, in his usual excellent manner.

Mr. Wm. R. Hood represented the electrical specialties of H. T. Paiste, of Philadelphia. Mr. Hood added many friends to his already large circle of acquaintances by his pleasing manners.

Mr. A. L Daniels represented Ford's Machine Works of Cleveland, Ohio. The patent trolley handled by this firm is meeting with a ready sale and general satisfaction.

The Vulcan Manufacturing Co., Kansas City, Mo., had an exhibition stationary and rocking fire grates.

G. E. Palmer manager of The Babcock & Wilcox Co., Chicago, was on hand.

Mr. A. L. Daniels, representing the Eureka Tempered Copper Co., Northeast, Pa., had on exhibition some excellent samples of tempered copper journal bearings for commutators and other machinery.

Chas A. Schieren & Co., and the American Leather Link Belt Co., had one of the finest exhibits at the convention. It was in charge of Chas. A. Schieren Jr., and F. W. Baugher. These people have their link belts running in the principal electric railway and isolated plants in Kansas City and have lately belted up the Chicago auditorium with these belts. The New York Life Insurance building in Kansas City is equipped throughout with their perforated electric belts.

The Boston Electric Motor Company of Baltimore was ably represented by their genial superintendent, David E. Evans.

J. M. Ernest Hofer, the Bishop Gutta Percha Company, has a brilliant representative, who could always be found in the exhlbition rooms explaining the merits of his goods.

Among the visitors to the convention are Mr. and Mrs. F. T. Walton and Miss Walton of Philadelphia. Mr. Walton is a member of the association and takes a great deal of interest in electrical affairs generally. He is a wealthy gentleman and is proprietor of The Stockton, the fashionable hotel of Cape May, N. J., where the next convention will be held. Mr. Walton is known in the east as "Plunger" Walton.

Among the resident ladies who have spared no pains to make pleasant the visit of the ladies accompanying the delegation were Mrs. E. R. Weeks, Mrs. Dr. Tiffany, Mrs. Jas. Scammon, Mrs. Edw. Lasalle, Mrs. Wyman, Mrs. A. H. Caryl, Mrs. H. C. Sprague, Mrs. Geo. M. Myers and Mrs. T. F. Clohesey.

Among the ladies present at the convention were Mrs. C. O. Baker, Mrs. S. S. Badger, Mrs. J. A. Corby, Mrs. A. J. Decamp, Mrs. Geo. Cutter, Miss M. E. Cromie, Mrs. W. J. Johnston, Mrs. J. E. Lockwood, Mrs. A. F. Mason, Mrs. A. H. Patterson, Miss Paine, Mrs. C. E. Stump, Mrs. J. A. Seely, Mrs. F. T. Walton, Miss Walton, Miss White, Mrs. W. R. Kimball, Mrs. W. H. Lawrence, Mrs. C. C. Haskins.

Mr. W. W. Smith, J. D. Cruise, Paul W. Bossart, T. F. Clohesey and F. K. Holtzinger were at all times attentive to the visitors, pointing out the sights of interest and conveying the delegates to desired points.

A SKETCH OF THE NEW PRESIDENT.

Marsden G. Perry, of Providence, R. I., the newly-elected president of the National Electric Light Association, was born in Rehobeth, Mass., one of the oldest towns in the commonwealth, in 1849, on the 2d day of November. on the ancestral acres where his ancestors in direct line had settled in 1641, and received his education in the schools of that vicinity. At the age of 20 Mr. Perry located at Providence, and very soon thereafter turned his attention to the business of banking, in which he is still identified under the original firm name of Perry & Co.

Early in 1883, Mr. Perry purchased a controlling interest in a central station electric light plant in the neighboring city of Fall River, Mass., and in November, 1884, he had become so thoroughly impressed with the value and importance of electric light business that, notwithstanding the fact that his first purchase was having a hard struggle to maintain its existence, he made a second purchase of a controlling interest in the Narragansett Electric Lighting Company of Providence, of which he is now vice-president and general manager. He is also president of the Fall River Company.

The Electro Mechanic, of Kansas City, made its appearance daily. Editor Cutler made many friends by courtesies extended, both for his journal and himself personally.

Mr. Benj. R. Western, of the Manufacturing Advertiser's Bureau, of New York, made himself known to every one present. Mr. Western devised the "Okonite" railroad train advertisement, for which piece of enterprise he received many congratulations.

The beautiful silver badges with raised gold letters were distributed quite generously and much admired.

ELECTRICAL PATENTS ISSUED FEBRUARY 11TH.

420,936. Electric Body-Battery. Oliver S. Hall, Marion, Iowa, assignor of one-half to James M. Gray, same place.

420,954. Electro-Mechanical Movement. Samuel E. Nutting, Chicago, Ill., assignor to the Nutting Electric Manufacturing Company, same place.

420,955. Electro-Mechanical Movement. Samuel E. Nutting, Chicago, Ill., assignor to the Nutting Electric Manufacturing Company, same place.

420,964. Electro Vote Indicator and Recorder for Legislative Bodies. Wm. H. Robinson, Rochester, N. Y.

420,975. Storage Battery. Charles Sorley, New York, N. Y., assignor to the Anglo-American Electric Light Manufacturing Company, of West Virginia.

420,984. Lightning-Arrester. George G. Bayne, Fremont, Neb.

421,006. Telephone Transmitter and Receiver. Hosea W. Libbey, Boston, Mass.

421,011. Attachment for Telephones. Geo. F. Newland, Detroit, Mich.

421,048. Regulator for Dynamos. Edward Heymann and Frank W. Heymann, Boston, assignors to James E. Maynadier, Taunton. Mass.

421,053. Thermo Electric Resistance-Regulator. Samuel E. Nutting, Chicago, Ill., assignor to the Nutting Electric Manufacturing Company, same place.

421,081. Galvanic Battery. Jacob F. Mehren, Chicago, Ill.

421,088. Conduit for Electric Cables. Wm. P. Tyler, Boston, Mass.

421,090. Starting-Switch for Electric Motors. Wm. A. Anthony, Manchester, Conn., assignor to the Mather Electric Company, same place.

421,114. Switch-Board. Wm. M. Stewart, Schenectady, N. Y.

421,177. Safety Device for Electric Circuits. Hermann Lemp, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut.

421,180. Thermal Cut-Out. Everett W. Little, New York, N. Y.

421,185. Electric Soldering-Iron. Willard M. Miner, Plainfield, N. J.

421,193. Transmission of Power by Electricity. Edwin W. Rice. Jr., Lynn, Mass.

421,195. Motor for Electric Regulating Apparatus. Friedrich Ross and Asmus Fransen, Vienna, Austria-Hungary.

421,207. Cut-Out for Incandescent Lamps. Elihu Thomson, Lynn, Mass.

421,208. System of Distribution for Alternating Currents. Elihu Thomson, Lynn, Mass.

421,214. Telegraphic Sounder. George W. White, Huntsville, Ala.

421,222. Commutator for Dynamos, Motors, etc. George H. Alton and William O. Wakefield, Lynn, Mass., assignors to the Thomson-Houston Electric Company, of Connecticut.

421,239. Railway Electric Signal. Paul D. Cable, St. Louis, Mo.

421,240. Thermal Cut-Out. Philip Cardew, Chatham, County of Kent, assignor to Bernard Mervyn Drake and John Marshall Gorham, Westminster, England, patented in England and in France.

421,294. Electrical Spray and Vapor Bath. Nathaniel Lyke, Williamsport, Pa.

421,304. Trolley for Electric Railways. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place.

421,305. Overhead Trolley for Electric Railways. Frank B. Rae, Detroit, Mich., a signor to the Detroit Electrical Works, same place.

421,320. Collecting Contact for Electric Machines. Albert Schmid and Edward C. Means, Allegheny, Pa.; said Schmid assignor to the Westinghouse Electric Company, Pittsburg, Pa.

421,339. Door-Alarm. John F. Wolleñsak, Chicago, Ill.

421,340. Electric Compound Push. John F. Wollensak, Chicago, Ill.

421,371. Electrical Communication. James L. Cutler Piketon, assignor to Joseph A. Sullivan, Frank O. Loveland, and Guy Mallon, all of Cincinnati, Ohio.

NEW PUBLICATIONS.

Mr. Edward Trevert, of Lynn, Mass., has just issued "Everybody's Hand-book of Electricty," which is published to supply the demand there is for a brief outline of the various systems of electric lighting, etc. This book will just fill this want. It not only describes the special features of the various systems of lighting, but also describes electric lamps, electric motors, electric railways and the process of electric welding. In addition to these subjects there is much other information of value. The book will be found very convenient for reference, particularly by the layman, because he will not have to search through a great volume of matter to get the information he wants. This book tells him plainly and briefly. The glossary of electrical terms at the back of the book will be valuable to beginners, and will materially aid in the study of the science. The price of this valuable little book is but 25 cents, and it is published by the Bubier Publishing Company, of Lynn, Mass. The same author has also issued a little work on "How to make Electric Batteries at Home." Plain directions are given, and any one with ordinary mechanical ingenuity can make any one of the various batteries treated of.

This latter book is printed by the same company, and the price is the same as that of the first named. Both books are well illustrated, and their low price brings them within the reach of all.

WELDING BY ELECTRICITY.—It seems not improbable that the invention of the electric welding process may lead to a series of discoveries in the same field not less remarkable than the original one. Many interesting phenomena have been brought to light lately, the latest of which is the improved method of electric welding devised by Mr. C. L. Coffin. He finds that, after the two pieces to be welded have been joined together, a better weld may be obtained by ceasing to press the joints together and applying stress tending to separate the joint while the current is passing, taking care, however, not to rupture the weld. This action is claimed to increase the electrical resistance of the joint, and consequently to increase the heat. This force is applied only for a short time, and the joint is finished, as usual, by rolling or hammering.

ELECTRIC STREET CARS IN CINCINNATI.—Actuated by the example of Minneapolis, where the street railway company has thrown aside $400,000 worth of new cable apparatus before laying a foot of it, and is now equipping 110 miles of track with electric motors, Cincinnati is seriously considering the question of adopting electricity on all the city lines. It is generally believed that this will not only add to the profits of the local street railway company, but will act as a material impulse to the growth of the suburbs.

THE NEW YORK STATE ELECTRIC LIGHTING ASSOCIATION.—This association has been organized and the following officers elected: President, T. F. Nevins; first vice-president, C. R. Huntley; second vice president, W. H. Browne; secretary and treasurer, E. A. Maher. Executive Committee—Mr. T. F. Nevins, Brooklyn; C. R. Huntley, Buffalo; W. H. Browne, New York; E. A. Maher, Albany; B. B. Odell, Newburg; J. J. Moore, New York; F. A. Cheney, Elmira; A. B. Smith, Poughkeepsie; Geo. A. Redman, Rochester.

THE ELECTRIC MOTOR.—It is hard to realize what wonderful proportions the use of the electric motor, the most convenient and reliable method of distributing power known to-day, has attained. There are now in operation in the United States stationary electric motors aggregating between 5,000 and 10,000 horse power, besides 6,000 to 8,000 small motors, fan outfits, etc. The confidence of the public in the electric motor as the most reliable and economical power available is now an assured fact, which is becoming more evident every day by the demand for power in shops and factories using from 20 to 100 horse power, and even higher.

ELECTRICITY IN PHOTO-ENGRAVING.—In commercial photo-engraving, zinc etching, and the gelatine relief process, it is absolutely necessary that the exposure be properly timed, the period depending on the depth of shading required. Any increase in the duration of the exposure will cause what is termed an "overprint," which is not satisfactory, as the finer lines of the original are not produced. An electric alarm has now been devised, which gives warning by the ringing of a bell of the proper exposure, so that the operator is free to attend to other duties without fear of neglect or over-exposure of the plate.

SUCCESS OF ELECTRIC TRACTION IN LONDON.—The semi-annual report of the North Metropolitan Tramway Company, of London, on the subject of electric traction on the Barking Road section of their line shows very gratifying results. The electric cars have run 34,366 miles and have carried 469,095 passengers. The cost to the company for electric traction has been 4½d. per mile run (including the wages of drivers), which is less than the average cost per mile run for horse traction over the entire system. The Barking Road section is a short single line with loops, requiring only a low mileage, with a small number of cars, which does not offer such facilities for economic working as a longer line would, with a higher mileage and more cars worked by a larger installation; but the result of the working of electric cars on the Barking Road justifies the directors in hoping that Parliament will sanction the introduction of electric power over the company's system and enable them to extend its application to other lines.

Such a reference to the work of the cars on the Barking road is very gratifying and encouraging for the future of electric traction generally.

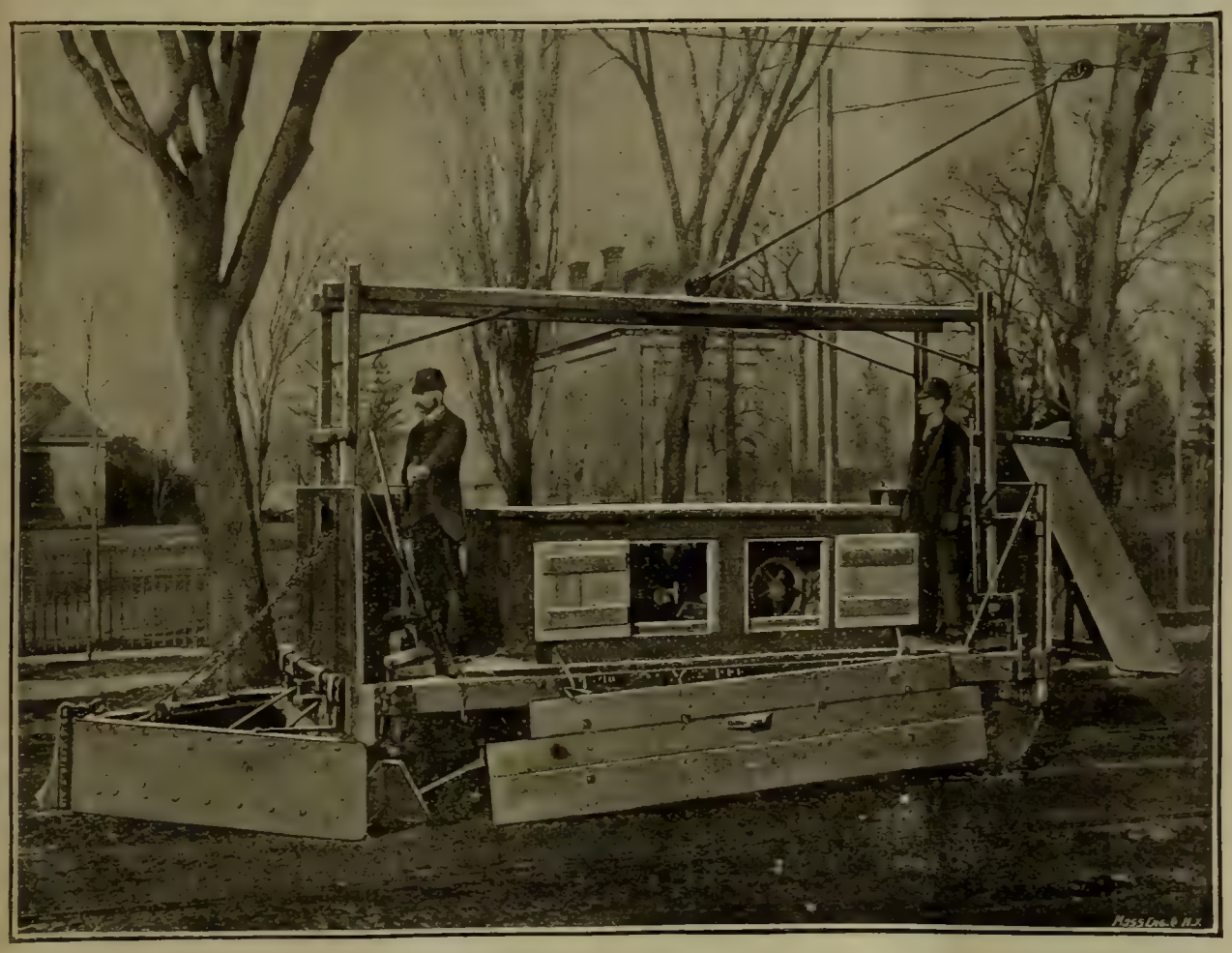
WASTE OF ENERGY.—It is held that even the very best steam engines lose 90 per cent. of the heat generated in their furnaces, and it has also been shown that in the incandescent electric lamp only 5 per cent. of the electricity consumed is converted into light, the rest being lost in heat. So it is not so much the problem of the scientists to discover new forces, perhaps, as to invent some way of reducing the waste that takes place in usage of those we have. When perfect combustion of fuel is accomplished, and when electricity can be quickened into light without the intermediation of heat, then if we have not reached the millennium, we may look for other forces to subjugate.

THE ELECTRIC NOVELTY COMPANY.—Articles of incorporation of the Electric Novelty Company have been recorded in the county clerk's office at Newark, N. J. The company will manufacture telegraph instruments and electric appliances. The capital is $45,000. The place of business is Montclair. The incorporators are Walter P. Phillips, Charles H. Bogle, Frederic N. Bassett, of New York; Thomas R. Taltavall, of Montclair; R. S. Howland of Providence; A. H. Sweet, of Norton, Mass., and Nettie B. Ryder, of Taunton, Mass.

SPRAGUE ELECTRIC SNOW-PLOW.

We illustrate in this issue of our paper a new Electric Snow Plow, which has just been manufactured by the Sprague Electric Railway and Motor Company. This plow is fitted with two 15 H. P. improved Sprague Motors, and is so arranged that it can be run either forward or backward, similar to an ordinary Sprague Electric car. The reduction in gearing between the motors and the car axles is greater than in the ordinary Sprague Car, so that a large amount of power is available from the motors in case of necessity. It is estimated that this plow will clear the track more speedily and effectually than an ordinary snow-plow drawn by twelve horses.

The view shown is from a photograph of a plow which has been in operation for some time on the Troy and Lansingburg Street Railway, Troy, New York. Although the season has not offered any chance to show the great capabilities of this plow on that road, the plow has effectually taken care of several light falls of snow which have obstructed the tracks this winter.



SPRAGUE SNOW PLOW.

We understand that the Sprague Electric Railway and Motor Company have nearly completed a special sweeper and track cleaner for clearing the track of dust, dirt, slight snow falls and other impediments. This sweeper will be operated by the Sprague improved motors, and will be illustrated in these columns as soon as completed.

ELECTRICAL EXECUTIONS. — The commission to test the electrical execution apparatus in this State have rendered their report. They are of the opinion that the apparatus at Sing Sing, Auburn and Dannemora can be used successfully, and that there is, in their opinion, no cause to apprehend any failure. They found that German silver wire was the best to be used.

ELECTRICITY THE ISSUE IN AN ELECTION. — The issue in the coming municipal elections in Milwaukee, Wis., is on the question of electric lighting by the city. The advocates of the city plant scheme are making an active canvass, and are working against candidates who are not pledged to favor city lighting.

HEATING BY ELECTRICITY.

What the possibilities may be in the application of electricity to warming buildings is beyond conjecture, but experiments in this line have been made by Dr. W. Leigh Burton, although his efforts have been directed mainly to the heating of railway cars. It is stated that the current is passed through a system of resistance coils. Each coil is enclosed in a cast-iron case, forming the radiating surface coils. The resistance coils are covered with dry, powdered clay, for the purpose of absorbing the heat from the wires, and thus preventing them from burning out. The electric current supplied to the heaters has a force of 80 volts, and each heater is expected to use about 2⅛ ampères of current, each heater having a resistance of 35 ohms, it being found by experiment that such a current raises the temperature of a heater about 200 deg. Fahrenheit. The heaters are arranged under alternate seats on either side of the car. It is proposed to generate the current for these heaters by dynamos driven from the car axles, a surplus of current being produced and stored for use when the car is disconnected from a train, or employed to illuminate the cars with incandescent lamps. To heat a car standing in the yard, it is proposed to establish dynamos at the stations where cars are stored. These heaters, once constructed, are expected to be permanent fixtures, requiring no further attention. The moderate rise of temperature produced precludes all danger of fire, it is stated, and it is impossible for the resistance wires to be burned, unless the surrounding clay is raised to the burning temperature of the wire. The probability of electricity becoming a rival of steam and water as a heating medium, is too remote for consideration at present.—*Master Steam Fitter.*

THE EDISON COMPANY IN CALIFORNIA.—The Edison Electric Light Co. of San Francisco have petitioned for a franchise to construct underground conductors for electric light wires for a term of 25 years. A 50 years' franchise is sought by the same company in Oakland, Cal., for the same purpose.

PHILADELPHIA NOTES.

The Pennsylvania Railroad Company seem to be bent upon assuming and maintaining a leading position when it comes to a question of improvement in means of comfort and modern ideas. They have lately replaced their storage battery system of electric lighting for their magnificent and extensive general offices on Fourth street with one of the finest isolated plants in this city. It consists of one Watts Campbell and one Corliss engine, each of 125 horse power, in connection with two United States dynamos with a capacity of 600 lights each, making a total of 1,200 lights. The plant is so arranged that the building can be lighted at all hours, and the hundreds of employés of the immense establishment will be sure to appreciate the benefits of the new system. The tug International, owned by Peter Wright & Sons, which sailed from this port Thursday the 6th inst., is the largest one in the world. She is destined for the West Indies. Her electric lighting plant is the finest of its kind known, and was furnished by the Philadelphia office of the United States Electric Light Company, consisting of a graded incandescent system, whereby from 16 to 100-candle power may be obtained; four arc lights of 2,000-candle power, and one search light of 6,000-candle power. There are two dynamos, one arc and one incandescent, and they are set up so as to be interchangeable without the loss of a moment's time. Mr. H. T. Paiste was unable to attend the Electric Light Convention on account of the large increase in his business which necessitated a removal from his Chestnut street establishment to the recently remodelled and enlarged building at Twelfth and Market sts., where he is now comfortably located in large, light and airy quarters. He has sent to represent him a very capable man, and his interests will be well looked after. The growth of Mr. Paiste's business in incandescent lighting supplies is a pretty thorough endorsement of the man's business capabilities, and of the character of the goods he supplies, the leading line of which is his compact and handy incandescent switch. An explosion occurred from an electric light conduit on North Broad street a short time ago, and was at the time declared by many to have been caused by electric light wires, but it was so easily traced to a broken gas main that it has thoroughly disarmed the residents of their belief in the danger of electric light wires or their conduits. The city officials are to be commended for their promptitude in placing the blame where it belonged, thus doing justice to the electric lighting companies of the city.—ELECTRO.

SUPERIORITY OF THE ELECTRIC CAR.—A Boston paper in commenting on an accident to a cable car in this city recently, through the failure of the brake to work, says "the failure of a brake, brings to the front again one of the chief points of superiority of the electric car, namely, the possibility of an almost instant reversal. If the brake of an electric car fails, the current can be reversed and the car brought to a standstill or even started in an opposite direction, quicker than any other method used on street railways, and this is unquestionably one of the strongest reasons why the electric car is best suited to run at a high rate of speed in ordinary city or suburban streets.

FRAUDULENT ELECTRICAL DEVICES.—The manufacture and sale of electric belts, brushes, shoes, pads, etc., has reached such proportions in England that an effort is being made, in the interest of an ignorant and deluded public, to restrict, if it is impossible to repress, the traffic in such fraudulent appliances. A man who sold an "electro-pathic belt," which was warranted to cure sciatica, lumbago, Bright's disease, and a host of other ailments, has recently been arrested and fined for obtaining money under false pretenses.

ANOTHER MUNICIPAL PLANT.—Mansfield, Ohio, proposes to have her own plant for lighting the streets and public buildings.

A TRIP TO EXCELSIOR SPRINGS.

At 3:30 p, m. February 12, 280 of the members of the National Electric Light Association and their friends took a Chicago, Milwaukee & St Paul special train for Excelsior Springs. The run to the springs was made in about an hour, all stops being avoided except those at crossings. At the Springs depot the party took stages and hacks and the procession was an astonishment to the residents of the health resort. The guests alighted at the Empire spring, where each was requested to get cured before dinner.

The electricians were shown through the hotel, and the opera house was illuminated for the occasion. Every attention was paid by those connected with the hotel to the comfort of the visitors, which all enjoyed.

Promptly at 6 o'clock dinner was announced, and though every table in the hall was comfortably filled, no one was crowded out. The menu card was beautifully executed. The outside front was a blue cloud with "The Elms, Excelsior Springs," in raised letters and a classic female face eclipsing a moon in the upper left hand corner, and on the outside back was the insignia of the association.

The menu itself left nothing to be desired. Everything that was anywhere near in season was obtained for the repast and some things that were not.

The dinner occupied nearly an hour and a half. Music was furnished by a mandolin club which was brought down from Kansas City.

While the coffee was being passed, President Weeks sent round word that he wished the guests to remain seated, and shortly after he rapped for order, and said:

"I don't propose to make this occasion anything than that which Mr. Holden desires it, an informal dinner, but I do desire to propose the toast of the 'cup that cheers but does not inebriate.' and ask Mr. Holden to respond."

There were calls for Mr. Holden, who rose and said:

"I feel that Mr. Weeks has put me in the position of the man who would seek to turn on the light without seeking first to generate the current. But I can say to you, ladies and gentlemen of the National Electric Light Association, on behalf of the Chicago, Milwaukee & St. Paul Railway Company and the Excelsior Springs Company, I bid you a cordial and unstinted welcome to this house. Of all the forces of nature electricity is the most subtle. We talk of gravitation that draws the feather to the floor and that holds the world in its place, but who can tell what it is? And we talk of electricity that flashes over the country with the speed of thought and carries our thoughts with it; that imitates our great solar fire and almost enables us to do without it; that drives our railway cars, and by practically decreasing the time of travel brings us nearer to each other, as each day discovers new improvements. Perhaps of all the mysteries of nature electricity is the most deeply buried of all those that lie hidden within the veil that hides the answer to the great questions that constantly arise in the mind of man. Between the conditions that surround the savage when electricity only existed to terrify him and to day, when it has been harnessed to the use of man, what a vast difference there is, and it is due principally to your intelligence, gentlemen, that this change has been brought about, that intelligence which makes you welcome here and everywhere.

"It is hardly suitable for me to speak of Excelsior Springs, of which probably many of you have never heard, but I could tell you of hundreds who have arrived here sick, crippled, almost dead, and gone away in perfect health and with a promise of long life that they never dreamt of. But this is not my intention here to-night. I can only remind you that if sickness should ever assail you to remember the life-giving waters that flow from the rocks of Western Missouri. Come to us and recover."

Mr. Holten's speech was followed by hearty applause, and the guests then left the dining room. The half hour before train time was passed in conversation and in listening to the music of the guitars and mandolins. Just before leaving the hotel Mr. T. F. Clohesey announced from the stairway in the office that he had been requested by some of the guests to propose three cheers for the hotel company and the railway company and they were given with an energy that shook things. The hotel coaches were again boarded and the procession retraced its way to the depot, the occupants of the vehicles enlivening themselves and arousing all within half a mile by singing everything that is popular.

The whole affair was a very pleasant one and reflects the greatest credit on those who managed it, as well as on the hotel company who proffered it. Everything was perfectly calculate.

The visitors were greatly surprised to find such a hotel as The Elms so for from salt water. It seemed as if they could hardly realize that Missouri had reached such a high degree of civilization as to require a summer resort, and when they found that The Elms was open throughout the year it was astounding.

ELECTRICAL STATISTICS FOR THE CENSUS.

In a circular Mr. A. J. De Camp, of Philadelphia, 1st Vice-President of the National Electric Light Association, urges the electrical trade to take advantage of a bill now before a Senate and House Committee to secure the necessary authority for making a complete investigation of the electrical industry for the coming census.

This investigation should include all necessary details pertaining to underground and aërial construction, underground and aërial currents, the character and voltage of all currents and their uses Lamps in use (arc and incandescent), and how wired for residences, commercial and municipal service; motors in use for stationary service and motor cars; income and expenses, etc.

An inquiry should also be instituted through sources independent of those interested in the industry, as to casualties resulting from the use of electric currents, both as to fire and to personal injuries. This investigation should be made in all cities of 10,000 population and over. The information should be obtained from underwriters, the records of fire departments, coroners' statistics, health boards or commissioners, or from whatever source of information that may exist in any city. The investigation should also make a comparative statement between the casualties resulting from electric currents, and the use of other agents employed for similar purposes.

To accomplish this object it is recommended that all persons interested in electrical matters make a personal effort to urge upon the committees having the bill in charge the necessity for having these provisions included therein. Directions for the proper procedure in this matter are given and it is hoped that prompt and general action will be taken by the electrical trade to secure this important result. An appropriation is to be asked for the purpose of carrying out this investigation. The value of the information which can be secured in this way is beyond measure, and the opportunity to get it should not be allowed to pass unnoticed.

One of the features of the Kansas City exhibition was the display of the "Royal Silk Mfg Co., of 2 & 4 Stone street, New York. This firm is manufacturing a silk machine towel for wiping and cleansing machinery; its advantages over cotton waste is its great absorbing power leaves no lint or fibre and is also likely non-combustible it can be washed from twenty to thirty times and in use is 50 per cent. cheaper than waste it is recommended very highly. Mr. A. J. Mayer was in charge.

Perret meters on exhibition attracted considerable attention and made many friends for the Elektron Manufacturing Co., of Brooklyn, N. Y.

ELECTRICAL HEATING AND COOKING.

One of the most interesting features of last week's convention was the electrical exhibition of a Kansas City inventor, C. H. Talmage, who for several months past has been working on a new electrical heater. This heater is not yet on the market, being still somewhat in the experimental stage, but such progress has been made that ultimate success is believed assured.

Like many electrical machines this heater depends upon the principle of induction, that is, the principle by virtue of which a current in one wire induces another current in a parallel wire. For this purpose it is necessary that both wires be insulated from each other and from the soft iron core around which they are wrapped. A current of high intensity—say one thousand volts—is produced at the electric light station. This is brought to the pole outside of the building, where as much as may be desired can be transferred by induction to a local circuit of lower pressure. This local current is taken into the heater and made to induce another current of greater quantity but still lower intensity. Comparatively little energy is wasted. Finally a large quantity or volume of electricity of low intensity passes through a good conductor. That produces heat.

In Mr. Talmage's heaters a current of fifty volts and ampère is converted into a current of one-sixth volt and nearly 300 ampères. The original current gives a little heat, but the induced current gives off two or three hundred times as much. The original current is not strong enough to produce a dangerous electrical shock and the induced current is in this respect absolutely harmless

The great advantage of these heaters is the facility and economy of distribution, making it possible to heat every house in the city from one great central station and thus have all the coal for heating purposes burnt at one place, where they would naturally have the best possible appliances and be enabled to get the greatest possible energy out of the coal. This would enable them to sell electric heat delivered to any house in town at a figure very little in excess of what coal costs that particular house buying it in small quantities. It can be taken into any isolated house nearly as economically as in a block, thus being superior to steam heating.

Another advantage claimed for Talmage's heaters as arranged is that they are absolute y automatic in their action and will hold a room at an even temperature within two degrees of heat. This is accomplished by the action of an automatic switch, a composite strip of metal. The bottom p ece of metal expands under heat faster than the top one, which causes the whole strip to bend upward, and as it bends upward the free end breaks the electric circuit and shuts off the current. The heater has a large amount of heat stored in its interior, and it takes some time for it to cool off, and meantime the temperature of the room may rise a degree or two above the temperature at which the current was broken. As soon as the temperature of the room falls the few degrees necessary the automatic switch will make connection again. This switch will be so regulated that the temperature may be maintained at any degree required. These heaters can also be used for cooking purposes.

Mr. George M. Myers, of Kansas City, will long be remembered by his friends who attended the late convention. Mr. Myers spared neither pains nor expense to make every member happy and comfortable. That he succeeded in his efforts is evidenced by the numerous votes of thanks he received daily. Mr. Myers was always on hand ready and willing to accompany those desiring a guide, or to accommodate those in search of information Mr. Myers has earned the good will of all those who had the pleasure of making his acquaintance, and they are unanimous in voting him one of nature's noblemen.

PARASITIC CURRENTS IN DYNAMO ARMATURES.

Not only must the greatest care be taken in laminating armature cores and keeping their supporting structures out of the magnetic field, but to prevent the generation of parasitic currents in the armature conductors themselves suitable precautions must be taken. It has been already stated that in any piece of metal moved in a varying magnetic field E. M. Fs. are induced, and obviously these E. M. Fs. are a source of loss if they cannot be usefully directed, since the currents to which they give rise instead of serving our purpose in the external part of the circuit are wholly expended in heating the metal in which they are generated. The old lecture experiment of rotating a disc of copper between the poles of a magnet until it gets hot, amply illustrates the truth of these observations.

When the angular width of the conductor on the armature is considerable it is necessary to adopt measures for the prevention of parasitic currents. Consider an armature wound with a rather wide conductor: when a length of this occupies a position approximately at right angles to the brushes a certain number of lines of force cut through its flat side, when on the other hand it is opposite a brush the lines cutting it are naught. During the motion, then, a certain number of lines has been subtracted from the flat surface, and an E. M. F. has been generated in consequence. We have seen in previous articles that the same result is arrived at whether we consider E. M. F. as due to a change in the number of lines enclosed by a coil, or due to the separate components of the coil cutting lines of

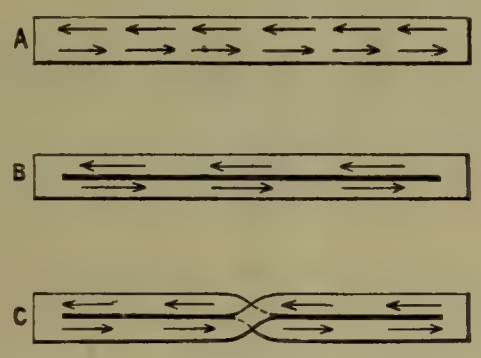


FIG. 1.

force. Accordingly if lines have been subtracted from the flat surface of the conductor during the motion, one of its edges must have cut more lines than the other. These considerations suggest the most obvious way of reducing parasitic currents, namely, increasing the diameter of the armature and making the pole pieces embrace as wide an arc of the circumference as possible. If this is done without altering the angular width of the conductor, less lines cut through the flat surface and accordingly the parasitic E. M. F. is reduced.

When the conductor is moving under the poles where the field is fairly uniform, the parasitic E. M. F. may be very small. As it leaves the polar tips, however, the field passing through it changes rapidly, and the E. M. F. may be here considerable. Now, the work done in a conductor varies as the product of the square of the E. M. F. and the time during which it lasts, so it follows that in a case in which the variation is sudden the heating due to parasitic currents may be much greater than where the change in the lines is gradual, though the mean E. M. F. over the time is in both instances similar. Another precaution to be adopted for the elimination of parasitic currents lies, then, in shaping the poles so that the change in the field passing through the conductor takes place gradually. This is accomplished by gradually increasing the clearance between the poles and the armature from the crown, where it is made small, to the tips, where it is made greater.

The parasitic currents may be reduced to some extent by dividing the conductors as shown in fig. 1. Here A is the undivided conductor, in which the currents may be assumed to flow in the direction of the arrows. The surface being continuous, the resistance opposing their flow is extremely small, the currents, of course, being proportionately large. If we put a slit in the conductor, as at B, thus dividing it into two parts, separated from each other—save at the ends which remain connected—we still have the E M F. in the same direction, but the current which results is compelled, by reason of the division of the conductor to take a path of comparatively great resistance, and the heat generated is reduced. It is difficult to understand how subdividing the conductor should make any difference to the heating, since, though we have increased the resistance of the

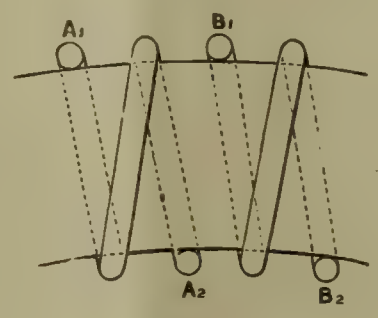


FIG. 2.

path, we have at the same time caused the E. M. Fs. to act summationally along that path. There is no doubt, however, that in practice the heat is by these means reduced, and we can only conclude that the sum of all the paths which the currents select for themselves, when the surface remains unbroken, is less proportionally to the E M. Fs. acting along those paths than when the conductor is divided. When the two divided halves of the conductor are crossed over each other, as in Messrs. Crompton's large current machines, the E. M. Fs. in the two divisions, C, fig. 1 annul each other, and the result is a great reduction in the heating. In the actual machines the conductor is formed by two bars, one of which, in middle of its length, dips under the other to cross over it.

In many cases we have to wind wires in parallel to form the conductor instead of one heavy wire. Sometimes we can only get on the convolutions we require by winding two or four wires together, while, at other times, the gauge of the single wire which would be required makes the winding less easy than if smaller wires in parallel are employed. When winding in parallel the considerations which have already occupied our attention should be borne in mind. Suppose, for example, we have to wind a Gramme armature, each section having two convolutions of two wires in parallel, one layer deep. We can either wind two turns of one wire first, as A1, A2, fig. 2; then two of the second wire B1, B2, coupling A1 to B1 and A2 to B2 when connecting up to the commutator, or we can wind both A and B wires together as in fig. 3, A1 and B1 being coupled, also A2 and B2 connected at the other end. We need only look at the two figs. to see that the latter is the correct and

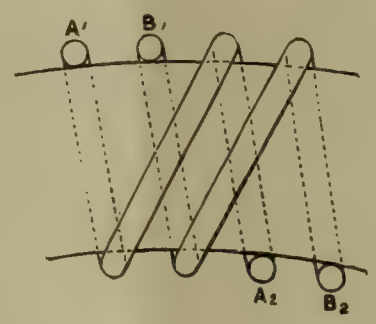


FIG. 3.

the former the incorrect method. In fig. 2, the conductor has double the angular width of that in fig. 3, enclosing in its own width, therefore, double the lines of force, and having, in consequence, considerably greater tendency to heat from parasitic currents. Though the wires are shown apart for convenience, it will be understood that they are in the actual machines wound close together.—*London Electrical Review.*

A GOOD RECORD FROM A SMALL ROAD.

The electrical and technical papers of the country have devoted considerable attention, as our readers are well aware, to the scientific aspects of electric railroading. New types and styles of motors have been treated thoroughly in this paper, and all improvements which have been made in electric street railway science have received due recognition.

In this discussion of the technical aspect of electrical street railroading, the commercial side has been, in a measure, overlooked, although this is the one which concerns particularly the street railway manager.

An electric railway, no matter how scientifically or carefully it has been built, will not be used unless its use gives actual returns to the investors. Under these circumstances, it is particularly interesting to note that the electric railways in operation have been successes in a commercial aspect, and that the records show that the capital invested in electric railways is sure to be remunerative when ordinary care and judgment is taken in its investment.

The report of the East Reading Electric Railway & Motor Co., for the year 1889, emphasizes the fact that electric railways are a commercial success, and that even during the first year of their operation they show gratifying financial results.

This road was installed a little more than a year ago upon the Sprague Electric System, and although its location is not particularly advantageous, the results have been extremely gratifying. The number of cars equipped is four, and the annual report of the treasurer issued on the 1st of January, 1890, shows that dividends at the rate of eight per cent. per annum upon the working capital were paid, besides leaving a large balance in the treasury.

Another interesting fact in connection with this report is, that it shows that during the last year the number of passengers carried was more then double the entire population of Reading. Nothing can more convincingly show the popularity of electric railway motive power. The operating expenses during that time were $4,380 81, or about 2.6 cents per passenger carried.

While the economic advantages of the use of electricity are not so pronounced on such a small road as upon a line operating a greater number of cars, these results are very gratifying to all interested in electric traction, and we congratulate the Sprague Electrical Railway and Motor Company for the excellent showing of this road equipped upon its system.

To Extend an Electric Road.—Cleveland, O., capitalists announce a project for the extention of the Collamer branch of the East Cleveland Railroad through the villages of Wickliffe, Willoughby, Mentor, Painesville, Perry, Madison, Unionville, Geneva, Saybrook and Ashtabula. It is claimed that a single track with the necessary switches can be put down cheaply, that wooden poles will do for wire supporters, and that a line operating on thirty minutes' time from car to car will pay. It is quite probable that the Collamer line will be extended ten or fifteen miles during the present year. The construction of this line to East Cleveland served to boom residence property in that locality. The distance from Cleveland to Ashtabula is about 60 miles, and the towns named are all enterprising and active.

An Electric Road Enjoined.—On February 2d an injunction was taken out by the Chicago & Alton Railroad Company against the Joliet, Ill. electric street railway and the Thomson-Houston company, restraining them from running cars or charging the trolley wire with electricity. The injunction is based on the claim of the railroad company that the wire was placed at a less distance than 25 feet above the Chicago and Alton track. The electric road was to have begun operations on the 3d instant, and trial trips were being made when the injunction was served upon the president of the road.

THE PERREUR-LLOYD BATTERY.*

The dominant idea of the system of generators invented by M. Perreur-Lloyd consists in the establishment of a manufactory of chemical products, in which electricity is considered as a veritable subproduct.

The generators are used for the fabrication of sulphates, and of simple or double chlorides of copper, iron, zinc, manganese, nickel, etc., whether for sale or to be employed in the manufacture of other more remunerative products.

Since the products formed by the combination of acids and bases giving birth to the electric current, possess a higher value than the sum of the values of their components, the inventors believe they can reduce the cost of the electric current to *nil* by assembling them for the above-mentioned purpose.

In a word, the system includes the kidnapping, so to speak, of the electric current wherever it has its origin by some one of the reactions used in chemical industry.

The inventors have sought to assemble together in the most economical manner the metallic salts which are formed within the interior of the generators by turning to account the difference in solubility of these salts when warm and when cold; the temperature rises during the working, owing to the heat which is caused by the interior resistances of the batteries; in case this is not sufficient, a jet of steam brings up the solutions to register the number of degrees Baumé corresponding to their crystallization by the simple cooling they undergo on leaving the generators, the walls of which are, moreover, sufficiently thick to make the loss of heat by radiation very slight.

The depolarizer is obtained by the regeneration of the nitric acid, which is used for this purpose.

The nitrous vapors formed by the reduction of the nitric acid surrounding the carbon electrode make their way into condensing vessels analogous to those employed in the fabrication of sulphuric acid, where, on contact with water, they form a combination of nitric and nitrous acids, and in this way the oxygen of the air is the ultimate depolarizer.

The generator is composed of a vat offering resistance to heat and acids. The upper portion of this vat is intended to receive the electrodes, while the lower portion forms a reservoir for the solutions. Glass plates divide the generator into compartments, each of which co-operates in the formation of a distinct element.

The elements are constituted thus: between the walls of the elements are placed flat porous jars, which are supported by ledges formed in the thickness of the sides of the vats; under these jars is a hollow place called the reservoir.

Each element comprises one or several porous jars, in which are placed carbons of a thickness which increases progressively towards the upper extremity; between the porous jars copper plates constitute the soluble electrode.

The reservoir communicates directly with the portion of the vat in which are the soluble electrodes.

The advantage of this reservoir is that it enables us to approximate the electrodes as closely as we may desire in the upper portion of the vat, and at the same time to have a volume of exciting solution, which is much more considerable than that of the depolarizing solution.

Since, theoretically, it only requires a third of the equivalent of nitric acid to oxidize the hydrogen which dissolves the combination of an equivalent of acid with the soluble electrode, and since, moreover, this last named acid is only used in a diluted state, it is evident that the depolarizing solution being concentrated, the relation between the volumes of the exciting and depolarizing solutions must often be considerable; it is necessary, in fact, for the proper working of the apparatus that the two solutions should be exhausted simultaneously.

The generators are covered with glass plates; the carbons of the porous receivers, as also the connections of the soluble electrodes, issue out of this casing. The latter presents a slant which facilitates the draught through the chimney in the upper portion of the generator. This disposition has another object; the battery in full working becomes heated, the water steam condenses upon the casing, and absorbs, in some measure, the nitric vapors that are set free; the nitrous products thus formed, are received into a gutter, fashioned in the interior portion of the generators at the precise spot upon which the casing rests.

The generators are always placed lower than the large reservoirs in which the depolarizing and exciting solutions are prepared. The reservoirs communicate by means of pipes with tubes that are placed in the fore part of the generators and of the crystallizing vats respectively; the tubes communicate by branch pipes fitted with taps, with each one of the porous jars. The supply is effected through a tube in communication with the depolarizing reservoir by opening the taps of the branch pipes successively. To empty the jars, the tubes are placed in combination with a receiver, into which the discharge is made, and each jar is emptied in the same way by means of the taps.

The battery circuit is closed upon the accumulators. The sulphates or chlorides are formed in the interior of the generators, and the nitrous vapors are set free to undergo condensation. When the solution in the latter registers 20 degrees, it is again made use of as a depolarizer by mixing it with one or two volumes of sulphuric acid. The depolarizing solution, when exhausted, is employed as an exciter.

The reservoir is heated by a steam pipe.

La Lumiere Electrique

CONVERTING GAS INTO ELECTRICITY.

Every other illuminant pales before the electric light. That this is so is well instanced by the demand made by parties in the rural districts who use their own gas machines to have their gas converted into electricity. With a view to meeting these demands, the National Meter Company, of 252 Broadway, and Mr. O. Tirrill, proprietor of Tirrill's Equalizing Gas Machines, of 39 Dey street, New York, have recently effected a combination which will bring joy to the hearts of our brethren in the country.

The combination consists in a Tirrill Equalizing Gas Machine, a Nash Gas Machine and a Perret Dynamo. The arrangement is automatic from first to last, the light is much steadier than gas, to say nothing of its other advantages, and a long felt want is filled. The dynamo used is the Perret automatic compound machine, the efficiency of which could not be better illustrated than by its many recent combinations with small engines of this kind, where the power supplied is very limited as compared with the results to be attained.

A 25 light plant of this description is now in very successful operation at 39 Dey street, New York.

STORAGE BATTERIES FOR HOUSE AND OFFICE USE.—Mr. W. M. Donaldson, a very enterprising electrical engineer of Baltimore, has recently entered into the business of distributing electrical energy by means of storage batteries in connection with small motors for household and office use in the cities of Baltimore and Washington. In Baltimore his batteries are charged by the arc light wires, and in Washington by a Perret dynamo. Mr. Donaldson's business seems to prosper, judging by his recent order on the Elektron Manufacturing Company for forty Perret motors for graphophone work. After a series of practical tests, Mr. Donaldson has adopted the Perret motor for his work. In some recent tests with this motor on graphophone work, using 2-volt battery, when recording the motor took 2.3 ampères, and when reproducing 2 ampères. With the ordinary 100 ampère hour storage cell, the motor will drive the graphophone from forty-five to fifty hours continuously, which lasts an ordinary business man about one month, the battery being then replaced by a freshly charged one, and the discharged battery taken to the charging station.

AN EXPLANATION.—In our issue of the 8th instant, a description was given of the wiring of the Rouss Building on Broadway In that connection we inadvertently failed to state that the Tucker Electrical Construction Company of this city was the contracting company. This well-known concern installed the complete plant and wired the building throughout, and the entire work has been done in a manner which reflects great credit on the company.

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THE PROPOSED COURT OF PATENT APPEALS.

It is likely that a Court of Patent Appeals will be established by the present Congress to relieve the United States Supreme Court of all patent litigation. The justices of this new court will be appointed for life and will receive salaries of $7,500 a year. They will class next to the Supreme Court in the Federal judiciary.

REGULATING TELEPHONE CHARGES.—A bill has been introduced in the New York legislature regulating charges for the use of telephones in cities having a population of 1,000,000 or over. It fixes the rate at not exceeding $84 per year. A violation of the provisions of the Act is made a misdemeanor and the violator made liable to a civil action for damages. The violator is also liable in a sum of not less than $50 nor more than $500 for each offence, recoverable at the suit of the people through the Attorney-General, one-half the money to be paid to the State and the remainder to the county where the offence occurred. Special and exclusive lines are excepted.

HON. J. D. REID.—Hon. James D. Reid, U. S. Consul at Dunfermline, Scotland, has been elected a member of the executive committee of the Edinburgh International Exposition of Electrical Engineering and Industries. His counsel will be valuable to the committee owing to his large experience in electrical matters in his adopted country, and we congratulate both Mr. Reid and the committee on the establishment of their new relations.

EARTH CURRENTS.—In a paper read before the Naples Academy of Sciences, Signor Palmieri gave an interesting account of some earth current phenomena recently observed by him in connection with an ordinary overhead telegraph line, five miles long, running from Resina to the Vesuvius Observatory, *i.e.*, from S.W, to N.E. Previous observers have noted the fact that in wires placed in the magnetic meridian, the direction of the earth current was from north to south, and in wires placed equatorially from east to west. Accordingly in the wire experimented on by Signor Palmieri the current *ought* to have been from N.E. to S.W., instead of from Resina to Vesuvius as was the case. Matteucci has observed that in wires inclined at an angle to the horizon, the earth currents are always in an upper direction. Now the difference in level between Resina and the Observatory was nearly 2,000 ft. Signor Palmieri, therefore, extended the line from the Observatory in practically the same direction for a distance of nearly 200 yards, and earthed it on the reverse slope of the mountain 52 ft. below. If the new line were earthed at the Observatory, the galvanometer showed that a current of less intensity but opposite in direction to the Resina-Vesuvius current was flowing in the wire. If the Resina-Vesuvius line were joined up to the extension line, the earth now being at Resina and at the point 52 ft. below the Observatory on the reverse slope of the mountain, the galvanometer deflections were found to be proportional to the algebraical sum of the current intensities. Signor Palmieri concludes his remarks by pointing out that previous observations which did not take this phenomenon into account are entirely vitiated.

RADIATION OF THE SUN AND THE ELECTRIC ARC.—Prof. Langley has recently been investigating, by means of his bolometer, the comparative radiation of the sun and the electric arc in different parts of the spectrum. The result given is that the solar radiation in the orange and red is nearly ten times that of the arc. Towards the violet end of the spectrum the relative importance of the sun's rays is less, owing to atmospheric absorption. The solar rays are relatively stronger than those of the arc in all parts of the infra red spectrum known until lately, although in the extreme portions recently investigated the rays of the arc are more powerful. When allowance is made for atmospheric absorption it is found that the superiority of the sun's rays over those of the arc continuously increases in proceeding from the ultra red to the ultra violet portions of the spectrum, the number expressing the ratio being 4 in the extreme red, 10 in the orange and red, and 26 in the extreme violet. These results show that there is considerable atmospheric absorption in the extreme parts of the spectrum, although in the red portions very little occurs.

DR. WERNER VON SIEMENS.—Dr. Werner von Siemens, who has just retired from business, is engaged in writing his autobiography, which will, it is stated, contain some interesting details of the development of the Siemens and Halske business.

PHONOGRAPH WATER MOTOR.—A water motor has been perfected at Mr. Edison's laboratory in Orange, N. J., for operating the phonograph. It is very ornamental in appearance, and works to perfection. The speed can be regulated to any degree, and wherever there is a supply of running water the motor phonograph can be used. The motor will likely take the place of batteries for driving power to a very great extent on account of the little care necessary.

MR. EDISON IN FLORIDA.—Mr. T. A. Edison is spending a few weeks at his place at Fort Myers, Florida.

DEPARTMENT OF INQUIRIES.

Editor ELECTRIC AGE: I, for one, desire to thank you for your announced intention to give a little of your valuable space for the benefit of the student. There is a large number of students throughout the country and many, like myself, have received very little help or information from the electrical trade papers. Even books do not always give the desired information, particularly on electric lighting. I am studying electricity, and I would like to ask you what is the difference between direct and alternating currents, and is the same type of dynamo used to produce these different currents? If you will please answer through the columns of THE ELECTRIC AGE you will greatly oblige

AN APPRECIATIVE STUDENT.

Answer. A direct current means one of unchanging polarity with reference to the line, while an alternating current means one in which the polarity is constantly alternating—that is to say, the current going out to the line through each brush is first positive, then negative, then positive again, and so on, in very rapid succession. The direct current is frequently called a "pulsating" current, because of its wave like character. It is variable in amount, according to the number of coils in the armature of the dynamo, but the variation is so slight in electric lighting dynamos that for all practical purposes the current may be regarded as a perfectly steady one. The direct and alternating current dynamos are radically different. The main points of difference are in the winding of the field magnets (which in the alternating machine are numerous) the winding of the armature, and the method of collecting the current.—Ed. ELECTRIC AGE.

A BILL TO ESTABLISH A GOVERNMENT TELEGRAPH SYSTEM.—Representative Wade, of Missouri, introduced in the House, on the 18th of February, a bill to establish a Government postal telegraph system. The bill creates a Bureau under the control of a Fourth Assistant Postmaster-General. This officer shall cause to be constructed through the States and Territories a trunk line of postal telegraph, to reach and connect all cities and towns that now have telegraphic communication. Such postal telegraph shall be constructed and kept in repair under the direction of the Secretary of War through the Corps of Engineers, and the Postmaster-General is authorized to employ all persons necessary to conduct the business of the proposed system. The rate for transmitting messages shall be for 500 miles or less, 10 cents for twenty words; from 500 to 1,000 miles, one cent a word, and a corresponding increase for greater distances. Press despatches are to be taken 1,000 miles or less at one-third of a cent per word and greater distances at proportionate rates. All persons shall have the right to the use of the telegraph lines for the purpose of corresponding at the rates fixed by the Postmaster-General. Nothing in this act is to be constructed to prohibit individuals or corporations from carrying on the business of operating telegraph lines. Eight million dollars are appropriated for the purposes of the bill.

ELECTRIC TRANSFER TABLE.—The Union Pacific Railway Company have decided upon an electric transfer table and overhead traveling crane, also a 500-light incandescent station in their new locomotive shops at Cheyenne. The system is not yet adopted, except for the transfer table, which will be driven by a 15 horse-power railway motor.

ZINC PRODUCTION.—The production of zinc in the United States last year was 59,500 tons. Of the total Illinois produced 24,000 tons; Kansas, 11,000 tons; Missouri, 12,500 tons; Eastern and Northern States, 12,000 tons.

A storage battery plant for 140 lights is to be placed in the bleachery at Lowell, Mass.

A RIVAL OF THE PHONOGRAPH.

A despatch from Berlin conveys the intelligence that the phonograph has been beaten in competition in that city by a grammophone.

Berliner patented his grammaphone several years ago, and it was exhibited in this city, Washington, Boston and elsewhere, but was not considered a serious rival of the phonograph, owing to its being more complicated and cumbersome.

Jesse H. Lippincott, President of the North American Phonograph Company, and licensee of the American Graphophone Company, says Berliner's machine is impracticable mechanically. It will do very well to use in a hall to record musical sounds, but is too unwieldy for ordinary commercial use.

The Edison people say that the fact that Professor Siemens was present at the trial does not carry much weight, as the result is not given as his verdict.

It is also stated that the Edison phonograph used at the trial was one of those exhibited at the Paris Exhibition, while since his return from Europe the inventor has made several important improvements to his instrument.

WATER POWER.—The London *Electrical Review* says: "The successful working of the Central Station at Keswick by means of water power should bring a considerable amount of attention to this method of obtaining power. There can be no question but that there are many places which do not require a very large amount of light, and where coal is expensive, which would very readily be supplied by means of water power close at hand. The economy of working is great, and the ease of regulation is known, and the only danger to be feared is the scarcity of supply from exceptional drought. This has been met with at Keswick by the addition of steam power as an alternative. Electric lighting by means of water power is well known, but this is, we believe, the very first application of it to the purposes of a central station in this country. The first instance of a private installation was, we believe, at Sir Wm. Armstrong's house, where water was used But perhaps the best known was that at Hatfield, where a varied amount of work is done on the Marquis of Salisbury's estate."

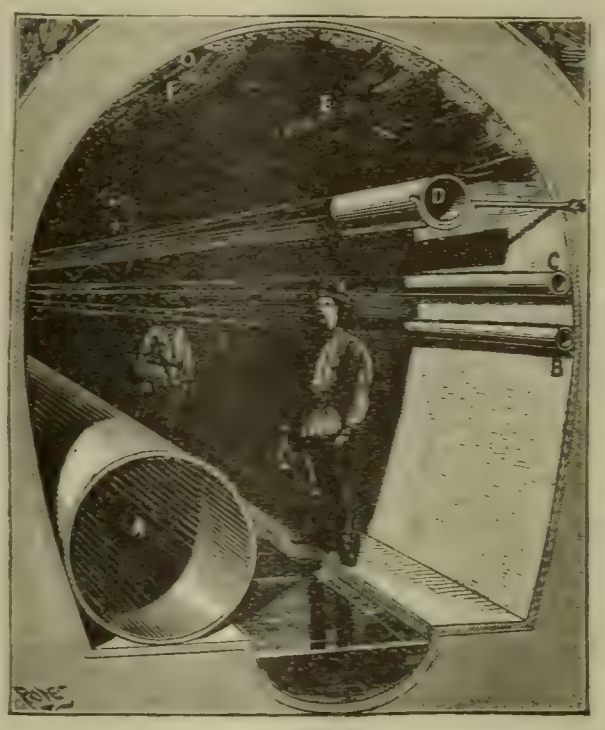
The Tucker Electrical Construction Company of this city report a large increase of business. This company has completed some of the largest contracts in the United States. Among them are mentioned the Plaza Hotel, Plaza Club, Amberg Theatre, New York Turn Verein Club, Consolidated Stock Exchange, Rouss Building (of which favorable mention was made in our issue of Feb. 8) and numerous other large buildings. The company employs the best talent, and the highest grade materials and all their work has given complete satisfaction. The President Chas. A. Tucker, through his genial qualities, has built a large and increasing business.

THE EDISON-LALANDE BATTERY.—The Edison-Lalande battery is attracting a good deal of attention among electricians. As a telegraph battery it seems to have taken the lead of all other makes. This is not to be wondered at when its valuable features are considered. The Philadelphia and Reading Railroad are about to instal a battery of 232 cells of the Edison-Lalande type, from which it is proposed to run eight wires. The total cost of labor in maintaining this battery will be $14.60 per year. The Pennsylvania Railroad Company are also going to introduce this battery in its Philadelphia office, and run 14 wires therefrom. It is possible to supply 30 wires with current from one of these batteries. The resistance of 100 cells is only 2½ ohms, which renders this battery particularly adapted to supplying several wires from one source.

ELECTRIC WIRES, ETC., IN THE PARIS SEWERS.

In Paris the city station Bergere has ærial cables, and these are used by the Faubourg St. Martin station. But the new companies that have just received grants will be able to establish subways only. The sewers have been reserved for the cables of the municipal service. If we consider that the cables, although protected by mouldings or otherwise, are at the mercy of the force of workmen who traverse the sewer, and are exposed to humidity and several other causes of damage, this is perhaps not an advantage. It must, moreover, be remarked that the sewers are greatly encumbered by telephone and telegraph cables, and by pipes for distributing compressed air.

In the illustration we show a section of a sewer in Opera avenue. At *A* there is a water main, 3¼ feet in diameter; at *B* and *C*, two 4 inch water pipes; at *D*, an 8 inch pipe for the distribution of compressed air; at *E*, several large bundles of telegraph and telephone wires; and at *F*, a pipe for the passage of compressed air for setting pneumatic clocks. To these still should be added the pipes that serve for the pneumatic post of Paris. The large



PARIS SEWERS.

number of conductors already established will be especially remarked. Under such conditions for the placing of wires, especially for alternating currents, it is indispensable to take precautions against the phenomena of induction. It might seem as if the most advantageous means for this purpose would consist in the adoption of concentric cables. Now, such cables, which are already employed in several distributions, present great inconveniences, both as regards making connections and the security of the service, and, despite experiments, the use of them has not as yet entered thoroughly into practice. It is probable that the sewers will not be used for this purpose The various electric lighting companies are taxing their wits to find models of subways for the laying of their cables as advantageously as possible.

We shall not fail, when the occasion occurs, to describe the principal methods employed, and which will finally settle us as to the practical establishment of subways—a question which is certainly the most important one in distributions.—*La Nature.*

The East Cleveland Railroad Company, of Cleveland, Ohio, have just put in three 250 horse power engines, and increased their rolling stock by the addition of 18 motor cars.

HONORS TO GEN. O. E. MADDEN.

The friends of Gen. O. E. Madden, who sailed for Europe on Wednesday, February 12th gave a dinner in his honor at the Electric Club on the evening of the 7th, which was one of the most enjoyable affairs of the many that have taken place since the opening of the club house.

The tables were laid in the large lecture-room of the club, and were beautifully decorated with "fairy lamps" placed among cut flowers and smilax. The centre-piece was a large floral steamship, bearing the name of the steamer *Lahn*, on which General Madden is to sail, and the words "*Bon voyage to O. E. M.*"

Mr. Henry L. Storke presided, and among the gentlemen present were his honor, Mayor Hart, of Boston; Allen V. Garratt, F. W. Toppan, W. L. Candee, A. H. Patterson, C. O. Baker, Jr., H. B. Thayer, W. D. Sargent, E. A. Leslie, Henry D. Stanley, A. F. Stanley, Paul T. Brady, B. Coggeshall, J. C. Chamberlain, F. Z. Maguire, J. J. Carty, C. F. Willard, Robert J. Steen, D. Frank Lloyd, Schuyler S Wheeler, E. T. Gilliland, Charles W. Price, J. H. Guest, A. B. Uline, T. E. Wardner, Charles P. Bruch, P. H. Alexander, George Worthington, and others prominent in electrical circles to the number of forty.

An elegant dinner was served, after which addresses were made by Mayor Hart, Mr. Patterson, Mr. Wheeler, Mr. Gilliland, Mr. Sargent, Mr. Candee, and many others, and songs were sung by Lieut. Toppan, Mr. Patterson and Mr. Maguire.

Gen. Madden had the best wishes of all for a pleasant and safe journey, and received many compliments and congratulations upon the excellent condition and continued success of the club under his management as its president.

He expects to remain abroad about eight weeks, combining business with pleasure, in England and on the continent.

A NEW DYNAMO.—A new invention is an alternating current apparatus that is an automatic continuous current machine, designed to operate without the intervention of external regulating apparatus. By making the armature winding of high resistance, a practically constant current is maintained under wide limits of load. The essential feature of the construction lies in the nature of the windings on the armature poles. These coils consist of many convolutions, so that a slight variation in the quantity of current flowing through the coils produces considerable variation in the ampère turns. In the operation of the machine, according to the inventor, the strong field magnets tend to develop a large number of lines of force, and the alternate currents generated tend to set up in the armature core lines of force which oppose or stem back a portion of the lines of force of the field magnet pole, toward which it is moving, thus permitting only a comparatively few to be effective in generating an electro-motive force in the armature coils. These two tendencies to establish lines of force may be considered as the magnetic potentials of the field and armature. The excess of the magnetic potential of the field above that of the armature at the time when the field poles are effective in sending lines of force through the armature-core is that which is effective in producing electro-motive force in the armature coils. The number of lines of force resulting from this difference of magnetic potentials, and which are thus effective in developing currents on the armature coils, will remain approximately constant so long as the resistance offered to the flow of the current on the work circuit remains constant; but as the resistance increases, the tendency of the armature current to be diminished will allow a greater number of lines of force to cut the armature coils, thus increasing the electro-motive force sufficiently to hold the current approximately at a predetermined value.

ELECTRICITY IN THERAPEUTICS.

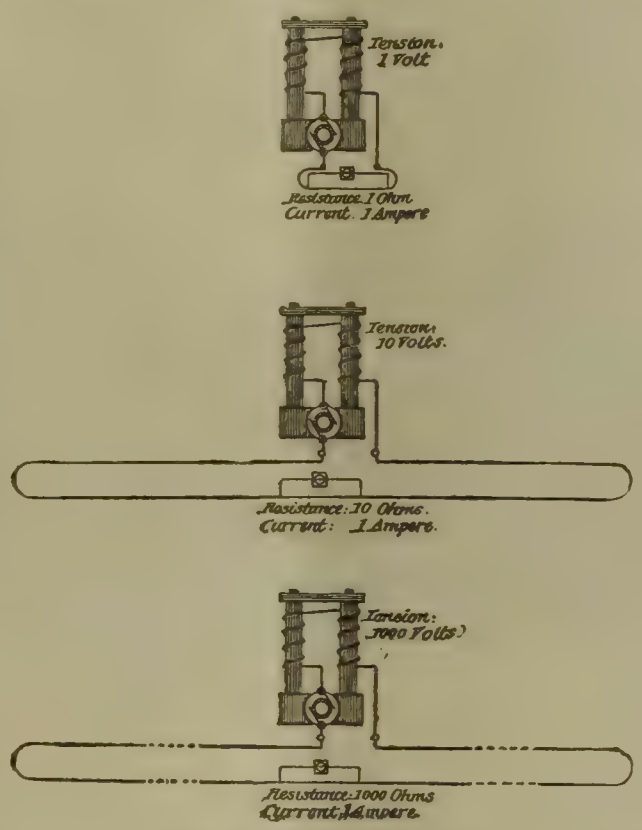
The costliness, the care and the special knowledge required to keep an electrical outfit in good working order and to properly apply it are the reasons for the diversity of opinions among medical men as to the value of electricity as a therapeutic agent. It seems most difficult of belief that scientists should reckon the value of a thing of this nature by the dollars and cents of its cost and the amount of special knowledge required; but such is the fact. You will hear a physician sneer when electricity is mentioned, and say something about imagining that it is an elixir of life and that sort of thing, all because he cannot afford to keep an apparatus himself, or will not, or is too lazy to acquire the learning necessary to practice with it. There are also some who are really prejudiced against it for what they believe to be good reasons. Any one, however, who has seen the mechanism of an asphyxiated new-born babe set in operation by the aid of a little pocket faradization machine will scarcely be in a mood to listen to the croak of the pessimists who call up cases where electrification of the heart has ensued from the blundering of an unskillful or careless physician. And his feelings of patience toward the aforesaid pessimist would scarcely mellow when he has seen the same little machine stop a *post-partum* hemorrhage that had proved rebellious to all other safe measures known; if he has seen galvanism, followed by faradization, not only bring back the lost plumpness of paralyzed muscles, but also—even if he cannot say how—lead the patient along the only road that ends in regeneration of the diseased spinal cord; if he has seen the cautery wire bury itself bloodlessly in parts that he would not have dared attack with a knife; or even if he had seen faradization give comfort in a few moments to a person suffering with muscular rheumatism. There ought to be no doubt entertained of the great therapeutic value of electricity; what is wanted is more precise knowledge as to when and how to use it. That knowledge must be obtained by experimental work, guided by correct knowledge of physiology and pathology. —*New York Medical Journal*

A new Storage Battery Electric Motor—E. Dederick, a Milwaukee inventor, has invented a storage battery electric motor, which he thinks solves the problem of electric rapid transit. At each end of the car are two closets which contain the storage battery cells, of which twenty-five are placed in each closet. The cells are all connected and unite with armature of the motor. The latter sets in motion two small leather-covered wheels, which press closely against the large wheels. At the center of the shaft, connecting the large wheels, is a third small wheel that in turn presses closely against another large wheel. In this case, however, a lever in the hands of the operator enables him to raise or lower one of the wheels, and by applying the brake stop the car. The motor continues to run, and the momentum gained thereby starts the car much quicker than if the motor had to be stopped every time. A pitman at each side of the last-mentioned wheels connects with the apparatus which sets the track wheels in motion, and this is the point on which Dederick claims the success of his invention hinges. The pitman rods set in motion two grippers, which are attached to the axle of the rear car wheels, the action being alternating. At the instant one gripper lets go the other connects, and a constant motion is thus given to the car. Two small levers are attached to the gripping apparatus, and by changing the position of these the action of the grippers and the motion of the car are reversed. When the battery has been fully charged, which takes from four to five hours, it is said that the car can run for eighteen hours.

A project is on foot to connect Richmond and Petersburg, Va., by an electric railway.

HIGH AND LOW TENSION ELECTRIC CIRCUITS.

An error in scientific nomenclature does not always imply ignorance. The chemist invariably calls carbonous oxide carbonic oxide, and calls the higher oxide of carbon either carbonic acid or carbonic acid gas. Several such inaccuracies have become so engrafted upon the science that they are accepted and used universally. Electricity has been defined as the science of measurements. It might with more propriety have been termed the science of nomenclature and definition. Any tendency to error in its terminology is to be avoided. Every day an inaccuracy is perpetrated by electricians as well as by the laity which should be stopped, especially as no end is served by its continuance. It is the use of the term high and low tension current or high and low potential current. Neither tension nor potential can be attributes of an electric current. The use of such an expression may conduce to convenience; but if for the word "current" either "system" or "circuit" be substituted, an improvement at least is effected. The worst of the matter is that this application of the term tension has given a false conception of the true nature of a current.



HIGH AND LOW POTENTIALS.

A current passing through a circuit is urged by electromotive force, or by difference of potential, which, in a certain sense, forces the current through the wire. The term tension is correct if used to denote the difference of potential; but it no more expresses an attribute of the current than the elevation of Lake Glazier expresses an attribute of the flow of the Mississippi. It influences its flow, but is not a function of it.

The error is worse when a current of so many volts is spoken of. A current is rated by ampères, not by volts. A wire carries current at the rate of so many ampères, a current cannot be measured in or be designated by volts.

Some diagrams are given to show when a current is produced how a high and low potential difference may produce absolutely identical currents. For convenience simple numbers will be used throughout the description.

Three dynamos with their circuits are shown. The first dynamo is supposed to maintain a difference of potential of one volt at its terminals. The terminals are supposed to be connected with a wire ten feet long of one ohm resistance. A current of one ampère will pass through the wire.

The second dynamo is supposed to maintain a difference of potential of ten volts, and to have its terminals connected by one hundred feet of the same wire. This will give a current of one ampère just as before. Finally the third dynamo is supposed to give a difference of potential of one thousand volts, its current passing through ten thousand feet of the same wire. As before, the current will be of one ampère intensity. Under the popular terminology, the first two cases would be called low tension currents and the last a high tension current. Yet the currents in the three cases are absolutely identical.

To illustrate this still further, equal lengths of the different circuits can be compared. Suppose a section of five feet is taken and its electrical data determined. It will in all three cases be found to be passing a current of one ampère intensity. The difference of potential from end to end of the section will in all three cases be one-half a volt. Thus if equal portions are compared, the three currents, high and low tension "currents" so-called, are found to be identical. In like manner if ten foot sections of the different wires be compared, the same current of one ampère, with a difference of potential of one volt, will be found in all three. The popular term indicates the original difference of potential, but is very incorrectly used. It would be far better to consider the whole circuit with its generator and apply the adjective to it—speaking of a high or low tension circuit or of a 1,000 volt circuit, alluding in all cases to the maximum difference of protential that is maintained in the circuit when in operation.—*Scientific American.*

Favorable to Electric Power:—Experts have for some time been experimenting and estimating upon the comparative cost of running a line of street cars by electricity and by horse-power. After careful inquiry and investigation they have reported that taking a line of fifty cars the average cost of operating per day with horses is $303,75, while with electricity the cost is but $68,50. This leaves a handsome balance of $231,25 a day, or nearly $5 a day on each car in favor of the electric plant. These facts being verified street car companies should not be slow in adopting the new motive power, as a line running fifty cars would save enough in a single year to go a great way towards equipping their cars with electric appliances for propelling them.

Tests of Safety Appliances.—At the present time Boston is foremost in the investigation and solution of electric light problems. The conflagration of last Thanksgiving Day was a costly experience, and, as the fire is generally supposed to have been caused by an electric current, the insurance people are taking the matter up themselves and making investigations as to means of removing the dangers in the use of electric light currents. The Fire Underwriters' Union are about to undertake a series of the most searching and crucial tests of every known device for protection against the dangers of heavy currents. Inventors and manufacturers are invited to submit their appliances for tests, and it is said that the electrical people are in perfect harmony with the movement, and are co-operating with considerable zeal.

Electric Lighting in London.—A cable message from London, England, for Westinghouse alternating current apparatus for 30,000 incandescent lights was received at the office of the company a few days since. The order came from the Metropolitan Electric Supply Company of London. The same organization has already several plants in the English metropolis which are all fitted out with machinery from Pittsburg. The cable states that the shipment of the machinery must be made immediately. The entire outfit for this plant, consisting of Westinghouse engines, dynamos, exciters and other electrical appliances, will be got ready for shipment at once.

Electric Railways.—The Sioux City (Iowa) Rapid Transit Company have let a contract to equip 1⅛ miles of their road electrically.

THE MASON BATTERY FOR LIGHT AND POWER.

There is a great need at the present day for an efficient and reliable primary battery for light and power purposes. Such a battery would be of great value for domestic lighting where a limited number of lights is required, and for performing light work. It has been the dream of electricians for years to produce such a battery, and much time and labor have been expended in this direction, but with practically no satisfactory results until recently. Mr. James H. Mason, of Brooklyn, after much experimentation, has successfully solved the problem, and has produced a battery which for efficiency and economy is as far in advance of any of its predecessors as the locomotive was of the stage coach. Hitherto, as is well known, lighting by primary battery power was considered an expensive luxury—in fact it was quite impracticable on account of the great labor involved in maintaining the battery up to its full working capacity, leaving out the question of expense. These obstacles have been completely overcome in the Mason battery, as will be seen later on. The main features of Mr. Mason's battery, an illustration of which is shown in Fig. 1, and on which he has obtained patents, are the solution, and the zincs. Mr. Mason experimented for a very long time, with a view of producing a perfect depolarizing solution, and in rendering the zincs self-amalgamating, both of which objects he succeeded in attaining to a perfect degree. The result is, Mr. Mason has a battery which he can honestly and confidently recommend as being perfectly reliable and efficient.

The advantages claimed for this battery are enumerated as follows:

1st. One charge of solution will last from 4 to 20 times longer than any other battery on the market and at much less cost. 2d. Its electro-motive force is high and constant. 3d. Its internal resistance is very low. 4th. It does not polarize and has large current. 5th There are no creeping salts. 6th. There is no formation of crystals on the carbons. 7th. There are no fumes. 8th. There is no local action or consumption of material when on open circuit (not at work). 9th. There is no danger even to the most inexperienced. 10th. It is inexpensive. 11th. It requires little or no attention. 12th. And the zincs never require amalgamation.

These are all admittedly very valuable features, and having seen a battery put to the test, we are firmly convinced that it possesses all of the qualities claimed for it. The fact that there is no local action aud consequently no consumption of material when the battery is not working, is a very valuable feature in itself. There is therefore no energy wasted; the strength of the solution is expended in actual work only, and not wasted, as in other batteries. Mr. Mason's method of making the zincs is a very excellent one. By a patent process the zinc is rendered self-amalgamating, which insures very even consumption. Some of the zincs examined by us, which had been in use several months, were consumed so evenly that they were not much thicker than writing paper. They never crumble nor break as ordinary zincs do, hence the full value of the zincs is returned in work—either light or power. The absence of poisonous fumes renders this battery especially adapted for domestic use, and it can with safety be placed anywhere in the house. There is also a total absence of danger from shock or fire. In the first case the current is hardly sufficient to give a perceptible shock, and in the second, there is not enough, by far, to burn anything under the most favorable, or unfavorable circumstances. From a scientific point of view, the fact that that common but injurious action—the creeping of salts—has been completely subjugated in this battery is worthy of special notice. It is well known that after some use carbon batteries lose much of their power. This is due to the fact that the salts creep up the carbon by capillary attraction and get in between the carbon and the metal ic connection, creating a resistance and a corresponding diminution of the current. Mr. Mason has, however, completely overcome that difficulty. He has invented a preparation into which he immerses the ends of the carbons. This substance renders the carbon proof against any capillary action above the line of the solution in the porous cup, while at the same time the resistance is not affected in the least. By this method of treatment a perfect and permanent contact with the carbon is insured, which cannot be injuriously affected by the salts. We were shown carbons treated in this way that had been in use many months, and the connection was as bright as it was the first day it was made.

Compared with gas, the cost of maintaining an electric light plant of these batteries is about equal to gas at $2 per 1,000 cubic feet—that is to say, the same amount of electric light as that given by 1,000 cubic feet of gas will cost about $2. But when the healthfulness of the electric light is considered, that light becomes much cheaper in the end. The electric light does not heat the air, nor consume any of its constituents, which are so essential to health.

Mr. Mason has constructed a night-lamp outfit which with two 2 candle power lamps and two cells of battery gives light for 100 hours. This is about 12 nights of 8 hours per night.

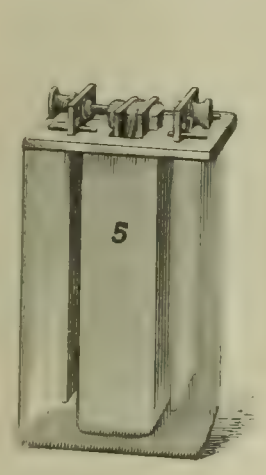


FIG. 1.

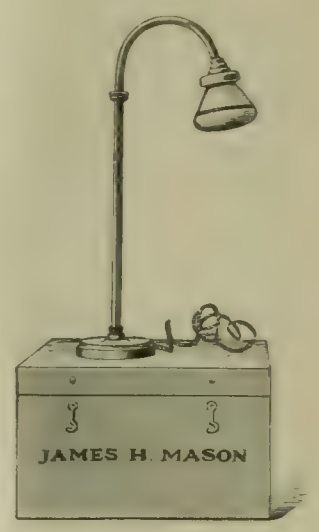


FIG. 2.

These lights can be placed anywhere about the house where necessary. They are excellent for a sick room, or wherever it is necessary to keep a light burning all night.

Another very convenient adaptation of the light is shown in Fig. 2, which represents a reading lamp. The lamp is so constructed that all the light can be concentrated just where it is wanted. At the point where the lamp is connected with the bent tube a swivel is inserted, which makes it possible to throw the light in any desired direction. For instance, in playing a piano, or organ, the light standard can be placed on a convenient stand and the lamp turned so as to throw all the light on the music. These lamps are very handsomely gotten up and are very portable.

Another of Mr. Mason's specialties is a fan outfit. A motor and fan are combined on one standard and their operation in warm weather, particularly in bed-rooms, insures comfortable and cooling breezes where otherwise there would be none. The size of the fan is twelve inches in diameter, and when it is in motion a cooling breeze is felt all over the room. The fan is adjustable to any angle and will run for seventy hours with one battery charge. There is little excuse for sweltering in our homes during warm weather when these outfits can be purchased at such a low figure.

On account of the efficiency of Mr. Mason's improved battery it becomes especially valuable for burglar alarm use. It will always do its work so long as it receives the little attention that is necessary. Thus, by its use, protection of homes and property is made more reliable. Gas lighting and automatic fire alarm are also valuable uses to which this battery commends itself.

The portability of the battery renders it peculiarly adapted for decorative purposes. Thus, for instance, a Christmas-tree can be readily illuminated with fairy lamps at small expense. Many other methods of decoration suggest themselves, and the effect of such is beautiful in the extreme.

In order to give some idea of the capacity of the battery for lighting purposes it may be explained that ten cells will give 16 candle-power light for fifty hours.

Mr. Mason has installed several plants, and in every instance the utmost satisfaction is given to the users of the light. Their delight and satisfaction are expressed in many testimonial letters which, being entirely unsolicited, speak well for the performance of the battery. In most all cases the writers testify that their plants have done even more work than was claimed they would do by Mr. Mason.

This battery has a bright future, and is one that has real, true merit. The rapid increase in the demand for it is a certain indication that the battery does, at least, all that is claimed it will do

Mr Mason is the sole proprietor of the business. He does not sell territory, as is usually done when it is desired to introduce a new article. All the business is done directly with him, and the advantage in this will be greatly appreciated by parties at a distance who would rather deal directly with the manufacturer than through an agent or intermediary. Mr. Mason's office and factory are at 120 Park avenue, Brooklyn. The manufacturing plant is a complete one, and all of his goods are first-class in every respect. He also deals in everything in the electric light line.

Mr. Mason's system of domestic lighting is particularly adapted for use in suburban or country homes, and, as oil or poor gas is the usual illuminant in such localities, a reliable system of electric lighting is a great desideratum. The Mason system certainly fills every requirement, and we are glad to note that a successful system of domestic lighting by primary battery has at last been produced.

Making Pulp by Electricity.—Pulp manufacturers are deeply interested in an electrical method of reducing the wood in the manufacture of pulp. By this process it is claimed that the fibre is manufactured so cheaply that the entire pulp business will be revolutionized, and the digesters now in use be driven out. Kelner of Germany has been experimenting for several years with electricity in this direction, and has now succeeded in perfecting the process. A patent has been applied for in the United States.

Electric Light Cheaper than Gas.—Inquiry is often made as to the relative cost of gas aad electric light. After a careful comparison it is found that gas at $2 per 1,000 feet is twice as expensive as electric light. At $1 per 1,000 feet for gas, therefore, the two illuminants would cost the same.

Edison's Birthday.—Mr. Thomas A. Edison recently celebrated his 44th birthday anniversary. His birthday is now noted in the almanacs of Great Britain.

The Edison Light in England.—Edison says his contemplated trip to London in the spring is to introduce his electrical plants there. He wants to let his light shine before (English) men.

Mr. E. A. Grissinger, of Harrisburg, Pa., has entered the Lehigh University for a four years' course in electrical engineering.

J. G. BRILL CO.'S KANSAS CITY EXHIBIT.

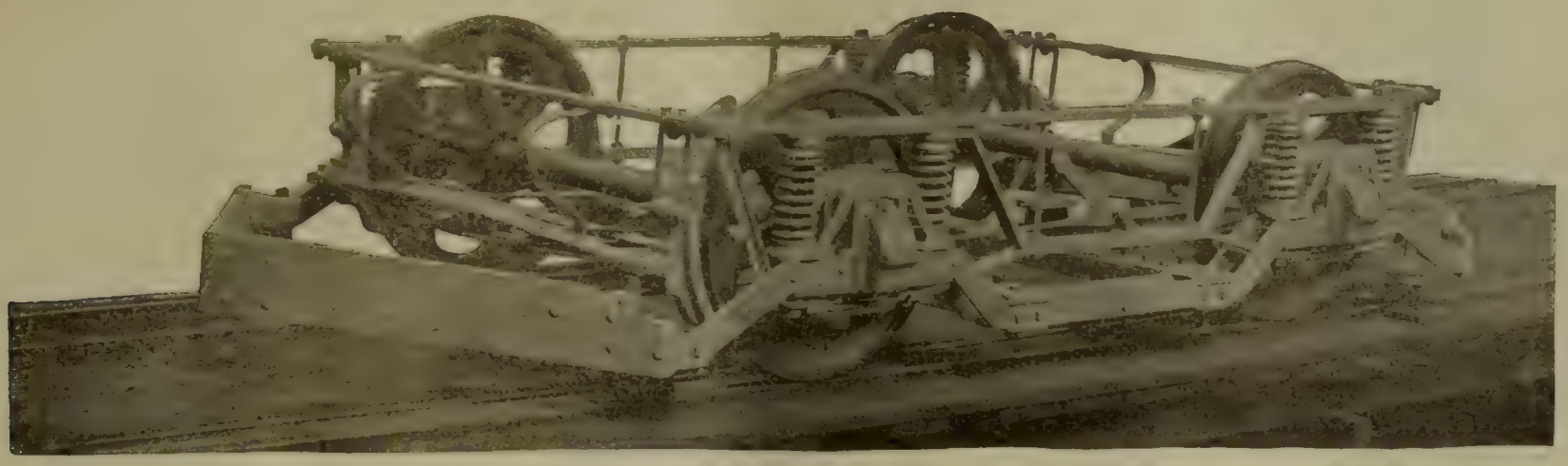
The J. G. Brill Co.'s exhibit at the Kansas City Convention of a handsome bronze model of their No. 6 independent rigid truck excited considerable interest among the electric railway men and made a very favorable impression. This truck, an illustration of which is given beneath, is designed to carry all of the propelling and operating machinery, such as electric motor and brakes, life guards, track-brooms, snow sweepers, sand boxes, etc., instead of attaching them to the car body. They are carried on the axle box frame which is supported on a cushion. By this arrangement they are not subject to the action of the car spring, hence their operation is positive, and at no time can vary their height from the track or from the axle.

Another leading feature in this truck is the ease with which the wheels and axles can be taken out and others replaced. The journal box is surrounded by what is termed an independent pedestal, to the bottom of which is fastened a small brace. By removing the brace and jacking up the car, then unloosing the brake rigging, the wheels and axles can be removed in a few minutes, effecting a great saving in time and labor, and without interfering with the other machinery of the truck. This improvement alone is greatly commended by railroad men everywhere.

It is made from standard templets, and all parts are interchangeable. The bolts are tapered and are well driven home, reducing the chance of loss and of rattling to a minimum. The upper cord of the truck is a solid wrought iron frame ¾ x 3, and gives greater stability to the truck. It also prevents the cars from spreading at the bottom frame, thus obviating the tendency to run off the track because of the lower frame of the car being out of square. This fault is a common one in old cars as is well known to railroad men.

The brake beams are made in two parts, truss-shape, with iron thimbles, making it impossible to spring or get out of shape. The brake shoes are of the Brill patent dove-tail type, and are simple in construction and easily removed, there being no nuts or bolts. The Brill equalizing brake is used and positively applies an equal pressure to the four shoes.

Altogether, the truck is without exception, one of the best in the market and every endeavor has been made to perfect it, making it as light as is consistent with strength. It is fitted with life guards and track brooms, and so arranged that it can be used on either open or closed cars.



BRILL'S INDEPENDENT RIGID TRUCK.

ELECTRIC LIGHT RIVALRY.—Two electric light companies are fighting for possession of Burlington, Ia., streets. One that has been running for some three years is trying to enjoin another which has just started up.

ELECTRIC LIGHTING IN JAPAN.—The Westinghouse Electric Light Company of Pittsburg, has just closed a contract for lighting a Japanese town with electricity.

PHILADELPHIA LETTER.

Messrs. James W Queen & Co. have received a large and flattering order from the Schaefer Electric Manufacturing Company of Boston, principally for Queen's standard resistance boxes, of which they make a specialty, and which range from 1.000001 ohm to 111 megohms, and are guaranteed to within $^1/_{50}$ of 1%. The order also included a number of Carpentier galvanometers, resistance coils, etc.

Bills have been introduced in the New Jersey Legislature providing for the placing of all electric light, telephone and telegraph wires underground within a specified time, and for the creation of a State Board of Electrical Control, which is to consist of four members.

An application will be made to the Governor of Pennsylvania on Thursday, March 13, by Albert G Hetherington, Stephen de Kosenko, Guy S. Hetherington, Charles A. Converse and Albert W. Campbell, for a charter of a corporation to be known as the de Kosenko and Hetherington Manufacturing Company, the object of which is manufacturing and selling of electroliers, gas fixtures and metal work. This is the present firm of de Kosenko and Hetherington, whose increasing business has necessitated the incorporation of the concern.

A special telegram from Williamsport, Pa., says: A representative of the Thomson-Houston Electric Company has been in Williamsport the past few days, and has recommended to his company the establishment of one of their plants here. There are now two other systems here—the Edison and Westinghouse—and if the Thomson-Houston people enter the field the competition promises to be very lively.

—ELECTRO.

THE PULLMAN CAR COMPANY.—The Pullman Palace Car Company report a brisk business in their street car department and orders are coming in very rapidly. They are now building electrical equipment as follows: Closed electrical equipment (Thomson-Houston system) for the Douglas County Street Railway Co., West Superior, Wis.; open motor cars (Sprague system) for the Metropolitan Railway Company, Portland, Oregon; open and closed motors (Sprague system) for the El Paso Street Railway Company, Colorado Springs, Colorado; closed car bodies (Thomson-Houston system) for the Green Lake Electric Railway Company, Seattle, Washington; closed motor cars (Sprague equipment) for the Capital City Railway Company at Salem, Oregon; closed motor cars (Thomson-Houston system) for the Joliet City Railway Company.

UNDERGROUND ELECTRIC MOTORS.—It is said that several inventors are trying to perfect a new street car motor to run in a conduit somewhat similar to that used for cables. Each motor is to be connected to a train of cars by means of a rigid coupling, which will run in a slot, just as the grip of a cable car does.

NEW PUBLICATIONS.

"Electric Light Installations and the Management of Accumulators," is the title of a book just brought out by D. Van Nostrand Company. The author is Sir David Solomons, Bart., M. A., who is a well-known writer on such subjects The book presents to the reader a general survey of the practice of electric lighting and the management of accumulators as are likely to assist in obtaining successful results. This is a very timely volume, as there is a great want for literature on these subjects. The book opens with a description of cells and their mode of employment, charging, discharging and failures, with directions for their proper management.

The second part of the book is devoted to installation work and practice, and describes engines, dynamos and electric motors in a comprehensive manner. All subjects are liberally illustrated, and the size of the book is very convenient.

The table of estimates at the back will be found valuable to those contemplating introducing electric lights, and taking it altogether the book will be found to be a most valuable acquisition to the literature of electricity. It is written in plain language, and is totally devoid of intricate problems. Hence, the student will find it as valuable and interesting as will the expert. The plain statement of facts is what all want, and in this work we find an abundance of such.

The book has 334 pages, and the price is very reasonable for so valuable a work, viz., $1.50.

THE BOSTON ELECTRIC CLUB.—We are in receipt of the Bulletin of the Boston Electric Club. It provides many interesting events up to and including May 19th. On Monday, March 3rd, the regular meeting of the club will be held; Monday, March 10th, club dinner, address to be announced; Monday, March 24th, paper by Mr. W. J. Denver, on "Induction and Interference with Telephone Service from Electric Light and Power Circuit, from a Telephonic View"; Monday, April 7th, regular club meeting; Monday, April 14th, club dinner, address to be announced; Monday, April 28th, paper by Mr. Geo. W. Mansfield, "Single and Double Trolleys for Electric Railroads"; Monday, May 5th, regular club meeting; Monday May 19th, dinner, at which Mr. S E. Barton will read a paper on "The relations between Fire Insurance and Electric Interests from the Underwriters' Standpoint."

Mr. H. D. Hall, who was prominently identified with the Empire City Electrical Company of this city, died on Monday, February 17th, of pleuro-pneumonia, resulting from an attack of influenza. He was buried in Woodlawn cemetery on the 19th. Mr. Hall was 39 years of age, and was well-known through his connection with the company that controls the system of train telegraphy.

LONG'S ELECTRIC SEMAPHORE SIGNAL.

In the operation of railroads it is frequently necessary to have signals placed at considerable distances from the person operating the signals and to successfully operate such distant signals with certainty has been found exceedingly difficult; especially if they were semaphore arm signals now justly regarded as the only proper sort of fixed signal for railroad purposes as its meaning or language is understood from its position and not from a difference in form. It seems at first a very simple affair to fix a light cable or wire connection from a semaphore signal to a hand lever and arrange to pull the semaphore to one position, using a weight to return the signal to another position, or using two wires, but it is found that wires shorten by cold and lengthen by heat, also by stretching, requiring compensating, adjusting and other devices to be employed, even for moderate distances, and that breakage of the wire is quite frequent.

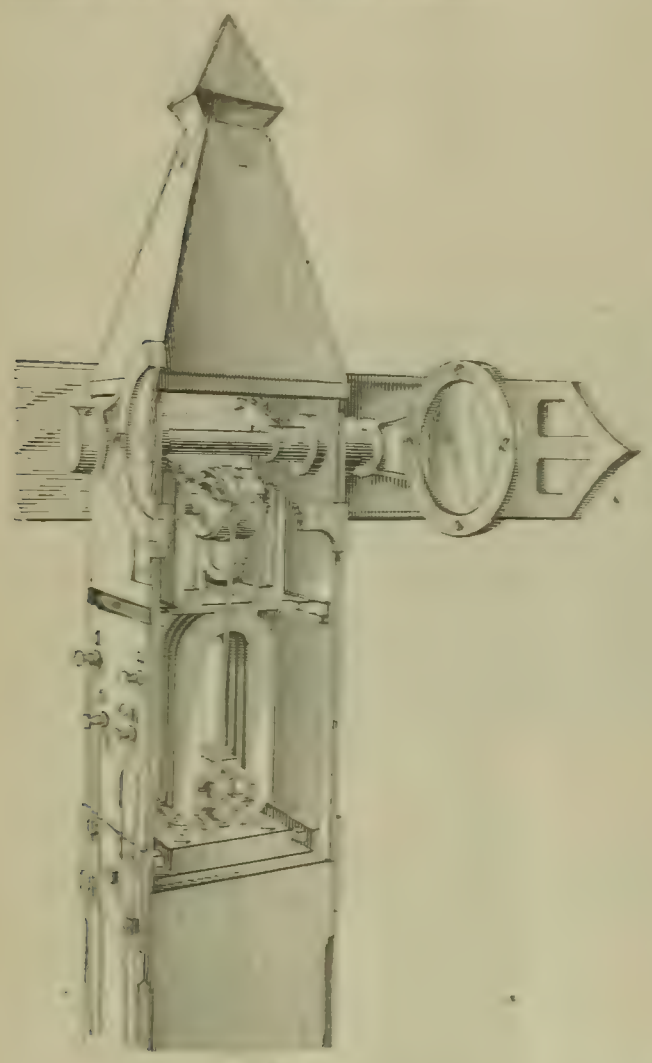


FIG. 1.

The difficulties multiply greatly when it is attempted to operate semaphores at considerable distances, or around curves, and it is often found necessary to fix a signal to be worked this way, far short of the place where it should be fixed for the proper government of trains, thus compelling the persons in charge of the trains to read the signal while at such distances from it that with adverse conditions, such as storms, fogs, etc., it becomes impossible to distinguish the "language" of the signal at the proper time.

Prior to the production of Long's patent electric semaphore signal it became necessary for the proper handling of trains to operate a semaphore signal at a distance of even three-quarters of a mile, which involved simply another telegraph office with its quota of expense to be added to the operating expenses of the railroad.

With Long's patent electric semaphore, by a new application of electricity, it becomes practicable to operate semaphore signals with certainty and precision, and with full knowledge as to their positions, at any distance required in the operation of a railroad and in any situation that can be reached by wire circuits.

This improvement consists of an electric motor geared to a semaphore arm (Fig. 1) to move it positively to its different signaling positions and provided with an automatic electric switch which stops the action of the motor when the semaphore arm has reached the desired position; these parts being connected by wire circuits leading to the controlling station, to a manual magneto electric generator (Fig. 2), a suitable manual electric switch (Fig. 3) to change the course of the electric currents according to the position into which the semaphore is to be moved, and to indicators, visual or audible, which automatically indicate the position which the semaphore has actually assumed.

That part of the actual labor of moving the semaphore arm required to be performed by one vibration of the electro-magnet is so very small,

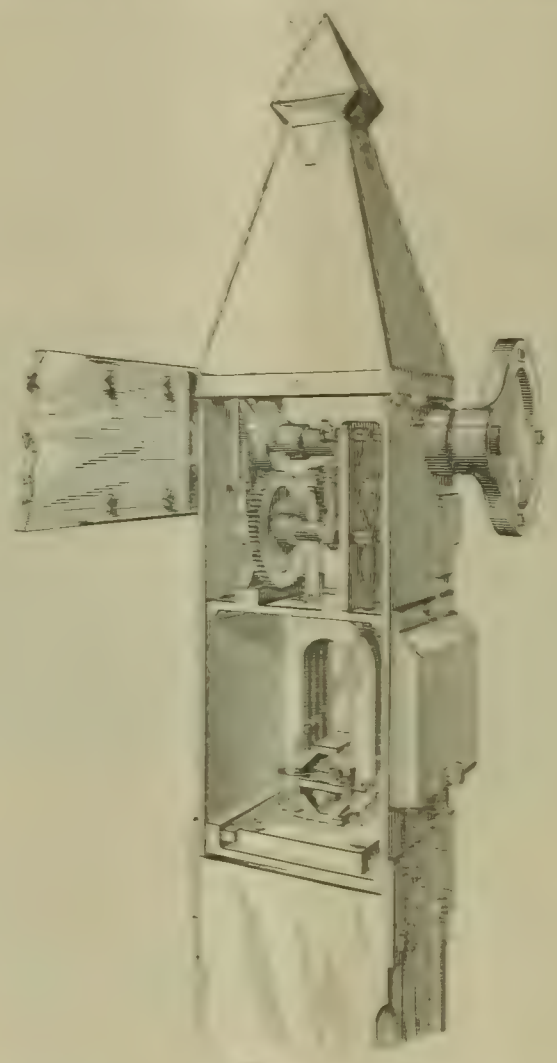


FIG. 2.

owing to the number of vibrations taken for a movement of the semaphore that there is no probability of any conditions sufficiently adverse to prevent the movement of the semaphore so long as the circuits are in act; and the operator cannot in any event be deceived as to the position of the semaphore.

The circuits between the semaphores and the electric generator, electric switch and indicators, in the office, consist of three wires, ordinary telegraph circuits carried on telegraph poles, with one ground wire at each semaphore and one at the office.

The number of electric semaphore signals which can be operated from one office with one electric generator is only limited by the form of manual electric switch. These are supplied for almost any required number.

The semaphore shaft is provided (as seen in Fig. 1) with a crank arm, pivoting vertically, and connected by a link to a revolving driving crank, on the shaft of a gear wheel which is driven by a small pinion, always in one direction only. When the revolving crank is on the "upper dead center," the semaphore is rigidly held in the "Danger" position, and the semaphore is held in the "Safety" position when the crank is on the "lower dead center."

In either of its two positions, the semaphore is so held against being moved except by working the motor apparatus.

The pinion that drives the gear wheel and revolving crank is rotated always in the same direction, by an electric motor, until the semaphore has been brought to the desired position, when a rotating electric switch, moved by the gear wheel shaft, automatically opens the circuit by which electricity reached the electric motor so that the semaphore arm will not be carried beyond the desired position, until the electric motor is reached by electricity over another circuit.

The electric motor consists of a vibrating electro magnet working between the pole-

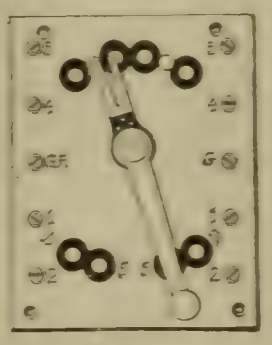


FIG. 3.

pieces of permanent steel magnets with which a limited vibration brings them into magnetic contact. As the electro magnet is charged by currents of alternate polarity, its poles become alternately attractive and repellant to the pole pieces of the permanent magnets, resulting in rapid and powerful vibrations of the electro-magnet, each vibration being similar to the action of a polarized relay. On the axis of the vibrating electro-magnet a cross arm is connected by light rods to the outer cases or shells of a pair of silent clutches or ball ratchets on the same shaft with the driving pinion of the motor apparatus. The hubs of the clutches, which are fixed on the shaft, have inclined recesses for the rollers or balls (see broken out part in Fig. 2) so that when the shells which are loose on the shaft are moved by the upward movement of the rods the rollers move outward without moving the hub, but when the rods move downward the rollers move outward and

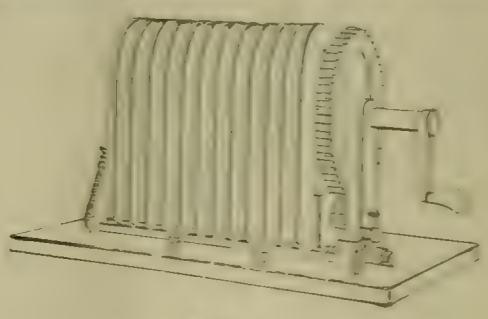


FIG. 4.

cause motion to be imparted to the hubs and the driving pinion.

Thus the vibrations of the electro magnet effect movement of the crank by which the semaphore arm is handled, and when the motor has given the crank a half revolution, say to the upper center as in Fig. 2, the semaphore will be locked securely in the "Danger" position, and the next half revolution of the crank to the lower center will return the semaphore to the "Safety" position.

Interlocking of semaphores, to prevent conflicting signals, may be effected by attachments to indicators whereby their action will open or close circuits to semaphores, and control the several semaphores of a system to be worked in the proper order.

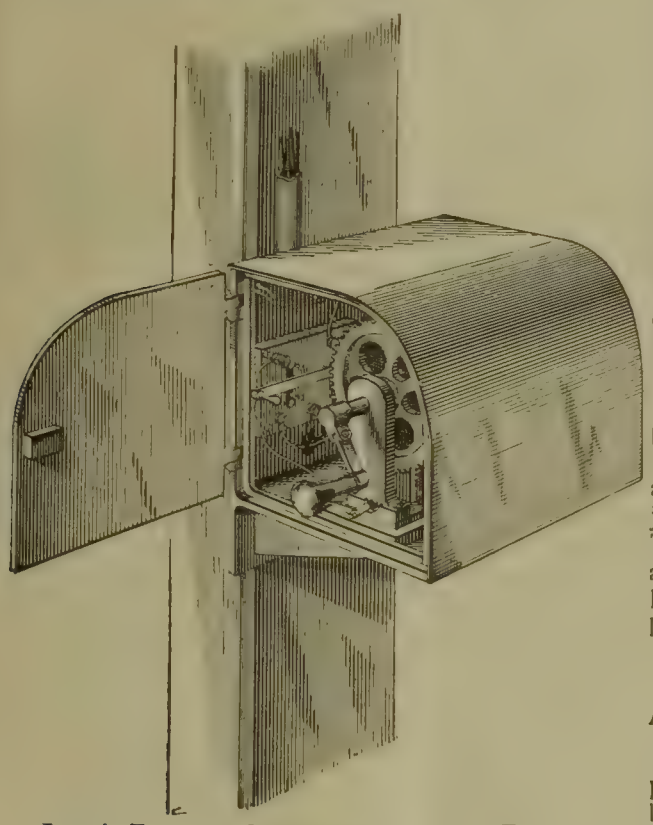
For outdoor use, generators are mounted in substantial iron cases which may be secured to

the outside of a building or on a post. When not in use handle will be folded inwards and case securely locked.

In this arrangement the indicator will be a bell, combined with a manual electric switch, all inside the case, the circuits being so connected that while the semaphore is being worked the bell will sound, and cease only upon the semaphore having taken the desired position, the indicator being for two semaphores or one, as may be required.

Distant Signals for Stations.—For this service the electric semaphore signal is of great value; having the semaphores placed at a distance of one half mile to one mile from the station, or such a distance that after any train has passed the signal, approaching the station, there will be sufficient time for the train to be brought under control and stopped as circumstances may require to avoid accident.

At junction stations, etc., it is sometimes desirable to have a number of signals operated from one office, in order to control the movement of trains on the several tracks With electric semaphores, at distances from the station that the circumstances require, the persons



Long's Electric Semaphore Signal.—Fig. 5.

on the trains may be accurately informed whether a train perhaps already late may run to the station at good speed, or should approach with caution. By the interlocking devices, which can be provided for such cases, confliction of signals will be avoided, and trains moving in accordance with signals will avoid danger of colliding.

The connections between the semaphore signal and magneto-electric generator, etc., in the controlling office, being simply ordinary telegraph wire circuits attached to binding screws duly numbered and lettered, linemen unacquainted with the working of the signal can readily place the apparatus and make it ready to be operated by telegraph operators, station agents, despatchers and others from their offices. By use of the electric semaphore signal the disfigurement of buildings, tearing up of platforms, etc., often necessary to arrange the cable or wire connections to mechanically operated station or distant signals can be avoided, also the liability of such connections being obstructed in their out of-the-way locations.

City Telephones to be Replaced.—The Chicago City Council has adopted a resolution instructing the mayor and controller to direct the Chicago Telephone company to replace the instruments removed from the police stations and public offices a short time ago.

GOOD CAR RECORDS.

When electric railways were first introduced, it used to be commonly said among street railway men that the motors were not built sufficiently durable and strong for the necessities of street car service. Such charges might have been true at that time, but they are certainly not applicable at the present day. The durability of the electric street railway motor, as exemplified by the productions of the leading supply companies of to-day, is probably as high if not higher than that of any other machine exposed to the same kind of service.

We are in receipt of some quite interesting statistics from Erie, Pa., in regard to the operation of electric cars upon the line of the Erie Electric Motor Company in that city, which illustrates this in a striking manner. One motor car on this line has run 19,300 miles without requiring any repairs of any kind. A second car, equipped with only a single motor, has run 15,000 miles without repairs being required, and other cars have records very nearly as large. When the arduous work required of these street railway motors is taken into consideration, this is truly a remarkable record, and one which is most gratifying to all interested in electric traction. The Erie Electric Railway has been in operation for a number of months, on the Sprague Electric System, and is said to be giving great satisfaction to the managers of the road, and to the general public. The equipment of the road is complete in every respect. At the station the power plant includes two 150 H. P. Ball engines, each engine being belted directly to two 50,000 Watt railway dynamos which furnish the current to the line.

The motor car equipment consists of fifteen electric cars, equipped with the Sprague improved motors and all the largest attachments and devices used by the Sprague Company upon its cars.

When the installation of this electric line was proposed, there was considerable opposition from property owners along the route who were not acquainted with electric railway systems, and objected to the installation of an unusual power. The road has become very popular, however, on account of the rapid transit facilities afforded, and has carried large numbers of passengers since it has been in operation.

AN ELECTRIC MOTOR IN A THEATRE.

An interesting and novel application of electric power has recently been made in New York City by the local agent of the Sprague Electric Ry. & Motor Company. In one of the theatres a spectacular play is being presented in which one of the features consist of a horse race on the stage. In order to keep the horses constantly in view of the audience, the platform upon which the horses race is endless, and kept constantly moving over a pair of rollers at each end of the stage. When the question of motor power for this movable stage was suggested, a Sprague Electric Stationary Motor was selected for the work. This is belted to a system of counter shafting which reduces the speed to that required by the rollers over which the movable platform revolves.

This is rather a novel application of electric power, but it is simply an example of the extensive and varied use to which Sprague electric motors are now being applied. When the manufacturers of this motor made the statement a year or so ago that their motors were used in more than one hundred and thirty industries, the statement seemed almost incredible, but the convenience of the electric motor and its wide range of adaptability to all classes of work, have made it almost a necessity in places where no other motor could be used.

We have no doubt but that the number of different industries to which Sprague motors have been applied, is now very largely in excess, probably double, what was claimed a year ago.

Cohoes and Waterford, N. Y., are connected by an electric road.

PUBLICATIONS RECEIVED.

A copy of the last issue of the *Revista Telegrafica de Mexico* has reached us. This is an electrical paper published in the City of Mexico, by F. A. Soni, who is editor and publisher. It is the only electrical paper in Mexico and has a large circulation in Central and South America. The existence of such a paper in Mexico is ample evidence of the growth of interest in electrical matters in that country. The Mexicans are quite progressive in this matter, and want the best of everything in the electrical line. This paper affords an excellent opportunity for American manufacturers and dealers to advertise in that progressive country.

We are in receipt of a pamphlet just issued by Partrick & Carter, of Philadelphia, giving many testimonials as to the excellence of their new covered cell of the Disque Leclanche type. Every one speaks highly of the performance of these cells.

Electric Lighting in Massachusetts. — The fifth annual report of the Board of Gas and Electric Light Commissioners of Massachusetts shows that there are in the State 75 gas companies, of which 26 have the right to supply both gas and electricity, and no fewer than 100 electric light and power companies. The number of public gas lamps continues to diminish, electric lights taking their places. The coal gas companies lost 999 lights. The year was an active one for those engaged in the electric lighting business. There were 44 new electric light and power companies and 4 new companies for the manufacture of gas and electric light incorporated.

Extending the Edison Light Territory.—The Edison Illuminating Company of New York have decided to begin without delay the construction of a new 100,000 light station, somewhere in the neighborhood of the City Hall, to supply the entire down-town district, and to push at once the construction of the Fifty-third street Station for 50,000 lights.

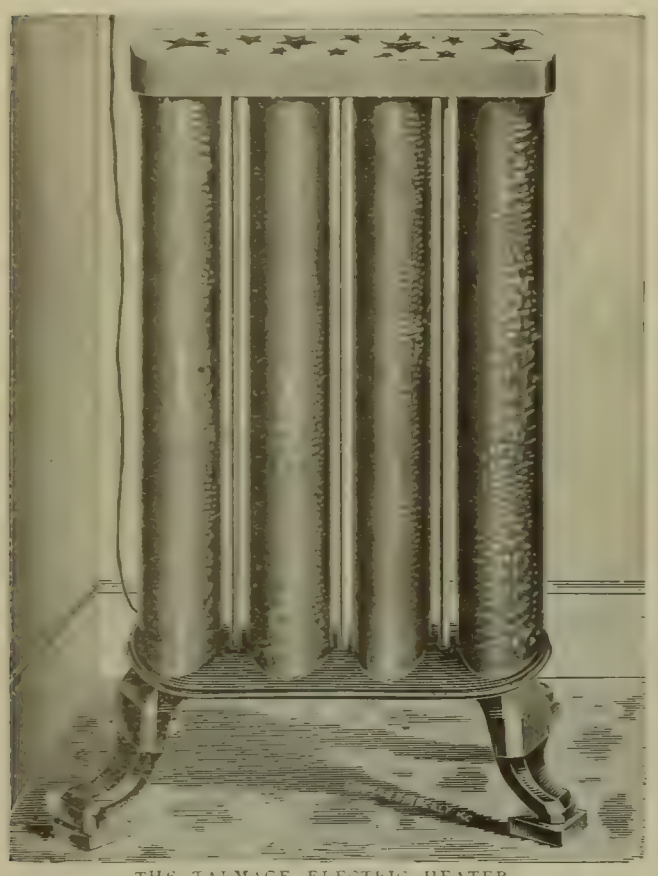
Electro Deposition of Iron.—Messrs. Barthe and Möller, of Hamburg, give the following recipe for the electro deposition of iron: Six hundred grams of ferrous sulphate ($FeSO_4$) are dissolved in five litres of water; to this is added a solution of 2,400 grams of carbonate of soda (Na_2CO_3) in five litres of water. The resulting precipitate of ferrous carbonate, $FeCO_3$, is then re-dissolved by the addition in small quantities of strong sulphuric acid, until the precipitate is just dissolved. when the fluid will show a green color; it is then diluted to twenty litres by adding water. The solution must be faintly acid, turning blue litmus paper deep claret color, but not red. An iron anode is used.

Testing the Power of an Electric Motor.—A test of strength of the electric motors in use on the West End electric car line in Boston was recently made. Three ordinary passenger cars were coupled to a motor, two of them being loaded heavily with a miscellaneous lot of articles of a weighty nature. The weight of each car was about 10,000 pounds. After the tracks were well sanded, the train was started, and the motor ascended the heavy grades on the line with great ease. The trial was a complete success.

Electric Tramway in France.—An electric ramway has just been opened beween Clermont Ferrand and Royat, two well-known holiday resorts, about seven kilometres apart. The installation consists of Farcot steam engine of 150 horse-power and a six-pole Thury dynamo of 300 volts and 350 ampères. A small 24 horse power steam engine and dynamo is used to excite the larger dynamo and to supply the station with electric light. The current is supplied to the motors on the cars by means of an overhead wire, and the return current passes along the rail. The speed of the cars is twelve kilometres per hour.

THE TALMAGE ELECTRIC HEATER.

The illustration given below shows the electric heater invented by Mr. C. W. Talmage, which was exhibited at the Kansas City Convention and which was fully described in our last issue. It is very ornamental in appearance, and marks a great step toward the ideal system of heating.



THE TALMAGE ELECTRIC HEATER.

ELECTRIC ROADS IN SALT LAKE CITY.—The Salt Lake City Railway Company have built 11 miles of Sprague electric railway through some of the principal streets of Salt Lake City, and have about six miles of extensions under course of construction. They have 15 Stephenson 16-foot cars equipped with Sprague motors, and five additional cars ready for placing on the road at any time. Thirteen of the above cars are equipped with single motors type No. 6, and seven are double motor cars of the same class. Their station equipment consists of a compound tandem Fraser & Chalmers Corliss engine, 240 horse power, and two No. 32 Standard Edison railway dynamos, 80,000 watts' capacity each. The railway has given such thorough satisfaction from the first that it is probable Salt Lake City will have 30 miles of road and 40 to 50 electric cars in operation at the close of the coming summer.

LIGHTING THE BRITISH MUSEUM.—The new lighting plant of the British Museum, which has been adopted after years of obstinate opposition by the old fogy conservatives, comprises 126 arc lamps and 627 incandescent lamps. Four of Siemen's dynamos, each capable of generating 450 ampères at 130 volts pressure, are used, their combined working power being more than 200,000 watts, of which, however, only 150,000 watts are required to do the work.

FIRE ALARM WIRES UNDERGROUND.—The Chicago fire alarm wires have been placed in the conduits under several streets in the city, and the fire alarm superintendent says he wishes there were conduits all over the city so he could put all of the department wires underground. He says the service is improved, and the cost of maintenance is greatly reduced.

Mr. M. Dixon, a well-known New York telegrapher, has been given a testimonial benefit, which will take place in New York on April 16, at the New Central Opera House, 215 East 67th Street. "East Lynne" will be produced by prominent telegraphers composing the cast.

MR. EDISON'S LATEST INVENTION.—It is said that for many months past Mr. Edison has been at work on a series of experiments in instantaneous photography which have been at last successfully concluded. The point desired was to devise a mechanical camera so arranged that instantaneous photographs, with an exposure of from the 250th to the 1,000th of a second, could be taken in a series following one another at the rate of from eight to twenty per second. It was found that the slight imperceptible tremor of the buildings caused by the vibration of the machinery was sufficient to interfere materially with the experiments, and hence it became necessary to erect a special building in which to conduct the experiments. This was done, and a solid pier was built on rock foundation, on which the camera was placed. The experiments were then begun, and were at last crowned with complete success. The idea Mr. Edison had in mind was to take a public speaker and photograph him successfully eight or twelve times a second throughout his entire speech, the subject matter being at the same time recorded by the phonograph. By an ingenious constructed mechanism the reproduction of the audible speech by the phonograph and the personal appearance, gesticulations and facial changes as thrown on a screen by the stereopticon are so exactly timed as to be synchronous. The photographic pictures following one another at the rate of eight to twenty a second produce a constantly moving picture, exactly simulating the appearance of the speaker, while the speech as reproduced by the phonographs will apparently come from the lips of the orator. The experiments were perfectly successful and are now concluded, the next stage being the development of the commercial side of the invention and the creation for a demand for the new process.

A COMMISSION WITHOUT AUTHORITY.—The Electrical Commission of Cleveland, Ohio, recently had an opportunity to test its own authority. The arrest of certain parties for disregard of the commission's orders was desired, and the police authorities were applied to to make the arrests. Their request was refused on the ground that there was no authority vested in the commission which would enable them to enforce their orders. The commission was appointed by the local board of improvements and certain powers were delegated to it. It never had any legal existence, but steps are now to be taken to reorganize in proper form.

THE FIRST ELECTRIC STREET RAILWAY.—The first electric street railway put into commercial operation in the United States was opened in Appleton, Wis., in July, 1886. Canada, however, antedates us in the first road of this class. Windsor, Ont., has the honor of being the first place on the American continent to operate an electric railroad. It was opened in May, 1886, and the Van Depoele overhead wire system was used.

BOSTON'S RAPID TRANSIT.—Boston wants rapid transit, and yet an ordinance has just been passed by the City Council prohibiting any street railway company from running their cars at a speed greater than seven miles per hour. This is aimed at the electric roads.

THE LIGHTING OF THE BRITISH MUSEUM.—A private view of the lighting of the galleries of the British Museum took place recently. A large number of visitors responded to the invitation, and from every point of view the preliminary trial was a great success.

ELECTRICAL RAILWAY SPEED.—The fastest time made by an electrical railway is, according to the *Age of Steel*, a mile a minute by a small experimental car. On a street railway system 20 miles an hour is the fastest.

ELECTRICITY TRIUMPHS.—A meeting was held in Pittsburg, Pa., a few days ago to protest against the use of electricity on the P. A. & M. Line in that city. A lively discussion ensued between those opposed to the electric motor and those in favor thereof, and the result was the almost unanimous adoption of a resolution giving the company the right to use any power employed by any other company in that city.

ELECTRIC LIGHT AND RAILWAY SECURITIES.—There is a class of investments which the public knows comparatively little about. Electric light and railway companies' bonds are among the most secure and profitable bonds on the market. They are always first mortgage, and bear six per cent. interest; are well secured and generally run for twenty or thirty years. In the case of nearly every company offering such bonds, it will be found upon investigation of the actual figures, that it earns on an average, ten to twenty per cent. per annum, which amply provides for the interest on the bonds, and leaves a good surplus for sinking fund and stock dividends. There are many considerations which make this class of bonds preferable to steam railroad bonds; and in this age of electrical advancement, they are certainly more desirable than gas bonds.

ELECTION OF OFFICERS.—At the meeting of the board of directors of the Metropolitan Telephone and Telegraph Company, of this city, held on the Feb. 12th the resignation of Mr. Theodore N. Vail as president of the company was received and accepted. Mr. Charles F. Cutler was elected to fill the vacancy. Mr. Wm. R. Driver was elected treasurer of the company to fill the vacancy caused by the death of the late Mr. Amzi S. Dodd. Mr. Joseph Kavanaugh, who has long been identified with the company, was elected to the position of assistant treasurer, and will have active control of the finances of the company. Mr. W. H. Wolverton was elected director of the company, in place of Mr. Dodd, deceased.

It is understood that Mr. Vail intends to devote himself to his many and varied other large interests, chief among which will be the matter of underground work in this city, with which he has long been identified, and where his great energy will find a field of a magnitude worthy of his best efforts.

ELECTRIC ROAD STOPPED BY AN INJUNCTION.—The injunction obtained by the Chicago & Alton Railway against the Electric Street Railway Company at Joliet, Ill., and the Thompson-Houston Company, has been made perpetual, and operation of the road is thereby prevented.

MUNICIPAL ELECTRIC LIGHTING.—It is proposed to transform the West Side pumping works, at Minneapolis, into an electric light plant, and thus shut out the old companies from street lighting. It is thought the city could save $50,000 to $70,000 per year by this transaction.

TRANSMITTING POWER A LONG DISTANCE.—The current to be used in lighting the streets of Portland, Ore., will be generated twelve miles away. This is thought to be the longest distance over which the transmission of electrical power has been attempted in this country. The current is to have an electro-motive force of 4,000 volts.

INJUNCTION DENIED.—Judge Bundy, at Eau Claire, Wis., has refused to grant an injunction restraining the Eau Claire Street Railway Company from operating its line because they interfered somewhat with the telephone company's wires.

The Concord, N. H., Horse Railway Company have asked permission of the city council to erect the single trolley system.

ELECTRICAL PATENTS ISSUED FEBRUARY 18TH, 1890.

421,394. Railway-Telegraph. James S. Foley, Toronto, Ontario, Canada, assignor of one-half to Joseph Ruse, same place.

421,398. Conduit for Electric Railways. Patrick H. Griffin, Buffalo, N. Y,

421,439. Annunciator. Thomas H. Shipway and James R. Dowdell, Toronto, Ontario, Canada.

421,449. Electro-Magnetic Valve-Controller. John V. Stout, Easton, Pa.

421,450. Graphophone-Tablet. Charles S. Tainter, Washington, D. C.

421,457. Electric Belt. Merian Wadleigh, Kansas City, Mo., assignor to Clarence S. Gilbert, same place.

421,464. Electric Railway Car. Herbert C. Wirt, Boston, Mass

421,469. Arc-Light Carbon. Walter E. Adeney and Llewellyn Saunderson, Kingstown, County of Dublin, Ireland.

421,479. Dynamo-Electric Machine. De Witt B. Brace, Lincoln, Neb.

421,484. Camera and Electrical Flash-Light Attachment. George E. Davis, Dubuque, Iowa.

421,498. Apparatus for Heating Water and Generating Steam by Electricity. John C. Hubinger, Keokuk, Iowa.

421,499. Art of Heating Water and Generating Steam by Electricity. John C. Hubinger, Keokuk, Iowa.

421,508. Electrical Annunciator. Albert F. Parks, Troy, assignor to Charles E. Lee, Rochester, N. Y.

421,530. Time-Alarm. George H. Straight, Kingston, R. I.

421,535. Switch for Systems of Electric Locomotion. Frank Wheeler, Meriden, Conn.

421,567. Electric Lock. Wm. Grah, Jr., Toledo, Ohio.

421,586. Incandescent Lamp Socket. Wm. P. Kookogey, Brooklyn, assignor to the Kookogey Electric Company, New York.

421,630. Electric Lamp Adapter. James Stewart, New York, N. Y., assignor of one-half to Edmund C. Stanton, same place.

421,636. Telephone Switch. Erastus C. Titus, Catskill, N. Y., assignor of one half to Harry M. C. Vedder, same place.

421,654. Machine for Turning Telegraph Pins. Wm. W. McNeal, Stockton, N. J.

421,666. Electrode for Secondary Batteries. Hiram H. Carpenter, New York, N. Y.

421,677. Support for Trolley Wires. John H. Cunningham, Chelsea, Mass.

421,733. Carbon for Arc Lamps. Edward L. Liedke, Sandusky, Ohio, assignor of one-half to Frank K. McCormick, same place.

421,781. Electric Conductor. John A. Stoughton, East Hartford, Conn.

421,790. Electric Motor. Philip B. Walsh, Philadelphia, Pa., assignor to Chas. M. Rhodes, same place.

421,791. Electric Railway Signal. Willie C. Walter, Richmond, Va., assignor of one-half to George B. McAdams, same place.

421,800. Mouth-Piece for Telephones. Ruel W. Whitney and Byron K. Cowles, San Francisco, Cal.

421,801. Electric Battery. Charles Willms and Gustav A. Liebig, Jr., Baltimore, Md., assignors to the John A. Barrett Battery Company, same place.

421,802. Flexible Electric Connection. John F. Wollensak, Chicago, Ill.

421,819. Insulator. John W. Davy, Pittsburg, Pa.

421,851. Electrical Indicator. Leo Bock, Jr., New York, N. Y., assignor of one-half to Charles L. Wright, same place.

421,852. Thermostat. George F. Bulen, Tompkinsville, N. Y.

421,853. Automatic Fire-Alarm System. George F. Bulen, Tompkinsville, N. Y.

421,854. Automatic Fire-Alarm Transmitter. George F. Bulen, Tompkinsville, N. Y.

421,864. Hanging Device for Electric Lamps. William H. Layng, New York, N. Y., assignor to S. Samuel Miller, Paul J. Chassagne, and Wm. R. Palmer, Akron, Ohio.

421,882. Visual Annunciator for Call-Boxes. Paul Seiler, San Francisco, Cal.

THE STUHL ELECTRICAL ALARM THERMOMETER.—The action of most electrical alarm thermometers consists in causing the expansion of the mercury to complete the alarm circuit by coming in contact with a platinum wire connected across the tube of the instrument at the required height. The disadvantage of these thermometers is that they can only be used to indicate one temperature, and the following arrangement has been devised by M. Stuhl to overcome this defect: Below the thermometer scale, but above the bulb, he places a glass ball which only offers a capillary passage to the expanding mercury; one end of the alarm circuit is permanently in contact with mercury in the bulb, the other end of the circuit terminates immediately underneath the glass ball. To set the thermometer it is only necessary to heat it to the required temperature, and then allow it to cool. A portion of the mercury has by this operation been forced past the obstacle, and remains there; the rest of the mercury on cooling sinks into the bulb. Whenever the mercury again expands and touches the platinum contact under the glass ball, a battery and bell in the alarm circuit results in the ringing of an alarm. If it is required to make the alarm ring at a higher temperature, the mercury has only to be heated to that degree. If an alarm is wanted at a low temperature the mercury above the ball must be made to fall into the bulb by giving the thermometer a sharp twisting motion.

ELECTRIC CURRENTS IN THE SKIN.—An interesting study has been lately made by Herr Tarchenoff of electric currents in the skin from mental excitation. Unpolarisable clay electrodes, connected with a delicate galvanometer, were applied to various parts—hands, fingers, feet, toes, nose, ear and back; and after compensation of any currents which occurred during rest, the effects of mental stimulation were noted. Light tickling with a brush causes, after a few seconds' period of latency, a gradually increasing strong deflection. Hot water has a like effect; cold, or the pain from a needle-prick, a less. Sound, light, taste and smell, stimuli act similarly. If the eyes have been closed some time, mere opening of them causes a considerable deflection from the skin of the hand. It is remarkable that these skin-currents also arise when the sensations are merely imagined. Mental effort produces currents varying with its amount. If a person is in tense expectation, the galvanometer mirror makes irregular oscillations. In all the experiments it appeared that, with equal nerve excitation, the strength of the skin currents depended on the degree to which the part of the skin bearing the electrodes was furnished with sweat-glands.

CENSUS COMPUTATIONS BY ELECTRICITY.—Among the vast quantity of printed blanks required for the taking of the next census, 100,000,000 blank cards will be necessary for the use of the electrical tabulating machine. By the use of this machine it is thought that a saving of three-fourths of the expense of computing the returns received from the supervisors and enumerators will be saved.

ELECTRIC LIGHT STATIONS.—Whipple's electrical report for January shows that the total number of central electric light stations in the United States is 1265. The total number of gas companies is 981, and of these 237 operate electric light plants in conjunction with their gas business.

TINTING INCANDESCENT LAMP BULBS.—The following recipe is due to Mr. Arthur S. Huey, of Minneapolis: Prepare the glass by thoroughly washing in soap and water and drying. Then dip in bath (made by beating up the whites of two eggs in one and a half pints of water and filtering) and hang up to dry. Dissolve the aniline color in photographer's common collodion. Red or blue aniline will form clear solutions, while the green solution will require filtering. Yellow aniline forms a handsome color, but the surface of the glass presents a frosted appearance after the application. Violet and purple colors may be obtained by combining red and blue in different quantities. When the solution is ready, dip the prepared glass bulbs therein, hang up to dry, and finally pass a current through the bulb for half an hour, that the heat thus generated may harden the coating of the collodion, or place in a current of air. The preparation can easily be removed with alcohol or sulphuric ether, but is not affected by water. Experience has shown that the best results are obtained by not using too much aniline. Make the color light rather than deep, and apply two or three coats.

ELECTRIC LIGHT EFFECTS.—Pyrotechnic effects in table decoration are rampant. Electric wires are run through the stems of tulips, white lilies and jonquils; a bunch of them planted in an epergne give the red, yellow, green and brown fruit the glow of enchantment, and when the white bright light streams from a plaque of nuts the sensation is rather more weird than poetic.

IS THE ELECTRIC LIGHT INJURIOUS TO SIGHT?—St. Louis has a physician who claims to have given much time and attention to the study of the effect of electric light on the eye, and he pronounces it injurous. His Chicago brethren pronounce him a crank, and flatly deny the statement.

THE VALUE OF THE OHM.—Recent experiments, according to Lippmann's method, give the value of the ohm as equal to the resistance of a column of mercury at 0° C., one square mm. cross section, and 106.27 centimetres long.

THE ELECTRIC LIGHT.—The Edison Electric Illuminating Company of New Orleans have added one 150 horse power engine and two Edison dynamos to their plant.

The Laredo (Tex.) Improvement Company are going to build one mile of line across the Rio Grande River into Mexico. This will be the first international electric motor railroad in America, and in the world.

The East End Electric Light Company, of Pittsburgh, Pa., have increased their plant with one 3000 light Westinghouse dynamo and one Westinghouse compound engine.

The Jamaica & Brooklyn Railroad Company have entirely reconstructed their road, and now operate eight Sprague motor cars.

The Western Light and Power Company of Chicago will add 1000 incandescent lamps to their plant during the year.

The Western Light and Power Company of Chicago have purchased the Lake View Electric Light Company.

The Edison Illuminating Company, of Newport, R. I., has absorbed all the other companies in that place.

Akron, Ohio, has now 12 miles of electric railway in operation. The Sprague system is used.

The Cedar Rapids Gas Light Company contemplate putting in an electric light plant during the spring.

The Cambridge, Mass., Electric Light Company have put in two 1300 light alternating dynamos.

IMPROVED TELEPHONE.

James Lowth of Chicago, Ill., has patented the "stetho" telephone, an invention which he believes will far surpass the present telephone system, without infringing upon its patents The new invention has been thoroughly tested in several conversations between Chicago and Milwaukee, over a common telegraph wire, with six other wires on the same poles, which were being operated by means of very heavy batteries. The absence of a diaphragm is one reason for its success on long lines. The operator places the receiver to the ear and the transmitting button against the side of the throat. Briefly described, the Lowth "stetho" telephone is a combined receiver and transmitter. It takes its name from the manner of using it. The instrument is said to have all the capabilities of the ordinary stethoscope, with the addition that it is able to transmit all voice sounds to a distance. The combined transmitter and receiver is 4½ inches long from the centre of the transmitting button to the centre of the earpiece. The transmitting button projects about two inches from the side of the instrument, and is in a convenient position to be placed against the side of the throat, when the earpiece is placed in its proper position against the ear. Holding the instrument with its transmitting button pressed lightly against the throat, the actual movements taking place in and about the larynx are conveyed by the button to the electrical parts of the instrument, and through them sent over the line to the distant receiver, in which the most perfectly formed words are reproduced. Mr Lowth distinguishes his system from those in which a transmitter diaphragm is used, by calling it "the solid medium system the agency through which the instrument is operated being positive and mechanical, and not atmospheric."

Electrical Monopolies in England. — Our esteemed contemporary, the London *Electrical Review*, in a leading article, appeals to the English electrical trade to take vigorous action with reference to monopolies in the English electrical industries. It says: "We groan under the great monopolies of the lamp and the telephone," and the time has come for definite action when an endeavor must be made to show where the monopoly is harmful. "We have great confidence in British enterprise," the article concludes, "but at the present day it must start level with its competitors, and when the goal is reached we shall not be far in the rear." The article characterizes the English policy with regard to lamps as short sighted. The price of the Edison lamp in England is 3s. 6d., while in America and on the Continent the same lamp costs from 1s. 8d. to 2s. The same policy is pursued with reference to fittings. The telephone monopoly begun about 8 years ago; previous to that there were numerous telephone factories established in England, but these were crushed out of existence by the United Company.

A Large Contract.—A large order has been awarded to the Thomson-Houston Company. It is for the complete equipment of 100 motor cars and 60 electric locomotives, for the St. Paul and Minneapolis street railway lines. Regular train work between the two cities will be established

COMPARATIVE COST OF ELECTRIC LIGHTING IN MUNICIPALITIES.

The rates charged by electric light companies for municipal lighting throughout the country have a great range, as will be seen by the following figures. Boston and Denver, Colorado, pay the highest prices, a fraction over 65 cents per light per night, and the lowest charge is 19 cents per night.

New Orleans has 934 arc lights of 2,000 candle-light power, 634 of which cost $125 per year; 262 suburban at $146, and 38 across the Mississippi at $205: the price per night in the city proper being about 34 cents. At Cleveland, Ohio, the lighting is done with 100 lights, eight of which, suspended from high masts, are of 4,000 candle power, and cost $394.80; the 92 others are of 2,000-candle power and cost $139.12 per year; the cost of the 2,000-candle power light being about 38 cents. Fort Wayne, Ind., is lit by 2,000-candle power lights at $135 per year, or about 36 cents each per night. Memphis has 100 arc lights of 2,000-candle power They cost $187.50 per year, or about 51 cents per lamp per night. Denver, Col., has 1,100 twenty-candle power incandescent lights at a cost of $26 a year. For its 2,000-candle power lights it pays $240, or about 65 cents each per night. St. Paul uses 54 arc lights at 35 cents a night; the lamps running until midnight only. Omaha for 100 arc lights pays $175 per year, or about 47 cents per light per night. Detroit uses 600 2,000 candle power lights at $140 a year, or about 38 cents each per night. Buffalo, with its 1,223 lights, pays the electric companies $155.61½ a year, or about 42 cents each per night. In Milwaukee 270 arc lights of 2,000-candle power are used, for cost of which it pays $150 a year, or about 41 cents per night. Quincy, Ill., pays $100 a year for 181 lamps of 2 000-candle power, the rate per lamp per night being about 27 cents. In St. Joseph there are 210 arc lights at $70 a year, or 19 cents per night. Pittsburgh employs 1,000 of 25-candle power incandescent at a cost of $16 per year, and 300 of 2,000 candle power, costing $105 per year, or about 28 cents each. Kansas City, Kan., uses 96 arc lights of 2,000 candle power and pays $144 for them, or about 39 cents each. St. Louis uses 1,600 2,000-candle power arc lights at $78 a year, or about 21 cents each per night, and 1,600 incandescent lights of 30-candle power, for 800 of which it pays $17.50, and for the remaining 800 $20.

An Electric Fire Kindler.—Every day electricity is put to a new use. It is gradually being made our most submissive servant in every department of life. It gives us light, power and heat. The latest use to which it has been put is in the capacity of a fire kindler. An electric connection from the bedroom lights the fire in the stove or range, so that the room may be warmed and the breakfast got under way without being obliged to leave the bed, and spoil the morning nap. Thus the most precious half hour of the whole day is saved.

Electic Tramways in Liverpool.—Arrangements are being made for experiments with the view of the introduction of electric cars on the tramcar system in Liverpool. A member of the company said that the time was not far distant when the company would be in possession of an electric engine, which would be tried on its merits.

Philadelphia to have an Electric Club.—Philadelphia's reputation as a slow-going place is again emphasized by the growing sentiment in favor of the establishment of an electric club in that city. Electrical interests have awakened to an appreciation of the fact that such an organization might be of benefit to the trade, and now it looks as if an electric club might be the outcome. Philadelphia is rather late. Many of the principal cities have an electric club, and much benefit is derived by their members at the meetings.

Electric Railroad to Washington's Home.—An electric railway from Washington to Mount Vernon—Washington's burial place, has been chartered by the Virginia Legislature. It will be 20 miles in length. The line will pass through Arlington and Alexandria.

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INVESTIGATING ELECTRICAL MATTERS.

The Senate Committee on General Laws, on February 28th, began an investigation in New York City into electrical matters. The committee procured the services of an expert electrician as adviser in F. W. Jones, chief electrician and assistant general manager of the Postal Telegraph Company.

George W. Hebard, President of the United States Electric-Light Company, was asked if his company "manufactured electricity for use in this city," and replied that it does not, but that the United States Illuminating Company, of which he is a director, does. He could not tell, however, "how much electricity was manufactured."

"The great demand for lighting at present is for incandescent lights," the witness explained.

Mr. Hebard said that his company believed in subways and was in favor of going into them. In small cities he did not believe subways practicable. The witness said that if wires were properly buried they would be safer under than above ground.

"What do you think of some sort of a commission to supervise electric lighting—something similar to the Railroad Commission, perhaps?" was inquired

"That is a many-sided question," Mr. Hebard replied. "If a competent commission could be constituted to work under some well-defined method it would be better than one working under no method."

"The Chairman asked 'if some supervisory power would not be useful in putting up or burying the wires, and thus be beneficial."

The witness thought that some regulation might be good if it was a proper kind of regulation. He doubted, however, if a general law could effectively cover the subject, as electricity is rapidly developing "and the law could not keep up with the procession."

Commissioner Hess, of the Board of Electrical Control, explained the work done by the Board and the obstacles it had contended with and overcome. He said the fact that 17,000 miles of wire, including a large quantity of electric lighting wire, had been buried and had worked satisfactorily proved the wisdom of burying the wires. Up to within eight months, he said, the electric-light companies objected to burying the wires, but now they are all in favor of it, as "they make a virtue of necessity." As to high and low tension currents, he considered both of them dangerous, but much less so under ground than above. The first cost of wires under ground, he said, was more than the cost overhead, but maintenance was less expensive.

Lawyer Gibbens asked some questions, bringing out that out of 4,281 deaths from accident and negligence in the city during three years past, only 15 had been caused by electricity. Commissioner Hess, in reply to a question put by Lawyer Cravath, said, that the Edison Company wires were too large to be strung upon poles and therefore they had to be placed under ground.

Edward H. Johnson, ex-President of the Edison Electric Light Company, and a director in many Edison companies, was sworn.

"Will you please tell the Committee about electric lighting and give us such views as you choose as to high tension and low tension currents?" Chairman Erwin suggested.

The witness looked dazed and said, that was a pretty large subject, and the question was made more specific. He said, that accidents from electric currents were due largely to the bad condition of the wires. No fatalities could result from contact with currents if they were not sufficiently intense to kill, and hence he thought low tension currents safest. No fatalities, he said, had been caused either in this country or Europe from the Edison currents. He considered the high tension currents the product of economy and doubted their expediency. As to fires, both currents, he said, were equally dangerous.

"I think it exceedingly important and desirable that there should be some one central regulating authority over electrical matters," the witness said.

He could not fix the line between dangerous and safe currents, he said, as there was a margin of from three hundred to six hundred volts. To Expert Jones the witness said that high tension currents of 5,000 and even 10,000 volts, he believed, could be conducted safely under ground, but the fact that the intensity of the current instead of the size of the wire, was increased indicated such a degree of economy that he did not believe the high tension currents would be made safe. He favored a proper authority to regulate the matter, and he added:

"We don't want 'cheap-John' systems competing with us."

Mr. Johnson said that his Company sent as much as 10 000 ampères of current out, and sent 7,250 ampères from the Pearl street station but it was divided between many wires and not over 700 ampères were sent out on any one wire.

On the second day of the investigation C. O. Mailloux, a well-known electrical engineer, who was the first witness, said that he was in favor of allowing all the systems to live, and he believed that laws could be framed so as to render all of them safe in use. The development of the use of electricity is in its infancy, he said, and it would be difficult to regulate it arbitrarily by statutes. As a preliminary step in that direction he said that the subject should be studied carefully by some authority competent to deal with it. As to high and low-tension currents he said that both had advantages and disadvantages. The high-tension is more dangerous to life and the low-tension more dangerous to property, but both could be rendered safe by proper precautions. He considered the burial of wires the best plan in large cities, but doubted the utility and necessity for it in smaller towns.

The witness explained that a current of 1,000 volts and 100 ampères would give the same electro-motive force, and consequently have the same lighting capacity, as a current of 100 volts and 1,000 ampères: but the latter would require one hundred times as much wire to carry it, and hence cost one hundred times as much as the former. This, he said, explained the commercial advantage of a high-pressure current. He said that he believed the converters in use in the high-tension alternating circuits could be constructed so as to prevent a dangerous current getting past them and entering houses or reaching the lamps. He said that it was difficult to measure the resistance of a wire with a high-tension current, but said that a means had been devised in London and would soon be in use here.

C. H. Jackson, president of the United States Illuminating Company and the United Electric Light and Power Company, testified that the former Company has four dynamo stations, and before the wires were chopped fed 2,000 arc lamps. Now it feeds 1,000 arc and 20,000 incandescent lamps. His company is in favor of subways and is now controlled by men who always have advocated burying the wires in thickly populated localities. In Philapelphia currents of 3,000 volts are carried underground. There were also electric light cables in operation underground in Pittsburg, Chicago, Cincinnati, Washington, Baltimore, Denver and elsewhere, a company in which he is interested having sold over one thousand miles of underground cable during the past year. There has been great improvement in the insulation of overhead wires recently, Mr. Jackson said, and had the present methods of insulation and construction prevailed when the electric light lines were built in this city there would probably have been no fatal accidents.

"A general supervisory power may be very desirable if we can have a commission composed of men familiar with the subject and the requirements for progress in electric lighting," the witness said. "The only way the companies can make money is by doing business safely, and thus, encouraging the use of electricity, and there should be such supervision and regular inspection as will insure against all danger of accidents."

The commercial advantage of high-tension currents was less expense, the witness said, but there was also another advantage in the alternating current in that by the converter system the current was reduced to a tension so low as to be absolutely safe before it was carried into buildings. Although over thirty thousand converters were in use, he said, not a single accident had ever occurred on a line carrying the current from them to the lamps.

Mr. Cravath asked some questions, and the witness said that his company formerly used the low-tension alternating current, and abandoned it partly because it caused too many fires and partly because it was less satisfactory to customers than the high-tension alternating current.

Col. Bliss learned from the witness that the advantage of high-tension alternating over high-tension continuous currents lies in the fact that the former do not and the latter do carry the high-tension current into houses.

Chairman Erwin said that when the committee adjourns Monday it will be to Friday, March 14, when the committee would like to have some expert testimony from representatives of the big companies. Mr. Erwin said that the committee would like to hear from the experts of the telephone and telegraph companies, and he also invited George A. Hamilton, of the Western Electric Manufacturing Company;-Wm. Maver, jr. of the Consolidated Subway Company; S. S. Wheeler, expert for the Board of Electrical Control, and W. D. Sargent, general manager of the Brooklyn Telephone Company, to appear at that time.

ELECTRICITY ON TRUNK LINES.

Mr. F. J. Sprague, in his paper on the Electric Railway, read before the Electric Light Convention recently held in Kansas City, gave some interesting and valuable facts and opinions in regard to the future use of electricity for passenger and freight traffic on trunk lines. He says:

I have been frequently asked whether in my opinion electricity will ever be used on trunk lines for through passenger or freight traffic? My answer is, probably not, according to present notion of trunk line transportation, and not by present methods of train dispatching. But in these qualifications I admit my hope and expectation of rapid through transit under certain conditions. Let us for a moment consider a few facts.

Railroad managers are constantly meeting with a demand for more rapid and luxurious methods of transit, and every effort which executive ability and financial expenditure within reason can devise, is made to meet this demand. I think I can safely say that, as steam railways are operated, a maximum speed of ninety miles per hour, and a running speed of sixty to seventy is all that can be hoped for in steam railway travel under the best conditions which can be provided. The limitations are too many. The maximum speed made by a locomotive today is but little more than was made twenty years ago. True, engines are larger and more powerful, but the increased weight of trains has made this necessary. To get pulling power there is a limit to the size of the drivers, and whatever their size there is a limit to the economical rate of piston speed and to the number of revolutions per minute. As the size of the driver increases, the centre of gravity of the engine is raised. As the steam demands become greater, the difficulty of taking water and firing grows more pronounced. Even now it requires the best work of a fireman when his engine is pulling a heavy load to prevent the engine "dying" on the road, or at least falling far short of its duty. The increase of running speed has been obtained principally by cutting down grades, straightening curves, filling up ravines, replacing wooden structures by permanent way of iron or stone, the use of heavier rails, safer switches, improved methods of signaling, the interlocking of switch and signal system, road-crossing gates, the abolishing of grade crossings; in short, by improvements in detail and management which permit a higher safe speed over a more extended section of road because of greater intrinsic safety, and of the greater degree of confidence inspired in the engine driver, rather than by marked advance in the speed capacity, which should not be confounded with the pulling capacity of the engine *per se*.

With respect to the electric motors the question is not now, can a motor of sufficient capacity be built, or efficiently and positively controlled, but rather how can the electricity be produced and supplied to the motor and at what potential can we work. We all hope to see the time when electricity can be produced economically from coal without the intervention of engines or dynamos; and it may be that something akin to the present steam practice will be common; but I think that even then it will be quite likely that a central station method of distribution will be the more advantageous. On the other hand, there are those who hope to see the storage battery so reduced in weight and improved in other particulars as to warrant its use in a large way in locomotives. For myself, I prefer to consider the possibilities of another method, the amplification and development to its full capacity of present street railway practice, and for that purpose I will briefly consider a suppositious case, namely, an express between New York, or rather, Jersey City, and Philadelphia. But before considering this problem let me point out a feature or two about steam roads. When first laid through a new country they usually consist of a single track which must do the manifold duty of providing for through and local freights, and local and express passenger traffic in both directions, with what success those who are called upon to travel in new countries are well acquainted. The route of such a road is determined mainly with the idea of getting from one place to another by a more or less direct line, but especially by one which shall not require too costly construction. Once determined, new towns spring up along the line of the road, and old towns grow until the demands of traffic make a double track necessary, and as civilization grows apace the freight traffic demands a track by itself and four tracks constitute the equipment. So, following the development of the road, we will find that in time the express and local passenger trains may require individual tracks and a six-track road will be a necessity. But it must be borne in mind that the express is not intended to cater to local travel, but its route is subordinated both in the matter of curves, grades and crossings to the requirements of the early construction. The highest demands of such a service would require that, independently of the local travel, a through express track should be constructed by the most direct route possible between the principal localities, and every effort made to reduce the curvature and grades as much as possible. No matter how much it costs to build such a road, when the traffic is sufficiently large, it will pay to do it.

Suppose such a road to be an electrical one, and the method of supply to be from one or more central stations, the current being taken by a universally flexible underneath contact from a rod carried above the car, and the return circuit made by means of the rails. This method, using of course a wire instead of a rod, having been almost universally adopted wherever street cars are propelled by electricity, its characteristics are well known. What the structure of the roadbed would be need not here concern us. We might use the standard T rail and roadbed, avoiding as much as possible curves, grades and grade crossings, and the overhead rod can be used simply for supplying the current; or some form of a double or single track road slightly raised above the ordinary level, and with the upper rod forming a steadying and centering cord as well as a current supplyer may be used. These are mechanical questions with which we need not concern ourselves at present. What does concern us, however, as electrical engineers is, whether the cost of copper, the potential required, the losses on the line and the number of stations are such as would be prohibitory.

As regards the potential, other things being satisfactory, whatever pressure is demanded in the interest of economical and effective service will be used, and means will be found, consisting mainly in cars of construction, which will make its use for the purposes, and as intended, safe and proper. We have in these matters to face the same questions that we have in the matter of steam pressure, or of railway speed. To accomplish the larger engineering feats necessary to meet the demands of economy and commerce, we will be governed more by belief in our power to fully subordinate a good servant to our will than by our fears of its vagaries when allowed to become a master.

THE TRANSFORMER PATENTS IN AUSTRIA-HUNGARY.—The action brought by Max Deri, engineer to Messrs. Ganz and Co., of Budapest, for the revocation of the Gaulard-Gibbs patent for the distribution of electricity by means of transformers, has been successful, and their patent of December 27th, 1882, has been annulled on the ground of anticipation and too broad a claim.

Salem, N. J., gets electric street lights at lower rates than any city in the State.

GAS ENGINES FOR ELECTRIC LIGHTING.

A highly interesting fact has been brought out by Mr. O. Tirrill of 39 Dey street, New York, in some practical tests in producing electric light by using illuminating gas for driving a gas engine and a Perret dynamo.

Naturally one would suppose that the loss due to the double transformation of energy in producing the electric light from illuminating gas by this means would place the cost of the electric light far above that of gas. On the contrary, however, Mr. Tirrill has found to his surprise that a given amount of gas will produce far greater illuminating effects when used to drive this dynamo that when burned direct.

The gasoline gas is produced by his machine for one dollar per thousand feet. The engine, it is found, consumes four feet of this gas per 16 c. p. lamp when driving the dynamo under full load, making the cost per lamp two-fifths of a cent per hour, so that the luxury of the electric light by this means, instead of becoming expensive, he finds in reality to be a great economy.

Mr. Tirrill explains the phenomenon by the fact that his gasoline gas contains eighty per cent. of air when delivered at the explosion chamber of the engine, and he gets the benefit of the expansion of this large volume of air by the heat of the explosion.

EAR TROUBLES CAUSED BY THE TELEPHONE.—*The British Medical Journal* says:—As civilization advances, new diseases are not only discovered, but actually produced by the novel agencies which are brought to bear on man's body and mind. The electric light has now created a new form of ophthalmia; and now we have the telephone indicted as the cause of ear troubles which reach on the spirits, and indirectly on the general health. M. Galle has observed, not in women only, but in strong-minded and able-bodied men, symptoms of what we call "aural over-pressure," caused by the condition of almost costant strain of the auditory apparatus, in which persons who use the telephone have to spend a considerable portion of each working day. In some cases, also, the ear seemed to be irritated by the constantly recurring sound of the bell, or by the nearness of the sounds conveyed through the tube, into a state of over-sensitiveness which makes it intolerant of sound, as the eye when inflamed or irritated, becomes unable to bear the light.

TRANSMISSION OF WRITING BY ELECTRICITY.—One of the most striking of the Edison exhibits at the Paris Exposition was the little instrument which enables the operator to sign a check one hundred miles distant. The writing to be transmitted is impressed on soft paper with an ordinary stylus. This is mounted on a cylinder, which, as it revolves, "makes and breaks" the electric current by means of the varying indentations on the paper. At the receiving end of the wire a similar cylinder, moving in accurate synchronism with the other, receives the current on a chemically-prepared paper, on which it transcribes the signature in black letters on a white ground.

TESTING THE HEARING BY THE PHONOGRAPH.—A writer in a German medical journal asserts that Edison's phonograph fills all the requirements for an acoumetre or instrument for accurately measuring the hearing. The operation of the apparatus is simple. The ear piece is applied to the ear which is to be tested, and a phonogram which is audible to the patient is sounded. The acoumetric scale is then descended until a phonogram is reached which cannot be heard. This marks the limit of hearing for that ear. In this manner the source of sound remains always at the same distance from the ear, and only the intensity of the tone differs.

ELECTRIC TRACTION IN HOLLAND.—The first electric tramway in Holland will be opened this month. It runs from the Hague to Scheveningen, a distance of about four miles.

UNDERGROUND WIRES IN PARIS.

Le Genie Civil, in describing the electric light plant at the Halles in Paris, gives an account of the methods used in laying the wires under ground, from which the following description is condensed :

The Municipal Council authorized the use of the sewers, but in spite of this the engineers have preferred to build special conduits. The cables, therefore, have been placed under the sidewalks in conduits of the form shown in Fig 1, made of cement and 10·23 × 11·80 in. in size. Wooden supports furnished with glass holders, which carry the cables, are placed at distances of 4·92 ft. apart. These wooden supports slide freely in grooves made in the conduit, and thus form a method of suspension easily accessible for repairs. In crossing the streets, where the soil is very damp and permeable, cables are sunk one meter below the surface.

For the circuit at low tension the cables are made as follows : The wires are twisted together and covered with a layer of pure rubber ; then with a layer of mixed rubber at least 2 mm. (0·08 in.), and finally by two bands of cotton impregnated with rubber. The whole cable is vulcanized in a compact mass, and is then protected by an outer covering of hemp soaked in rosin or tar.

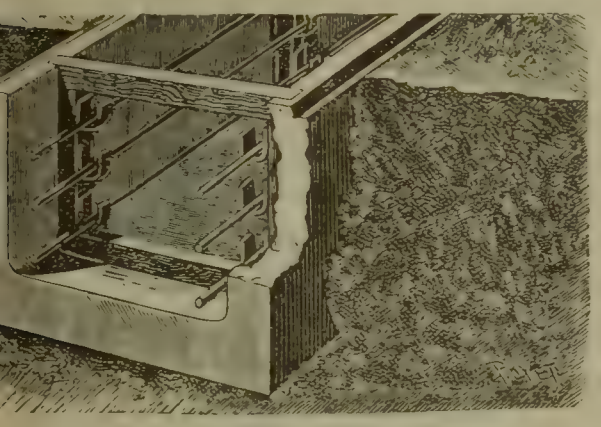


FIG. 1.—UNDERGROUND CONDUITS.

For the high-tension circuit, on account of the narrowness of the sidewalk in certain streets, it was necessary to use, for a short distance, the sewers, and in order to avoid any disturbance of the telegraph and telephone wires on these sections, use was made of concentric cables. These cables were thus formed : A core of 19 copper wires of 2 mm. (0·08 in.), giving a section of 60 sq. mm. (9·3 sq. in.) ; the wires outside were covered by two layers of pure rubber 1 mm (0·04 in.) in thickness, and then by several layers of vulcanized fibre wound in different directions ; outside of this was a series of copper wires rolled in helical form and forming the second circuit, having the same total section as the core. These were covered in turn, first by two layers of pure rubber, then by several layers of vulcanized rubber 3 mm. (0·12 in.) thick, then by two vulcanized bands wound in opposite directions, then of hemp 3 mm. (0·12 in.) in thickness and saturated by a resinous composition, and then by two bands of vulcanized cotton. The whole was enclosed in a leaden pipe 2·5 mm. (0·10 in.) in thickness, which again was covered by twisted cord. This cable rests on wooden supports fastened in the masonry of the sewer.

For the ordinary high-tension cables the conduits are similar to those for the low-tension cables described above. The degree of insulation was carefully provided for in the specifications. These cables rest on wooden supports injected with sulphate of copper and covered with tar, which rest on porcelain insulators in the cement conduits. At the crossings of the streets the conduits are arranged as mentioned above.

The total length of 2,952 ft of concentric cables in the sewers and 19,024 ft. of the ordinary cables was put down at a cost of about $15,000. The current furnished from the light station is sent out under a pressure of 2,400 volts. As it is furnished to each user under a tension of 100 volts, it is necessary to use transformers between the main circuits and each side connection.

CALIBRATING THERMO-COUPLES. — A practical method of calibrating thermo-couples for high temperatures is described in the February number of the *Phil. Mag.*, says the London *Electrician*, by Carl Barus, who has investigated the variations caused in the boiling points of various metals by changes in external pressure. The result of these investigations, combined with the known boiling points of different metals at the atmospheric pressure, enables the calibration to be performed at all points over a very large range of temperatures. The apparatus for fusing the metals used in the experiments is described in detail. A platinum iridio-platinum thermo couple was employed, the thermo-electric constants of which were measured, by a null method, in terms of the electromotive force of a Latimer Clark cell. It was, however, found best to use a torsion galvanometer, and to directly express the thermo-electromotive forces in terms of the twist of a platinum fibre. The instrument used was 135 cm. high, and when the needles of the galvanometer were strongly magnetized, it was found that a platinum wire 0·018 cm. in diameter was sufficiently thin In order to avoid the error caused by the directive force of the earth's magnetism the needles were always brought back to zero by turning a torsion head at the top of the instrument. A mirror was attached to the needle, and a telescope and scale were employed to measure the fractions of a degree. A thermo-couple calibrated in this way should form an invaluable instrument for the measurement of high temperatures.

THE CONDUCTIVITY OF COLORED FLAMES.—Several attempts have been made to measure the conductivity of flames, and especially of those containing the vapor of metallic salts. These investigations have up to the present only furnished contradictory results. To obtain colored flames under definite conditions Wiedeman and Ebert have, by means of a spray, impregnated the air feeding a Bunsen burner with a saline solution of suitable density, and have thus been in a position to know exactly how many milligrammes of metallic vapor were contained at any moment in a unit volume of flame. The character of an electric discharge is, of course, considerably modified by interposing a flame in its path ; the discharges become more rapid and the sound given out by a telephone is increased. On the introduction of metallic vapors into the flame, a still further change takes place, the nature of which essentially depends on the nature of the metal introduced. With potassium the telephone is reduced to silence, the discharge becoming almost continuous. Sodium, even in considerable quantities, produces a far smaller effect. In both instances the discharge remains disruptive in character, and there can, therefore, be no question of the flame being electrically conducting. Potassium and magnesium have peculiarly strong effects, due doubtless to the ultra-violet rays which they emit in abundance, and the effect of which when they fall upon the negative electrode is to lower the difference of potential necessary to cause a discharge.

NEW WESTINGHOUSE DYNAMO.—A 125 light arc dynamo of the new Westinghouse pattern has been received in New York. The machine will be run in connection with converters, and the flat carbon lamp is to be used.

THE ELECTRIC LIGHT OF THE FUTURE.

While Mr. E. H. Johnson was in Kansas City in attendance at the recent Electric Light Convention he was interviewed by a reporter on the subject of electric lighting.

"The greatest desideratum in the business of electric lighting," said Mr. Johnson, "is something to propel the dynamo. The dynamo itself is one of the most economical machines in existence. The total loss arising when mechanical motion is turned into electricity is less than 5 per cent. The economy of the electric light is the direction for development now. Its success is assured, and the extension of the business depends only on the cost of production. No great advance in the economy of light can be made until some cheaper power is found, for the cost of the power to drive the dynamo is by far the greatest expense.

I think that if it is ever accomplished it will be done by turning heat directly into electricity, as has already been done on a very small scale in the laboratories of Sir William Thomson, Siemens and Edison. There is no natural law to prevent this ; it is merely a question of inventive genius, and it is probable that inventive genius will be equal to the occasion. In this event the gain to economy would be great, as 92 per cent. of the heat is now wasted. The loss might only be as great as 8 per cent. or 10 per cent when the new invention shall be perfected. This would mean a gain of 300 or 400 per cent. in the work done by the same quantity of coal.

"This remarkable result," continued Mr. Johnson, "cannot be prophesied for immediate realization, but I believe that there are people now living who will see all this accomplished and the steam engine take the position in industrial machinery that the bow and arrow now hold in the machinery of warfare.

"There is only one difficulty now in the way of introducing electric light, and that is lack of confidence of capitalists in its dividend-earning capacity. This is due to the fact that many concerns have been badly managed, and, no matter what the profits of an industry ought to be, bad management will eat them all up. Such concerns have entailed heavy loss on some investors, and from such failures during the past eight or ten years the evil effects have been widespread. Where the concerns have been well managed, however, there has been no failure."

ELECTRIC LIGHT COMPANIES SUE EACH OTHER.—The Brush Electric Light Company has brought suits in the United States Circuit Court against the United States Electric Lighting Company, the Excelsior Electric Company, the new American Electric Arc Light Company, and the Ball Electric Light Company for an injunction to restrain them from using a certain patented arc lamp. In the same court the Edison Electric Light Company sues the United States Illuminating Company for infringing on a patent electric meter.

ENLARGING ITS PLANT.—The present light plant in Nashua, N. H., has been so overtaxed by the increased demand for the electric light that it has been decided to erect a larger plant at a cost of $60,000. The new station will be ready for operations in the fall, and the old will be used for the power house for the proposed electric street railway.

TO EXTEND AN ELECTRIC ROAD.—At a meeting of the directors of the Saratoga Electric Railway Company, held at Saratoga, February 25th, it was resolved to increase the capital stock from $50,000 to $150,000, and to extend the lines of the road from Ballston and Rock City Falls.

NEW PLANT.—The North Adams, Mass., Electric Light Company will put in a new plant in the spring near the Gas Works, and it will probably be run by gas engines.

THE COUNTER-ELECTROMOTIVE FORCE OF THE ARC.

Mr. Friedrich Vogel, in *Repertorium der Physik*, writes as follows on the subject of the title-head :

In a former paper I briefly indicated how a series of peculiarities and anomalies in the arc might be explained by electrolytic processes within it. More recent researches on the conduction of electricity in gases and kindred phenomena have raised what I then conjectured almost to a certainty.

According to the theory of A. Schuster gases conduct electricity only when they have been resolved into atoms, whether by electric power, by heat, or by illumination. A series of valuable investigations, such as those of Arrhenius, Nahrwold, Narr, and others support the above theory, and it has recently received a complete confirmation from the admirable researches of Elster and Geitel on the excitation of electricity by the contact of expanded gases with wires ignited by the current.

The production of the arc is generally begun by bringing the carbons into mutual contact. On the passage of the current the points of contact, which present a small section, become incandescent and warm the adjoining particles of the air. We have thus the condition for the transmission of electricity through air, as according to the observations of E. Becquerel, which have been confirmed by Blondlot, air becomes conductive when heated to the temperature of redness. According to Schuster's view, we must regard the gases as, in part at least, dissociated.

The notion of the counter electromotive force of the arc was first introduced by Edlund, and has latterly been the subject of various investigations, especially by V. von Lang, Nebel, Cross and Shephard, L. Arons, and others. We insert here a few measurements of L. Arons. On the one hand, the true resistance of the arc was determined ; and, on the other hand, the tension in the arc and the strength of the current. True resistance, 2·1 ohms; tension, 40·6 v.; strength of current, 3·4 amp. ; apparent resistance, 11·8 ohms.

True resistance, 1·6 ohms; tension, 39·6 v.; strength of current, 4·1 amp. ; apparent resistance, 9·7 ohms.

The apparent resistance is approximately six times as great as the true resistance—*i.e.*, there is other work performed in the arc in addition to Joule's thermic work. Lecher contests the existence of a counter electromotive force, and inclines to the assumption of Wiedemann's discontinuous discharges, having found by experiment that the arc, after interruption of the current produces no deflection in the galvanometer, as is the case with electrolytes.

But it has not been found possible to demonstrate such partial discharges by means of a rotating mirror: secondly, a telephone introduced parallel to the arc gives no sound when the arc is burning quietly and a constant current is employed, such as that of accumulators. Lastly, Wild states that he has succeeded in obtaining a counter-current by rapidly connecting the electrodes with a galvanometer. The negative results of Lecher, always assuming their accuracy would not give any direct disproof of the existence of a counter-electromotive force. If the region of gases between the carbons has become cold during the displacement of the switch, etc., it acts as an insulator. In that case only the free portions of electricity existing on the electrodes can flow back, and these are, in any case, very trifling.

Schuster's views on the conduction of electricity in gases are calculated to explain the counter-electromotive forces of the arc, if we consider the single stages of the process separately, and regard them as analogous to the decomposition in liquid electrolytes. We conceive the arc as in a stationary condition. In order to keep this gaseous region and the carbon terminals at a constant temperature, a certain electric work must have been expended, to which the true resistance of the arc corresponds. Secondly, the electrodes (in this particular case the carbons) must be gasified. Thirdly, the hydrocarbons and other gases produced, and the gases which pass into the arc from the surroundings, are dissociated. For both these processes an expenditure of work is required, and consequently an electromotive force which must act in addition to the power for Joule's heat $J\,w$, when w is the true resistance of the arc. We will in particular consider the last-mentioned, the work of dissociation.

If, for an elctrolyte, w signifies the quantity of heat liberated on the formation of a molecule of the compound, Q the quantity of electricity, by which the molecule is resolved into its constituents, the ions, a quantity of electric work must be conveyed to the electrolytes $c \cdot Q \cdot E$, and according to the theorem of the conservation of energy.

$$c \cdot Q \cdot E. = W.$$

c is the electrical equivalent of a unit of heat. For a continuous resolution into ions, there must, independent of the electromotive force corresponding to the Joule thermic work, be an electrolytic force acting at the electrolyte :

$$E = \frac{W}{c \cdot Q}$$

In the same manner in the dissociation of a gas an electrical expenditure of work is requisite and a minimum electromotive force for continued decomposition. If e denotes this electromotive force, q the quantity of electricity by which a molecule of the gas is resolved into atoms (ions) Φ the atomic heat of combination of a molecule, then,

$$c \cdot q \cdot e = \Phi.$$

and

$$e = \frac{\Phi}{c \cdot q}$$

The electromotive force, e, for the dissociation has the character of a counter electromotive force, even when it does not make itself perceptible by polarization. It is the correlative of a performance of work.

The above considerations explain certain anomalies of the arc, such as that identical carbons, with an identical strength of current and an equal tension at the lamps, may give off different quantities of light according to external conditions, such as the proportion of moisture. The work expended in electrolysis, including dissociation, is various. If it is proved that gases conduct only as electrolytes by the resolution of the molecules into atoms the counter electromotive force of the arc supplies an important means of determining the heat of atomic combination.

According to Foeppl a perfect vacuum is a non-conductor. Monatomic mercury gas, which cannot be dissociated, is, according to Schuster's views, non-conductive, an inference which is confirmed by Elster and Geitel. The mercurial vapors, which are always present in a vacuum, obtained with the mercurial air pump, do not interfere with the phenomena. Between mercurial electrodes no arc could be produced in a vacuum.

Carbon electrodes are not suited for the study of dissociation since they both absorb gases and are resolved into unknown carbon compounds. If we suppose pure metals burning in a vacuum the thermic work can be calculated which must be conveyed to the metal in the form of electric energy in order to heat a certain quantity to the point of ebullition. By weighing we find the quantity of the dissociated metallic vapor corresponding to the quantity of electricity, $q = i\,t$, if i is the strength of the current and t the time. From the difference : total electric work, less the Joule thermic work, $J^2\,w\,t$, less the thermic work for heating up to the boiling point, we find the work of dissociation for the quantity of metal evaporated. If the experiments are repeated in simple gases with the same metals under different pressures, the work of dissociation for these can also be determined, which is equal to the work of forming the molecules.

Here we have merely indicated the approximate way for the experiments. The region for research is extensive and a wide sphere is open for theory and practice.

The Coney Island & Brooklyn Railroad Company are constructing five miles of electric road.

ELECTRICAL PATENTS ISSUED FEBRUARY 25TH, 1890.

421,887. Electrically-Propelled Vehicle. Jas. Adair, New York, N. Y.

421,911. Regulating Apparatus for Electric Motors. Philip Diehl, Elizabeth, N. J.

421,916. Secondary-Battery Plate. Justus B. Entz and William A. Phillips, Schenectady, assignors to said Justus B. Entz and Montgomery Waddell, New York, N. Y.

421,967. Dynamo-Electric Machine. Mathias Ffatischer, Philadelphia, Pa., assignor to the Electrical Accumulator Company, of New York.

421,968. Electric Conductor. Eugene F. Phillips, Providence, R. I.

422,058. Electric Connector. Charles McIntire, Newark, N. J.; Charles H. McIntire, administrator of said Charles McIntire, deceased.

422,072. Telegraphy. Thomas A. Edison, Menlo Park, N. J.

422,073. Telegraphy. Thomas A. Edison, Menlo Park, N. J.

422,074. Telegraphy. Thomas A. Edison, Menlo Park, N. J.

422,082. Telephone Line Vibrator. Hermon W. Ladd, Boston, Mass.

422,107. Voltaic Shoe. Clark H. Ayer, Boston, Mass.

422,147. Electric Switch. Wm. E. Parker and Harry E. Temple, Buffalo, N. Y., assignor of one-half to Henry H. Humphrey, same place.

422,148. Dynamo-Electric Machine or Electric Motor. Edward B. Parkhurst, Woburn, Mass., assignor to the Florence Motor Company, of Maine.

422,149. Electric Motor. Edward B. Parkhurst, Woburn, Mass., assignor to the Florence Motor Company, of Maine.

422,164. Support for Overhead Electric Conductors. Charles K. Stearns, Newton, and Geo. K. Wheeler, Boston, Mass.

422,174. Grinding Electrodes for Microphones. Samuel H. Bartlett and Henry E. Waite, New York, N. Y., assignors to the Waite & Bartlett Manufacturing Company, same place.

422,190. Method of Electrically Heating Bars, etc., for welding and working purposes. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place.

422,196. Electric-Lighting Device. Ellsworth E. Flora and Philo R. Hoy, Chicago, Ill.

422,201. Electrical Apparatus for Driving Artesian Wells. Geo. G. Fryer, Philadelphia, Pa.

422,216. Secondary Battery. William B. Hollingshead, Bronxville, assignor of one half to Sydney H. Carney, New York, N. Y.

422,265. Carbon Commutator Brush and Holder. Charles J. Van Depoele, Lynn, Mass.

422,266. Electric Railway Motor-Car. Chas. J. Van Depoele, Lynn, Mass.

422,295. Pyromagnetic Generator and Motor. Wm. B. Cooper, Philadelphia, Pa.

422,300. Electrode for Storage Batteries. Chas J. Hartmann, Summit, N. J.

422,301. Electrode for Secondary Battery. Chas. J. Hartmann, Summit, N. J.

422,302. Carbon for Electric Lamps. Henry H. Head, Dublin, and Llewellyn Saunderson, Kingstown, County of Dublin, Ireland ; said Head assignor to said Saunderson.

422,308. Electrode for Secondary Batteries. Farnham M. Lyte, London, County of Middlesex, England, assignor to the Electric Car Company of America, of Philadelphia, Pa.

422,339. Electric Motor Car. Isaac H. Farnham, Malden, assignor of two-thirds to George Willis Pierce, Boston, and Albert P. Sawyer, Newburyport, Mass.

422,354. Safety Cut-Out. Frank B. Rae, Detroit Mich.

422,360. Incandescent Lamp Socket. Wm, F. Wollin and Elmer H. Werline, York, Pa., assignor of one-half to Amos E. Rieker, same place.

ELECTRIC TRANSFER TABLE, NEW YORK CENTRAL & HUDSON RIVER RAILROAD.

We illustrate in this issue an electric transfer table, recently installed by the Sprague Electric Railway & Motor Company for the New York Central & Hudson River Railroad.

These tables differ from the earlier ones, which have been described in these columns, chiefly in the electric motor which is of 15 horse power instead of 7½ horse-power, and also in the contact arrangement. The contact is obtained from a couple of heavy copper wires stretched taut about three feet apart over the second of the four parallel tracks, the wires being carried on insulators fixed to light cast iron cross beams, so as to be a few inches above the rails. The conductors are kept taut under all changes of temperature by springs at one end. Over these wires the contact rollers travel beneath the tables, being kept in contact by gravity only. In the Altoona electric transfer table, installed by the Sprague Company for the C. B. & Q. R. R., there is an under contact maintained by springs, while the Waukesha electric transfer table, installed by the Sprague Company for the Wisconsin Central R. R. Company, an overhead contact is used. The current used is only 220 volts, and hence, while not wholly pleasant to take in one's body, it is in no way dangerous. The current is taken from the same dynamo that furnishes light for the station. The full current capacity of the table motor is 60 ampères.

The speed of the electric motor is governed by a switch which throws the winding of the field into different combinations, thus altering the current, maintaining a practically constant strength of field without the use of any wasteful resistance.

The control over the speed of the motor is perfect, and no complicated nest of gearing for changing speed is required.

The motor is supported at one end by double compression springs playing upon a bolt which rests upon the platform of the transfer table, according to the regular Sprague method, which has been developed in street railway and other work where it is desirable to start slowly under a heavy load. At the other end the motor is sleeved on to a rigid support. By means of this flexible attachment, danger of stripping the gears is eliminated, and the strain upon the gear is always a progressive one.

The advantages of electric power for this work are claimed to be great. The equipment is very much lighter than if steam power were used, and there is no expense of operation when the table is not in use. One man can easily handle the table, and more conveniently and directly than with steam.

The two-end capstans shown on the table are fixed; the centre one is revolved, in either direction, though in and out of gear by a simple clutch. It is used, of course, for working cars on or off the table without locomotive power.

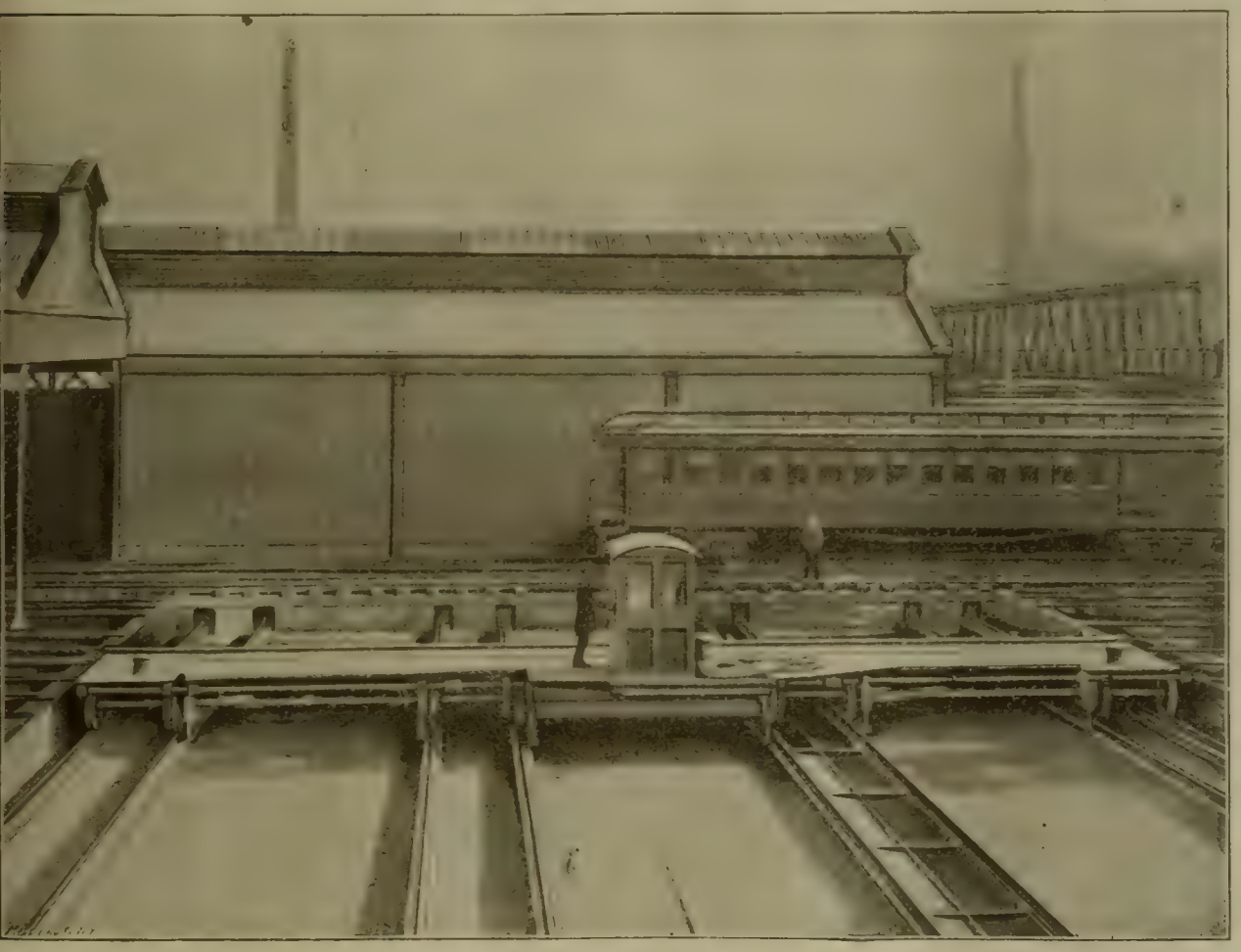
The capacity of the table is 100,000 lbs. Ordinary car axles, bearings and wheels are used throughout for the running gear, and the total cost of the table and motor complete was under $7,000. The speed is about 150 ft. per minute, the same as the old wire rope table which it replaces. The old pit was lengthened somewhat, and accommodates ten tracks as shown in the illustration. The rails are carried on longitidinals resting on small masonary foundation walls. The pit drains directly into the city sewers.

The table is constructed with 15-inch cross beams and 12-inch longitudinals, thorougly braced with a rigid iron lateral system.

It was designed and built by the Yale & Towne Mfg. Company, of Stamford, Conn.

The small cabin, shown in the centre of the table, is provided for the man operating.

Electric transfer tables have now been adopted by the Pennsylvania R. R. Co.; Philadelphia & Reading R. R. Co.; Chicago, Burlington & Quincy R. R. Co; Wisconsin Central R. R. Co., and other prominent corporations, and they are now recognized as an essential feature of every extensive and well-equipped railway switch yard.



ELECTRIC TRANSFER TABLE.

Electrical Conductivity of Wood. — When wood is fresh cut it is a good electrical conductor on account of the sap, etc., but when it is dried it becomes an insulator. Take the same piece of wood and bake it to charcoal it becomes once more a good conductor, and finally it can again be made a good insulator by burning it to ashes.

IMPORTANT PATENT DECISIONS.

PROCESS AND APPARATUS MAY BE COVERED HEREAFTER IN THE SAME PATENT.

A new patent decision, very interesting to inventors, and perhaps the most important decision of the present Commissioner of Patents, has just been rendered in a test case. It has long been a vexatious question whether a process and the apparatus therefor could be covered in the same patent. The decision is rendered in the case of Daniel W. Lord, No. 319,641 presented by Wallace A. Bartlette, of Washington, as attorney. The decision is as follows in brief:

1. Although a process and an apparatus for carrying out the process are separate inventions, they are not necessarily independent inventions within the meaning of rule 41, and when they are dependent upon each other and mutually contribute to produce a single result they may be joined in one application.

2. Rule 41 does not require that in order to authorize a single patent for several distinct inventions which mutually contribute to a single result there must be such intimacy of interconnection and co-operation as to result in a third invention or combination.

3. Perhaps a good working rule would be that process and apparatus are presumptively connected in design and operation where the examination of both belongs to the same division of the office.

Commissioner Mitchell of the Patent Office rendered a decision on February 24th denying the application of C. A. Fauze for a patent for alleged new and useful improvements in the application of secondary electric batteries as a motive power for the propulsion of vehicles. It was urged on behalf of the applicant that he was the first to practically and commercially succeed in accomplishing the desired result; that prior to his invention chemical generators of electricity had been employed to propel boats, engines and vehicles, but owing to the weight of a cell of battery all the electrical energy it was capable of generating was expended in moving itself, and he, being the first to apply a newly discovered property to this use, was entitled to protection.

The Commissioner holds that the application of the Fauze secondary battery to the propulsion of vehicles was an obvious use, requiring no change in the battery or in any of its parts to adapt it to the specified purpose, and that to use a better battery in a combination in which an inferior one had been previously used did not involve the invention of a new combination for which the skilled mechanic would be entitled to a patent.

The Commissioner further holds that the public are entitled to practice a given invention in all its obvious utilities when the patent has expired, and may not be lawfully debarred from the enjoyment of it by subsequent patents seeking to monopolize uses which, although special, are at the same time recognized by persons skilled in the art as pertaining to it.

The New York Insulated Wire Company's goods are rapidly growing in favor and the demand is constantly increasing. The excellent quality of the goods has made a name for the company which is not confined to the limits of the United States. A large order has just been received from Yokohama, Japan. An order for a car load of assorted sizes of wire is being filled for Chicago, and a similar one is destined to Detroit. The subject of properly and reliably insulating wire is receiving very earnest and close attention by manufacturers, and the New York Insulated Wire Company are abreast of the times and are producing goods that cannot be surpassed in point of efficiency and durability.

Quicksilver. —The production of quicksilver in the United States during the past year is estimated at 26,650 flasks, having a total value of $1,154,000. The lowest price during the year was $40 and the highest $50 per flask.

NON-REVERSIBILITY OF POLARITY IN ARMATURE COILS.

BY J. M. LENNON.

Much has been said in the last few months for and against the subject of dynamo machines whose main feature is that of the non-reversal of the polarity of the armature core, or, more strictly speaking, machines in which the polarity of the separate sections of the armature is a constant factor, no matter what its space or position in the field. Under the classing of such machines may be put Siemens' electro depositor or non-polar dynamo, with its low pressure and high ampèrage; Forbes' uni-polar dynamo; Eckemeyer's cylinder machine, and numerous others, of all of which Faraday's copper disc and horse-shoe magnet machine may well be called the mother. Yet in none of these machines does the voltage exceed much over 4, although theory tells us that we may increase that indefinitely by proportionately increasing the longitudinal surface. But at present a machine of 60 volts is a mechanical impossibility. There is, however, one great redeeming feature about machines of this class, and that is the

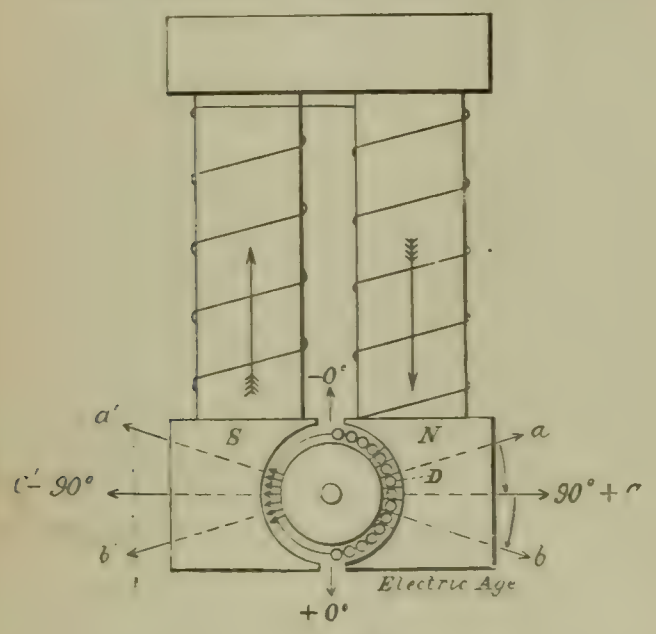


FIG. 1.

use of either the conductors or a round ring as a collector, not requiring to be split to give up a constant current. One often hears, even in this enlightened age, the worn out cry "equal lines of force in equal time will not produce a current." That is true when the conductors and field are at rest, but not when in motion, or where they are free to produce motion. One proof may be shown with a well known machine, namely the Edison. This proof may be found on any dynamo machine providing the time and distance each infinitely short with the speed constant.

1. Now suppose from a to $b = \frac{1}{2}$'' and from a to $c = \frac{1}{4}$'', and say conductor D passes between a–c in $^1/_{10}$ second; then, if the speed is absolutely constant, D passes from c to b in $^1/_{10}$ second, or equal distance in equal time.

2. Again suppose the iron be saturated, then the field of a–c and c–b must be equal, if the iron be uniform in texture and magnetic susceptibility; then, if time is constant as in No 1, equal field is cut in equal time, or equal field in equal distance and equal time will produce a current, and that at its highest point of potential, and, moreover, that point lies where conductor D comes the nearest to cutting the lines of force at right angles. Therefore, a machine which cuts an equal number of lines of force in equal time at absolutely right angles must generate the highest E. M. F. A machine I am at present experimenting with is of this principle, yet radically different in construction from any of the above-mentioned machines, all of which use a cylinder as armature, while I use a specially wound armature. Below is appended its size and weight:

	Feet.	Lbs.
Diameter of armature	2.7	
Thickness of core	.68	
" " over all	.15	
" " hub	.55	
" " rim	.25	
Distance between F. M. pole-pieces	.17	
	Feet.	*Lbs.*
Height of machine	3.5	....
Width " "	2.	....
Length from one end of shaft to end of shaft	4.5	....
" of case	2.1	....
Weight	.....	310
" of field, magnets and case cast	.....	225
" " armature, wrought iron and brass	.....	100
" " wire No. 8 on F. M's	.....	40
" " " 16 " armature	.....	15
" " armature core, wrought iron	.....	20
Diameter of pole-pieces	2.5	....
Thickness " "	.25	....
" " case	.2	....
Diameter of F. M. cores	.8	....
Length " " "	1.	....
Number of turns on F. M. ..... each	130	....
Total effective length of wire on armature, in series	297.5	....

With a current of 10 ampères at a pressure of 250 volts through the F magnets, the external field outside of case was 0. with Okonite wire in armature and 80 effective a constant deflection on a tangent galvanometer of constant $K = .7175 : S = 75°$. This was without armature core and the two F magnets in parallel as the winder has short circuited both at entrance through case. Nothing, you will say, to be proud of. True, but the principle is there and only needs to be drawn out. The above was at 1,100 speed. Some time after I connected the same galvanometer by means of 90-foot cables to the rim and shaft of armature turning the machine so as to put the armature at right angles to the earth's horizontal. This time I obtained a deflection $S = 64.31°$ at 250 revolutions—a decided increase for the wrought-iron core which I now had in. When spring arrives in earnest I hope to be able to inform the readers of THE ELECTRIC AGE that I have a machine whose line of pressure and current is a straight line, using a collector and absolutely no back pressure in armature.

THE INVENTOR OF THE ELECTRO-MAGNET.—Sturgeon's right to be considered as the inventor of the horse shoe shaped electro-magnet is rather contested by Mr. T. Gilliard, says the London *Electric Review*. This gentleman recollects Mr. Richard Roberts, C.E., showing him an electro magnet similar to that described by Dr. Silvanus Thompson, and which had taken a medal and premium at the Society of Arts, somewhere about 1825. This, curiously enough, is the date mentioned by Dr. Thompson as that at which Sturgeon contributed a paper to the Society of Arts describing his alleged invention. The writer thinks that perhaps among the collection of Roberts's inventions at Peel Park Museum, Salford, this magnet could be found.

UNDERGROUND WIRES IN MILWAUKEE.—The Milwaukee fire alarm and police wires were placed underground a year ago and have worked in a very satisfactory manner since. There have been no interruptions whatever in that time, and no repairs have been necessary. As far as appearances go, it can be said that the wires are in just as good condition now as they were when first laid. This experience is of importance at this time, when there is so much discussion over the merits and demerits of the various systems of placing wires underground. The experience in Milwaukee has been corroborated in many other places where work of this sort is done quietly.

MOVING DAY IN DANBURY.—About half of the electric clocks in Danbury, Conn., stopped recently. Investigation showed that the circuit had been destroyed by a man who cut off a piece of the wire to tie up his stove pipe.

PERSONAL.—Mr. Wm. Hood, the western agent of the Electrical Accumulator Co., with headquarters at Chicago, was in town last week.

TRACTION INCREASED BY AN ELECTRIC CURRENT.—During some of the earlier experiments with electricity as a motive power for railways, in which the rails were employed as conductors of the current, it was observed that the wheels which received the current from the rails had an enormously increased traction while the current passed. This was at first attributed to the direct action of the current, then to molecular change caused by the electrical heating of the surfaces in contact, but the phenomenon has never been fully explained. The contact between the wheel and the rail under the conditions of actual use upon railways is scarcely more than a short line. If the surfaces were perfect as well as infinitely hard and rigid, the contact would be simply a mathematical line. In reality the surfaces in contact are very small, so that any current meeting the resistance of such a contact must produce some heat, which becomes greater as the current is increased. Experiments show that a current of several ampères, having a pressure of one volt or less, is required to secure good results. Different metals are not all affected in the same degree. As would be expected, the effect of the same current on good conductors, such as silver and copper, is less than it is on iron and German silver.

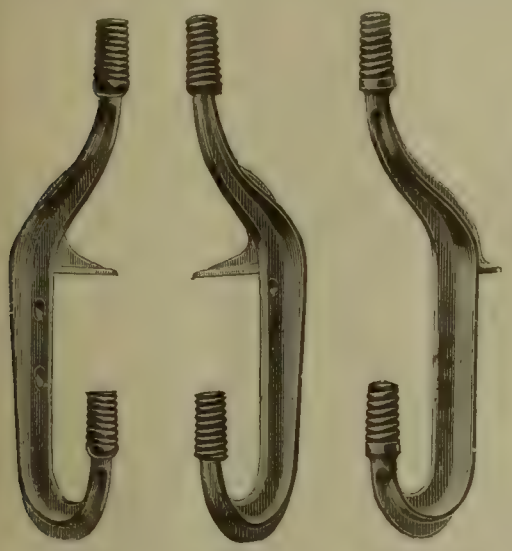
PLOTTING CURVES BY THE AID OF ELECTRICITY AND PHOTOGRAPHY.—Prof. Eric Gerard, of Liège, thus describes a process of plotting curves by the aid of photography. An induction coil is used to produce a spark between a strip of magnesium and carbon point. The spark is thrown on a concave mirror, attached to a galvanometer-needle, and is thence reflected to the sensitized paper covering a rotating cylinder or other moving screen. A short white spark, invariable in position, is obtained by connecting the terminals of the secondary coils to the coatings of a Leyden jar. The breaks in the primary circuit are effected by means of a tuning fork, so that the successive spark photographs occur at regular known intervals of time. The error due to irregular movement of the scale is thus avoided, without the complication introduced by the usual method of taking a separate time curve. The method is illustrated by a photographed curve, showing the variations in the field of an electric motor. A short length of wire, fixed to the armature parallel to the axis, is connected by suitable collectors with a galvanometer whose moving parts have little inertia. The lateral displacement of the photographed spark then measures the strength of the induced current, while its number represents the time.—*London Electrician*.

ELECTRIC SPARK ARRESTERS.—In the development of the locomotive engine the "spark arrester" has been relegated to the old iron pile. But according to a daily contemporary, a new use has been found for these once useful articles, as will be seen from the following extract: To prevent electric light fires originating from sources outside the building, Mr. Edward Atkinson suggests a law similar to one applied to railroads, making the company whose wire carried the current into the building liable in a claim for damages, with provision for recovery from the company upon whose wire the spark originated. That would stimulate the use of spark arresters and make all companies using wires of any kind careful to guard its lines from crosses. The self interest of the companies is relied upon to remove the dangers incident to the use of wires carrying dangerous currents, and also to encourage them in having "dead" wires removed from poles and connections. Such a law would also stimulate the putting of wires underground where they would be safe from "crosses."

We are advised that on April 5th, a new electrical journal entitled *Electrical Reporter*, published at Pittsburgh, Pa., will make its appearance.

HIGH INSULATION BRACKETS.

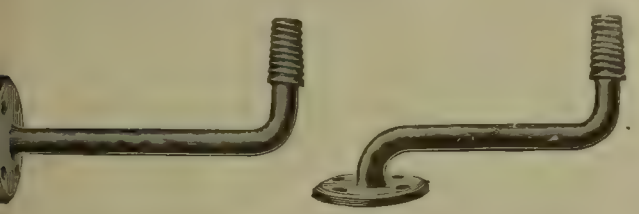
High insulation brackets have an important and peculiar field of their own in the economical operation of electric light apparatus. The Electrical Supply Company of Chicago, and Antonia, Conn., has devised brackets, of various shapes and forms, to meet every emergency in the safe wiring of buildings, inside and outside, for high tension currents.



LEFT. RIGHT. FORWARD.

LOOP OR SPREADER BRACKETS.

Our illustrations show left, right handed and forward iron brackets for pole lines to be used on cross arms for the taking off from the poles of loops for the various uses



WALL BRACKET. OFFSET ROOF BRACKET..

The wall, offset roof and straight roof brackets are useful for wiring along roofs or against walls. The wires are stretched from the poles to these brackets, from which they are dropped to points where needed.



CORNICE BRACKET.

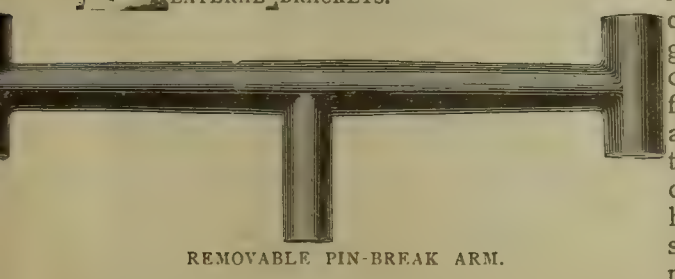
STRAIGHT ROOF BRACKET.

The cornice bracket is useful for wire work upon protruding cornices to which it is very often difficult to attach insulators without inverting them or forming an angle where the moisture will destroy the insulating qualities.



LEFT. RIGHT.

LATERAL BRACKETS.



REMOVABLE PIN-BREAK ARM.

The lateral brackets are designed to convey wires from corner to corner of buildings, and are made to fasten to brick or stone walls.

The removable pin-break arm and permanent pin break arm and the iron pin are very useful devices designed to be used in the construction



IRON PIN.



PERMANENT PIN-BREAK ARM.

of careful line work, which is now demanded generally by owners of property and insurance companies.

BOOKS RECEIVED.

The Manhattan Electrical Supply Company, at 26 Church street, New York, has issued its catalogue and price-list for 1890. It is very neatly gotten up, and we notice some improvement in some illustrations over those usually found in catalogues. The Edison talking dolls are illustrated in this catalogue, which we think is the first time these goods have been described to the public.

We are in receipt of a copy of the transactions of the Kansas Academy of Sciences for the year 1887–88. It contains papers on a great variety of scientific subjects.

THE MEHNER DRY CELL.—An improved dry cell has recently been brought out by Dr. C. H. Mehner, of Berlin. In dry cells it is usual to employ as a vehicle for the exciting liquid a neutral material which absorbs the liquid excitant and forms therewith a stiff paste. The materials commonly employed for this purpose are sponge, sawdust, gypsum, gelatine and the like. It is evident that the introduction of these inactive materials, is prejudicial to the action of the cell, as they form an encumbrance which, apart from its purely mechanical action, in no way promotes, but on the contrary tends to diminish, the effective working of the battery. In order to dispense with this inactive matter, Dr. Mehner imparts the required consistency to the exciting agent by preparing it as follows: The exciting salts, consisting of suitable chlorides of the alkalies, are mixed with a "mineral gelatine." This gelatine retains the salts in a paste, and, possessing exciting properties in itself, also acts an an exciting agent. The "mineral gelatine" consists of crystallized hydrated basic chloride of magnesium, which is formed by the addition of magnesia to a highly supersaturated and concentrated solution of magnesium chloride. If a suitable quantity of the solution of magnesium chloride is added to the oxide of magnesia, for example, in the first instance, a liquid product of a creamy consistency results, at first gradually gelatinizing and ultimately acquiring a pasty consistency. The degree of stiffness of the final product can be readily controlled by suitably regulating the addition of chloride solution. Dr. Mehner utilizes this property of oxychloride of magnesium in the preparation of his dry cell. He stirs the exciting salt with a solution of chloride of magnesium and calcined magnesia until he obtains a liquid of about the thickness of cream, which he pours into the cell. In the course of a few days the liquid changes to a stiff pulp, and the cell can then be closed. The "mineral gelatine" being in itself a substance capable of producing an exciting action in a galvanic cell, the employment of an inactive material is thus entirely obviated.

TESTING A SEARCH LIGHT.—On the night of February 24th during a heavy fog some practical tests were made at St. George, Staten Island, of an electric search light. Mr. Dwight Wiman has for some time past been experimenting in this direction, and the dense fogs last week gave him an excellent opportunity to put his device to a thorough test. A good deal has been said of late about a vertical beam of light being visible at a greater distance during foggy weather than one projected horizontally. This was proven to be a fact during these trials. When the light was thrown vertically it was seen at a distance many times greater than a horizontal beam could be seen. The lamp with which Mr. Wiman is experimenting has a number of new features. There is a parabolic metal cup at the bottom of the big reflector, the arc light standing precisely in the focus of this cup. Then in front of the light is a lens that is so placed as to collect and throw the rays of light out in a cylinder, if the term may be used, which is three and a half inches in diameter. Another feature of the light is the automatic feed which regulates the carbons, no matter what the position of the reflectors may be. The search lights hitherto used on war ships must be regulated by hand. Still another advantage is that it uses an incandescent current. Mr. Wiman has used the light for signalling to the army officers at Fort Wadsworth with perfect success on foggy nights. It is proposed, when the experiments are satisfactorily concluded, to place these lights on the ferry slips. With the beams thrown vertically the pilots will be able to approach without being blinded by the glare, and yet the vertical beam of light will be as plainly seen in the fog as an ordinary lamp is on a clear night. Mr. Wiman is at work on a system by which he hopes to adapt the light for signalling in case of fire. The system, although not yet complete, will include the use of red glass over the light and a well-defined code of flashes by which to locate the fire. An ingenious adaptation of this light to the use of navigators has been made on the Sound steamer Rhode Island. The light is located on the top of the pilot house, and is connected with the regular incandescent system of the boat. Then by means of a weight that may be operated by a magnet, the steam fog horn of the vessel is brought under the control of the electric current. In the pilot house there are four switches controlling the current that runs to the search light and the fog horn, and by means of these switches the pilot can start the search light so that it will flash at regular intervals automatically; or it may be made to burn steadily; or it may be made to flash automatically at the instant the fog horn begins to blow and cease to flash when the blowing ceases; or the horn may automatically blow alternately with the flashing of the light; or the flashing and blowing may be done alternately or simultaneously by hand. No such use of electricity was ever made before, and it is the opinion of the officers of the Stonington line that nothing yet invented will be so valuable as this combination in preventing collisions at sea. This search light weighs but 130 pounds. It occupies a deck space of two feet square. It was manufactured by the Scott Electrical Works, and is known as the Huntington Search Light.

RESISTANCE OF BISMUTH.—M. Leduc has recently shown that the alteration in resistance which bismuth undergoes when placed in a magnetic field varies considerably with the temperature of experiment. An analogous influence of heat occurs in Hall's phenomenon. The intensity of the magnetic fields used varied up to 9,000 C.-G.-S. lines per square centimetre. M. Leduc finds that, for temperatures between 0°C. and 45°C., the alteration produced by imposing a field of 7,000 lines diminishes by 1.09 per cent. for every degree centigrade increase in temperature.

ELECTRIC RAILWAY ASSOCIATION.

Regarding the recent meeting of the Western Electric Railway Association, says the *Street Railway Gazette*, of Chicago February 15th, we cannot help expressing the opinion that a greater interest should be shown in this association by electric street railway men, not only by the officers of the western roads, but also by those in the east. The objects sought to be accomplished by this association are certainly of a nature to commend themselves to all who are in any way interested in electric street railway enterprises

The primary object of the associat on is to effect interchange of experiences in what is, practically, a new field and regar ing which but very little is known by the majority of men. It is one th ng to operate a mule bobtail line, and quite another thing to operate with equal success and increased prosperity a line equipped with the n w motive power. We do not mean to intimate by this that there are not a great many gent emen who have adopted electricity as a motive power on the lines owned by their companies, who understand the electric railway business, but what we do assert is, that it is impossible, or next to impossible, for any ordinary railway man, be he president or superintendent, to jump all at once from animal to electric traction, and to know as much about the latter at once as he learned about the former in passing through the experience of a number of y. ars.

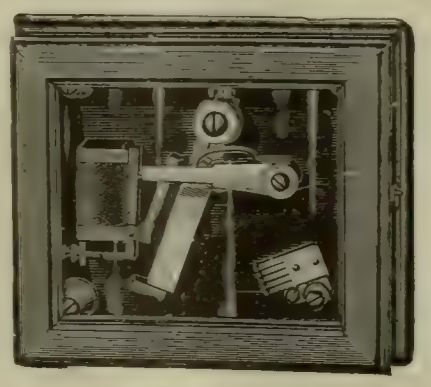
It appears to us that the policy of this Western Electric Railway Association should be to leave no stone unturned to get the officers of electric railways in all parts of the United States thoroughly interested in the work it aims to accomplish, and bring all possible influences to bear upon them to permit the *practical* men of their companies, whether supe intendents or general managers, to attend these conventions and reap the benefit of the experience of others in the same field. That there is ample room in the field for an association of this kind can not be denied, and because it is organized separate and distinct from any other, it must not be understo d that it is the desire of its members to conflict in any way with the American Street Railway Association. We have good reason for believing that a feeling once existed among some gentlemen prominently identified with the A. S. R. A., that the Western Electric Railway Association was intended to be somewhat in opposition to their association. But this was before the annual convention of the A. S. R. A. in Minneapolis, and the regular meeting of the W. E. R. A. held in the same city. Now that the objects of the W. E. R. A. are better known, we think that the feeling has died out, and that nothing but the best interests, affiliation and cooperation is desired by the western men.

When the A. S. R. A. was organized, such a thing as the use of electric power for the propulsion of street cars was not seriously thought of as a factor in street railway business, but within the last few years, however, it has been generally adopted, and to-day almost two hundred street railways are using electricity as motive power. It certainly appears to us that the gentlemen connected with the electric interests, and having but little interest in animals as motive power, would be doing a wise thing in getting together at least once or twice a year—without regard to other associations—and discussing among themselves ways and means for a better and more economic operation of their cars by electricity, and by these meetings or reunions be benefitted by the experience of those who have become practical men by having been through the mill.

A number of the members have expressed the opinion that it might be advisable to drop the first word of the corporate name of the W. E. R. A., in order that it may thus announce itself as the Electric Railway Association of America, and largely increase its sphere of usefulness.

AN ARMATURE PROTECTOR.

We illustrate a simple device which performs an important function in the protection of armatures of dynamos. This device is designed to operate on all makes of dynamos which are liable to become short-circuited, and thereby overstraining the conductivity of the wire and burning the insulation upon the armature. The armature entirely destroyed or seriously injured in short-circuiting the dynamo, is a common experience in electric light station



ARMATURE PROTECTOR.

work. The instrument is so arranged that upon an increase of current to any desired percentage above the normal, the magnetism of the field is instantly neutralized and the machine rendered incapable of generating the least current whatsoever, and thereby absolutely protecting the armature from sustaining serious injury in case of a short circuit or anything that approaches thereto. The action is instantaneous, leaving no time during which the insulation in the armature may be charred or broken down. This is done without any undue strain of any of the insulation of the dynamo. The simple return of a lever instantly replaces all parts in their normal position, and everything is ready to go forward. No time is therefore lost in the use of this Protector and the armatures are absolutely safe against destruction in the ways above referred to. The device is the property of the Electrical Supply Co., Chicago, Ill.

THE SUBWAY QUESTION.—On the 17th of February a meeting of the Board of Electrical Control was held to consider the question of granting the Standard Electrical Subway Company a part of the contract to build subways in this city. The original contract is held by the Consolidated Telegraph and Electrical Subway Company, which company has agreed to divide the work with the Standard Company. The corporation counsel had decided that the Board had power to contract with the Standard Company. Much opposition to the proposed division of contract was made by counsel for the East River and Manhattan Electric Light Companies, but the Board finally resolved to contract with the Standard for light and power subways On the following day, however, the 18th, an injunction was obtained by the Manhattan Electric Light Company restraining the Board of Electrical Control from entering into any contract with the Standard Subway Company.

ENGLISH EXPERIENCE WITH LEAKY GAS MAINS.—The accumulation of escaping gas in the "flush" boxes which contain the underground telegraph wires in Barnsley, England, recently exploded and shook things up in a lively fashion. While the employees of the Gas company were trying to discover the leak one of them lighted a match. Immediately a loud explosion occurred, and the box covering, weighing 1 cwt. was blown into the air and fell fifty feet away. One man had a very narrow escape.

Mr. A. C. Terry, President of the Buffalo Electrical Society, says of the AGE: I am quite smitten with its bright, newsy appearance, and I congratulate you on its rapid development. *Vive le* AGE.

HARMONIZING INSURANCE AND ELECTRIC LIGHT INTERESTS.

The subject of harmonizing insurance and electric light interests is one of paramount importance. At the Kansas City convention the committee having in charge the consideration of this subject made its report, which we give herewith in full.

REPORT OF THE COMMITTEE ON HARMONIZING INSURANCE AND ELECTRIC LIGHTING INTERESTS.

The committee on harmonizing the insurance and electric lighting interests was continued at your session, held at Niagara Falls last August, and requested to confer once more with the fire underwriters regarding the best means of preventing fires from electricity, and to try and bring about a reduction of insurance on the buildings lighted by electricity. The committee has had many sessions, and a great deal of correspondence with fire underwriters, and can only reiterate the recommendation made at the last meeting of this convention regarding the desirability of examining and licensing men employed in electric lighting and would further recommend all electric light companies to contribute toward the remuneration of several expert electrical engineers in different parts of the United States, who should instruct special agents or inspectors of insurance companies in the necessary knowledge to discern between good and bad electrical installation. The committee thinks that special agents and inspectors of insurance companies ought to qualify themselves in inspecting electrical installation, as far as fire is concerned, the same as they qualify themselves in inspecting other appliances put up in buildings, and judge of their relation to fire hazards. The committee realizes that as long as inspectors are employed at the expense of the electric lighting companies, underwriters will take no pains to acquire for themselves the necessary knowledge to inspect such risks. The committee would therefore recommend to electric lighting companies the appointment of an instructor to special agents for a period not exceeding one year, feeling certain within that time every special agent and inspector of fire risks could acquire all the necessary knowledge to enable him to judge of electrical installation as far as it applies to fire hazards. The committee has communicated this, its ideas, to underwriters' associations and insurance boards, but must confess that it has not met with the favorable responses to this proposition that it anticipated; however the insurance interests seem to be willing to take some steps to bring about the harmonious relations so much desired. Your committee was also instructed to report upon the advisability and feasibility of a mutual insurance company for insuring central stations. A plan was proposed by S. E. Barton, and Captain William Brophy, both of them well known to you, for the establishment of such a mutual insurance company, a prospectus of which is filed herewith, and has been forwarded to the members of this association. The committee after carefully considering the plan of operation as prepared by these gentlemen, has unanimously indorsed their ideas, as have a great many central station men of note, members of this association, as well as of the association of Edison Illuminating Companies. The plan proposed, will not only reduce the cost of insurance, but will aid in perfecting the construction of central stations; and by frequent inspections will aid the managers of such stations in the knowledge of modern appliances. Your committee would be glad to have this matter freely discussed to see if the project is not worthy of the official indorsement of the National Electric Light Association.

A protracted discussion ensued and was participated in by many members. The report was finally adopted.

The question of inspection and insurance of electric light stations received considerable attention during the discussion. In this line a prominent Ohio insurance company has already taken the initiative and has prepared a tabulated form of questions for the use of their inspectors of such plants. The questions are divided into eight

heads, viz: 1. Pertaining to dynamos and motors; 2. Switch boards; 3. Wiring; 4. Lamps; 5. Cut-outs and switches; 6. Exit and entrance wires; 7. Converter and testing; 8. Underground system. The questions to be answered under each division cover every essential point that has any direct or indirect relation to a fire risk.

Under the first-named subject, *i.e.*, dynamos and motors, the questions are: "whose," "alternating or continuous," "volts," "ampères," "speed," "kept clean," "exposure of combustible material," "foundation," "insulation," "wood-filled or not." The questions under the third head covers a large range on the subject of wiring, including "system," "size," "insulation," "special insulation—where passing walls and partitions, floors and ceilings," "method of fastening," "joints, how made," "how wrapped," "dampness," "exposure to injury," etc.

It is quite evident that with all the questions answered by a competent inspector any insurance company would have valuable and reliable data on which to base their calculations pertaining to the risks involved. Such inspection to be of value to any insurance company should be thorough and complete in every detail, and the plan adopted by the company in question seems to cover the ground very thoroughly. If all insurance companies would adopt a similar plan, and employ a thoroughly competent inspector to represent their own interests, we can readily see how the question of harmony would be to a great extent practically settled.

The report of the committee recommends that the insurance companies take this step, and this recommendation seems to be entirely in accord with business principles. After a plant is established and ready for operation, and the question of insuring the same comes up for consideration, it would seem to be the manifest duty of the insurance companies interested to first ascertain whether the establishment is a good risk before placing an insurance thereon. To find this out an inspection must be made.

But who shall supply the inspector? This is the point of difference between the two parties. There is no doubt that the insurance companies would prefer to make their own examinations, and be guided thereby rather than take the statement of the opposite party. Life and ordinary fire risks are accepted or rejected on the report of physicians or inspectors paid by the insurance companies. It would seem, therefore, that the inspection of electric light installations should be made by these companies and not by the parties seeking the insurance. The electric light people, in order to insure acceptance of the risk, would exercise proper care and comply with all rules in the equipment of their plants. They would understand that if their work was not up to the prescribed standard the insurance companies would reject the risk.

The example of the company in question should be generally followed, then the discord existing between insurance and light interests would disappear and satisfaction on both sides would result.

DEATH OF C. L. MITCHELL.—Charles Le Moyne Mitchell, ex Congressman from the city of New Haven and President of the Mitchell-Vance Company of New York, died February 1, of chronic gastritis. Mr. Mitchell was about forty-six years old. He was elected to Congress, and served from 1880 to 1884. Mr. Mitchell was a prominent member of the Electric Club. He leaves a widow and a son seventeen years old.

The Edison Manufactaring Co., through its general sales agent, James F. Kelly, No. 19 Dey st., has just issued pamphlets and price lists of the Edison-Lalande battery, copies of which can be procured by addressing that gentleman.

ELECTRIC RAILWAY.—Nashville, Tenn., will at once construct a five-mile electric railway.

AGAINST A POSTAL TELEGRAPH.

DR. NORVIN GREEN'S OPINION OF MR. WANAMAKER'S PET SCHEME.

Dr. Norvin Green, president of the Western Union Telegraph Co, on February 28th, appeared before the House Post Office Committee and delivered an argument against postal telegraphy.

Postmaster-General Wanamaker, with his assistants, Attorney General Tyner, Gardner Hubbard and representatives of different telegraph companies were present. Dr. Green began by discussing the merits and demerits of the European Governmental telegraph systems. He presented a table showing that the domestic companies had 18,000 stations and handled over sixty millions of messages annually, as against 53,000 stations and 173,000,000 messages in the rest of the world. They had more than half of the entire mileage of the world. The Western Union controlled ten elevenths of this business. Its stock was held by 3,550 persons in the United States, and 1,141 of them were females.

Dr. Green believed that the United States Government had no business with the management of the telegraph; it could not manage as cheaply; it could not do it better, and none of the senders of telegrams had asked it. It was prepared to make a rate of one-half of the cost of sending messages; and the deficiency would have to be made up by the 57,000,000 people who did not use the telegraph. The Government would need twice as many lines as were now in existence to do business. Here was a scheme presented to go to 447 post-offices where there was free delivery, and where there were abundant telegraph facilities. This was the way the Postmaster-General proposed to supply the needs of 58,000,000 people. This was the entering wedge of a movement to break down the present companies and establish a complete Government telegraph, and against that he protested.

Dr. Green then made a comparison between the American and English telegraph systems, and maintained that our rates were in reality much lower than the English low rates. And yet it was proposed to reduce these rates arbitrarily still lower. It would require 21,875 miles of wire to suppy a single connection to 447 places comprised within the Postmaster-General's plan, and to do business pratically would require at least 100,000 miles of wire. At the press contract rates, the rental of this wire would be $3,600,000. Whoever undertook to do the telegraph business over this system would do it at a loss.

The Chairman asked how much of their business the Western Union did in the free delivery cities.

Dr. Green replied that about 30 per cent. would cover it. That business was more largely speculative than the remainder of their business, as it would include the great money centres of the country.

The Chairman said that it was proposed to pay the operators out of the two cent charge for the postage stamp; he would like to know what the operating cost was.

Dr. Green replied that a close estimate placed it at three cents per message. In cases of long-distance messages it ran up to nine cents. The average compensation of first-class operators was $75 per month. Asked how the rates suggested by the Postmaster-General compared with the present rates, Dr. Green said that they were generally two-fifths lower. In the case of long distance messages they were one-half lower. To the broad question as to how the Postmaster-General's plan appeared to him as a business proposition, Dr. Green said that of course it could be carried out, but the business could not be done by the Government or a corporation at a profit, and somebody would have to make up a deficiency. The Postmaster-General's rates would cause a deficiency in the Western Union Company of $3,000,000 a week.

After arguing that the suggestions of Postmaster-General Wanamaker were impracticable, Dr. Green said that the Postmaster-General, in his order fixing rates for Government business, had made an order which the Board of Directors of the Western Union had decided was practically an order of confiscation of their business.

The Doctor became somewhat excited at this point and looking hard at Postmaster-General Wanamaker, who steadfastly returned the gaze, he exclaimed:

"And yet he says he is on first rate terms with the telegraph companies. He may congratulate himself that he can smile and smile, and murder while he smiles. We propose to controvert that order (fixing the rates for Government messages) in the courts and to demonstrate that it is not one-half of the cost of the service. We have not received a dollar on account of Government telegraph service since last July; we would not accept the rate. One word more—I don't know whether I am right, but this is the way it looks to a man up a tree.

"This is a Government of the people, by the people, and for the people. In England and other monarchical governments, in Canada, and in the so-called French republic, the Cabinet Ministers are members of the legislative departments and act as members of the legislature. But in a constitutional form of Government, as it is here, the executive, legislative and judicial departments are made independent departments. The President may recommend from time to time such legislation as may be needed. This proposed legislation has failed to receive his recommendation, although submitted in the Postmaster-General's report before his annual message was sent to Congress. I have never heard before that a Cabinet Minister may come before a committee to coach it and help his pet schemes through when they have not been recommended by the President."

Chairman Bingham, replying to Dr. Green, said:

"The Postmaster-General is here by the same invitation as you are—to discuss the half dozen bills referred to the House for its action. The Postmaster-General has not coached the Committee nor does the Committee propose to be coached by any one."

Dr. Green closed his testimony after engaging in a controversy with Mr. Chandler, who insisted that every man in this country was interested in cheap telegraphy.

ANOTHER LARGE SPRAGUE RAILWAY CONTRACT.

Information has just reached us that the management of another large street railway company has decided to equip its lines with the electric system. This is the Lindell street line of St. Louis, Mo., where there are now about twelve Sprague cars in operation. The satisfactory operation of these cars have been so marked, that the entire line will be equipped with the Sprague electric system.

Double bracket iron poles placed between the two tracks will be used, and will be of an ornamental and tasteful design.

Each pole will carry an arc lamp and so will act for the double purpose of lighting the street and carrying the trolley wires.

The only wires overhead will be the trolley wires. The main, feeder and arc light wires will all be carried under ground.

The last order of this company, for electrical apparatus, includes one hundred and thirty-six motors, and it is intended to have the road in operation as soon as possible.

AUTOMATIC REVERSAL SIGNALLING ON LONG SUBMARINE CABLES.

The ordinary "reversal key" has hitherto held its own against all rivals as a means of transmitting signals through long ocean cables. This is partly because it is extremely simple in construction and not liable to get out of order, but principally because all the different "curb keys" and "curbing" systems have proved unnecessary since the present system of signalling was adopted, viz., the insertion of condensers at both ends of the cable. The "curbing" is so well known that I shall not attempt any description here; be it enough to say that the condenser performs the curbing, for while

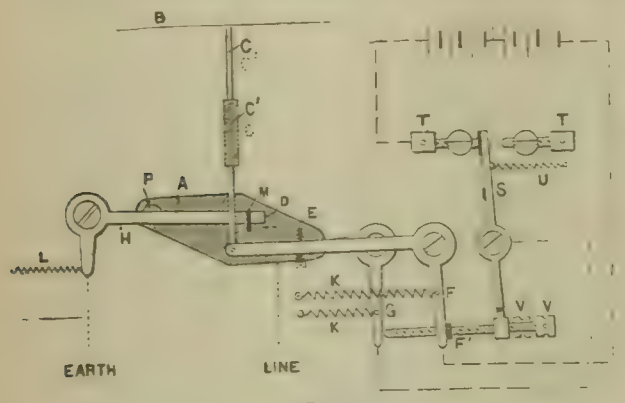


Fig. 1.

it is being charged, say positively, a positive current of short duration enters the cable and produces a signal, and as soon as the key is raised the condenser is discharged, which is equivalent to a negative current flowing into the cable, thereby neutralizing the effect of the former, or positive, current.

Very elaborate methods of improving the signals and increasing the speed of signalling by automatic

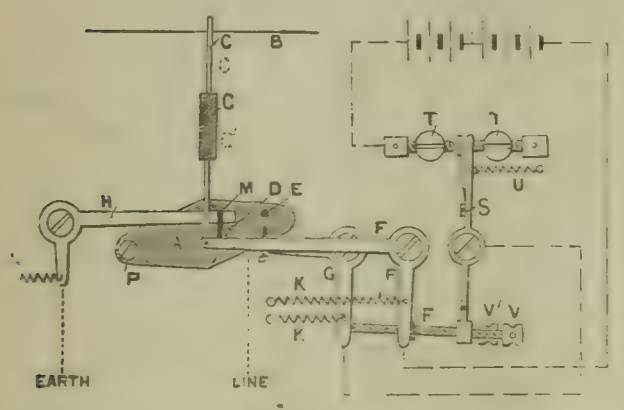


Fig. 2.

senders have been devised from time to time, and Sir William Thomson's automatic curb sender stands as a monument to his mathematical skill carried into the domain of practical life. None of these, not even Thomson's automatic curb sender, have, however, met with any great favor or proved remarkably successful, and this is, apart from other

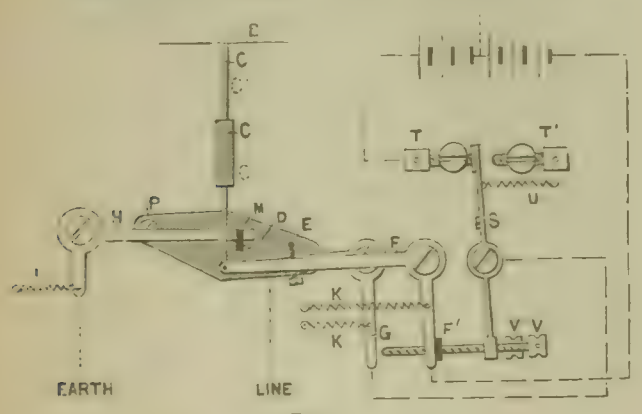


Fig. 3.

considerations, mostly due to the fact, that the *working speed, on long cables, cannot be increased beyond the capabilities of an ordinary "reversal key."*

Being engaged in the working of comparatively short cables, say 500 to 900 knots, it occurred to Mr. Julius Timm, the Great Northern Telegraph Company's mechanician at Shanghai, that the speed of signalling through these cables might be increased and the signals improved by doing automatically what was done by the key manually; and after a series of experiments he arrived at the conclusion that certain modifications of the Wheatstone Automatic Transmitter and Perforator would answer his purpose perfectly, and at the same time to enable him to utilize the beautiful mechanical details of these instruments This *automatic reversal-transmitter* devised by Mr. Timm, a description of which is given below, performs the work of the reversal key automatically, and produces the signals by means of currents of equal duration but of opposite sign for either dots or dashes, each individual signal being succeeded by a short interval of time during which the cable is connected to earth.

The principal parts of the transmitter are shown in their different positions in the figures 1–6, which are front views, and in figure 9, which is a plan view of the transmitting mechanism.

A is a pivoted ebony "rocking beam" pivoted on fulcrum pin, N, that is given an up and downward oscillating motion by means of a clockwork and crank, working on the pin P. On the "rocking-beam" is a platinum contact, D, connected to line, and an insulated stud, E. The levers F and

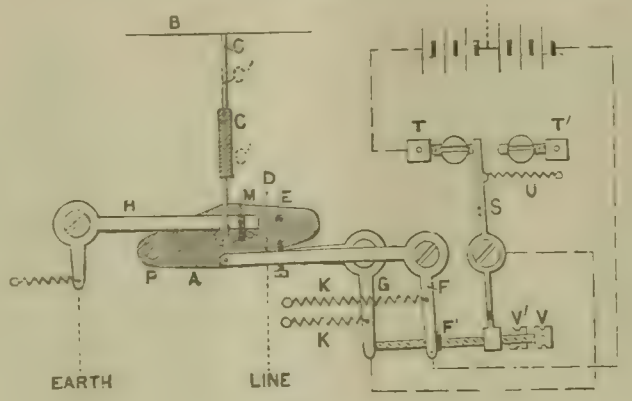


Fig. 4.

G, with the needles, c c′, pin-jointed thereto, are connected to the poles of the battery. The lever, H, is connected to earth, and so is the centre of the battery. The levers, F and G, are pivoted, and made to press against either the contact, D, or stud, E, by means of the springs, K. The lever, H, is also pivoted and rests on the contact, D, but as the springs, K, are stronger than the spring, L, the line only comes to earth through H, when the stud,

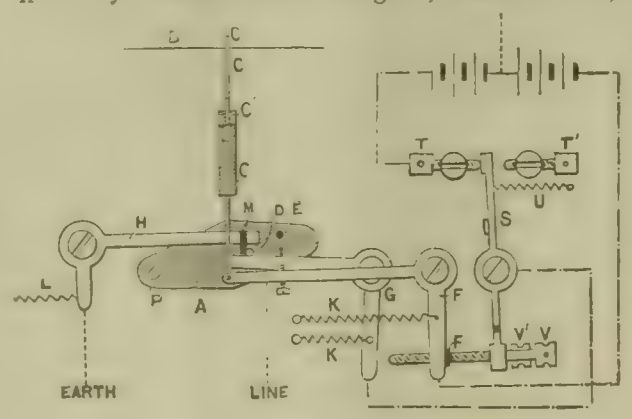


Fig 5.

E, takes the battery levers away from the contact, D. When one of the two battery levers for G rests on the contact, D, the lever, H, is removed from D by the ebony crosspiece, M. The motion of the battery levers is controlled by the holes in a perforated slip of paper, B, that, by means of the clockwork, is made to travel over the top of the needles. Fig. 7 shows a perforated slip of paper with the word "gutta-percha;" and the actual printing of this work by the receiving instrument is shown in fig. 8. The upper holes on the perforated slip represent dots and control the lever, G, the lower holes represent dashes and control the lever, F. By means of the centre row of smaller holes the slip is made to travel through the instrument when working.

On the right-hand side of the battery levers is provided a switch, to prevent the battery from being short circuited when the instrument is set in motion without any perforated slip being inserted. The action of this switch, with its tongue, S, moving between the contact screws, T, T′, is readily understood by referring to the figures. The lower part of the lever, S, is fork-shaped, and carries in each prong an adjustable screw, V, V′, placed just opposite the lower ends of the levers, F and G, respectively; V is prevented from coming into contact with F by the latter having a small insulated stopper, F′, inserted in its lower end, and the result of an up and down movement of the beam, A, is to send a negative current of short duration to line, and to put the latter to earth immediately

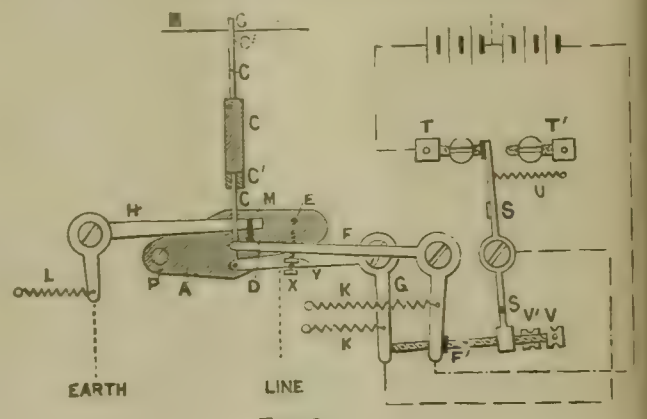
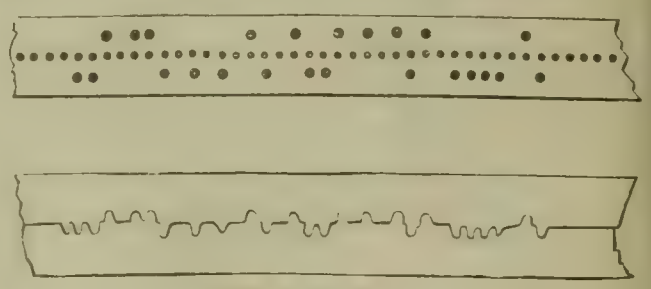


Fig. 6.

after (fig. 1 and 2). When a perforated slip is inserted three cases may occur :—

(*a*) Fig. 3 and 4.—The needles, C, C′, meet no holes in the paper; that is to say, the line remains to earth through the lever, H, during the full up and down movement of the beam, A, as both battery levers, F and G, are now prevented from touching the line contact, D; consequently no current can be sent to line.

(*b*) Fig. 5.—Needle c′, on the lever, G, meets a hole in the paper; that is to say, the lever, G, only is brought upwards to touch and follow the motion of the line contact, D—the lever, H, being meanwhile removed therefrom—and the positive pole of



Figs. 7 and 8.

the battery is applied to line, until the stud, E, removes G from D, putting the line to earth through H, and assuming again the position shown in fig. 3.

(*c*) Fig. 6.—Needle, C, on the lever, F, meets a hole in the paper; that is to say, the lever, F, only is made to touch and follow the motion of D—H being again lifted from D—and a negative current is now allowed to flow to line until the stud, E, takes the lever, F, away from D, thus bringing the line to earth through H.

In order to regulate correctly the functions of E,

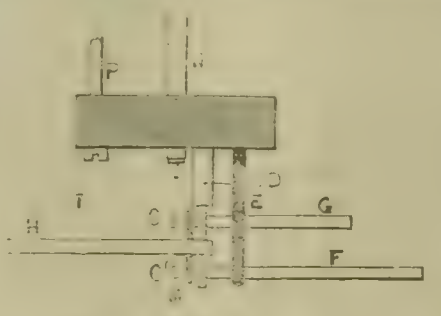


Fig. 9.

each of the battery levers, F and G, is provided with a small adjustable screw, Y and X, situate just below the insulated stud, E.

Since April last Mr. Timm's automatic reversal sender has been in use on the *Hongkong-Shanghai cables*. The operators much prefer the automatic signals to those sent by key, the former being clearer and more regular; and, as the reversal sender is easy to adjust and keep in good working

order, there seems a prospect of its introduction by some of the leading submarine telegraph companies, at all events upon such cables which are not worked up to their maximum capacity by hand, and where a continuous stream of traffic throughout the 24 hours may be disposed of somewhat more satisfactory by an automatic than by a manual system of working.—P. CHR. DRESING in *London Electrical Review.*

THE LIGHTNING ROD.—In 1749 Benjamin Franklin suggested the lightning rod in the following words: "May not the knowledge of this power of points be of use to mankind, in preserving houses, churches, ships, etc., from the stroke of lightning, by directing us to fix on the highest part of those edifices upright rods of iron made sharp as a needle, and gilt to prevent rusting, and from the foot of those rods a wire down the outside of the building into the ground, or round one of the shrouds of the ship, and down her side till it reaches the water? Would not these pointed rods probably draw the electrical fire out of a cloud before it comes nigh enough to strike, and thereby secure us from from that most sudden and terrible mischief?" It is a remarkable fact that the lightning rod of to-day is precisely the same as the one above described, and it occupies a unique place in the long list of inventions in that it has been in use for over 140 years without change or improvement.

CURIOUS EFFECT OF ELECTRICITY.—It is frequently noticed that where electric light wires are placed along the ceiling both soon become blackened with dust. What is most curious is the fact that this is true of direct current wires only. It does not happen in the case of the alternating current except what is deposited naturally. The cause of the attraction of dust is supposed to be due to the magnetic field surrounding the wire when the current is passing. The magnetism induced by the current is communicated to the surrounding air, which also becomes magnetic. Oxygen being a paramagnetic gas is attracted by the magnetism, and in its passage towards the wire carries with it particles of dust which adhere to the insulation, while hydrogen, which is the most diamagnetic gas, is repelled by the same force. This repulsive action transfers particles of dust to the ceiling to which they adhere. The accumulation of dust is more noticeable on positive current wires than on negative. The reason alternating currents do not accumulate dust to the same extent is due to the fact that the alternations are so rapid that the magnetism is practically at zero.

ELECTRIC LIGHT CHARTERS.—The United States Electric Lighting Company, of Philadelphia, capital $1,000,000, and the Brush Electric Light Company, of Philadelphia, with a capital of $1,000,000, have just been chartered by the Pennsylvania State Department.

DEPARTMENT OF INQUIRIES.

Editor ELECTRIC AGE:—Can you give me any information concerning the efficiency of the Edison Lalande battery, which you advertise? No one around these parts seems to know anything about it, and if you will reply through the columns of your valuable paper you will greatly oblige,

A SUBSCRIBER.

Answer.—The reason our correspondent has not been able to learn much about this battery is because it is a new one and is not as yet much known. It is, however, one of the most remarkable batteries ever produced. It was invented by Mr. Edison, and originally intended to drive phonographs. After it was perfected it was found to possess some very superior qualities admirably adapting it to all classes of work on open or closed circuits. A solution of caustic potash is used as the exciting fluid. The elements are zinc and carbon. The electro-motive force varies from 0.7 of a volt to 0.95, according to the character of the work performed. The internal resistance is 0.025 of an ohm, and the cell is perfectly non-polarizing. The endurance of this battery is one of its chief features. In our last issue we gave some facts concerning this battery as applied to telegraph work.—Ed. ELECTRIC AGE.

Ed. ELECTRIC AGE: I have noticed that a swinging compass needle comes to rest much quicker when a plate of copper is placed beneath it than it does when placed over any non-metallic substance, such as wood, etc. If copper is a non-magnetic metal, how is this phenomenon explained?

J. S. M., Jacksonville, Fla.

Answer.—The explanation is found in the fact that the moving magnet induces electric currents in the copper plate, and the reaction of the current on the magnet tends to bring the latter to rest. The currents in the copper are opposite to the force producing them, hence the tendency is to neutralization in accordance with Lenz's law.—Ed. ELECTRIC AGE.

A correspondent at Mill City, Nevada, says: "It seems to me that while two or more wires are supplied from the same battery if we open one or more of them it would throw the full battery on the others and throw the relays out of adjustment, and thus they would interfere with each other. Is this the case?"

Answer.—A direct anwer to this question in the absence of data is not possible. It depends altogether upon circumstances We would say, however, that under ordinary conditions, with the proper arrangement of batteries, etc., there would be no difficulty of the sort our correspondent apprehends.

To understand the reason for this Ohm's law must be considered. Take for example a wire with, say a resistance of 100 ohms. Supposing it receives current from a battery of 50 cells, and each cell has an electromotive force of 1 volt and an internal resistance of 2 ohms. These figures are approximately correct but we give round numbers to facilitate the solution of the example. According to Ohm's law, which is that the current on a wire is equal to the electromotive force of the battery divided by the resistance (of the battery itself and the external wire), the current on this hypothetical circuit would be .25 of an ampère, since the

Electromotive force E = 50
Internal resistance R = 2 x 50 = 100
Wire resistance r = 100

hence $\frac{50}{100+100} = .25$, which is the current in ampères.

Now supposing we connect another similar wire to the same battery, without changing the battery in any way, we find the combined or "joint resistance," by the usual rule, to be 50 ohms, which, added to the 100 ohms resistance of the battery makes a total resistance of 150, instead of 200, as in the former case. According to Ohm's law under these new conditions the current will be .33 ampères, .165 ampères for each wire.

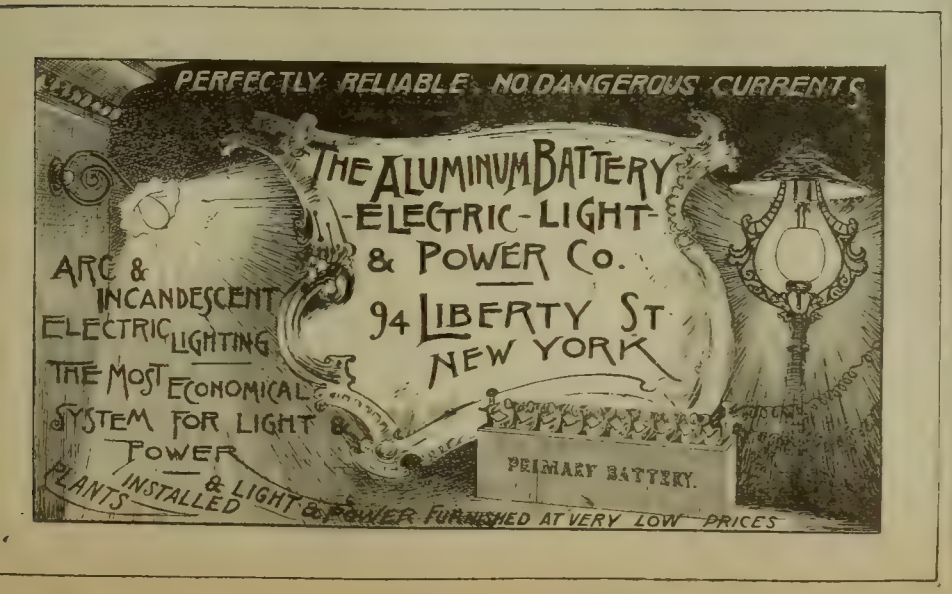
With all parts of the combined circuits properly proportioned this difference in current strength would not be appreciable in actual practice.

The key to the solution of the problem is in the simple fact that the current from a given battery is, within certain limits small when the outside resistance is comparatively large, and large when the outside resistance is comparatively small. Hence in working two wires from one battery a larger current is sent out by the battery than when one wire is worked.—Ed. ELECTRIC AGE.

RIVETING BY ELECTRICITY.—Riveting by electricity has been successfully accomplished. The cold rivet is placed in the hole, and when heated to the proper temperature it can be closed by any of the ordinary apparatus now in use. The heating of a half-inch rivet of two or three inches in length takes about half a minute.

THE KANSAS CITY VIEW COMPANY of Kansas City, Mo., is prepared to furnish pictures of the various groups made during the recent electric light convention. The pictures are excellent, and should be prized highly by those whose faces appear thereon.

EDISON LAMPS,
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2½ TO 40 VOLTS.
FOR BATTERY OR DYNAMO.
These Lamps can be used in Series on Dynamo Circuits for all kinds of Decorations and Displays.
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A first-class Electric Light Plant in a growing town of 8,000 population. Best equipped plant in Wisconsin; well established; pay better than twelve per cent. Good reasons for selling. Cash only will buy it.
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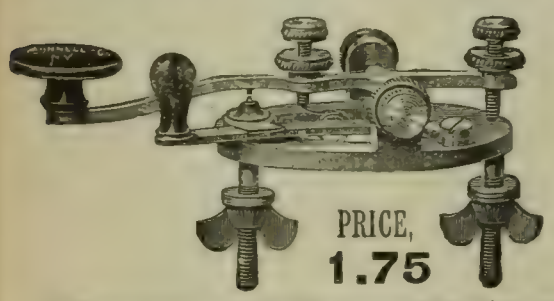
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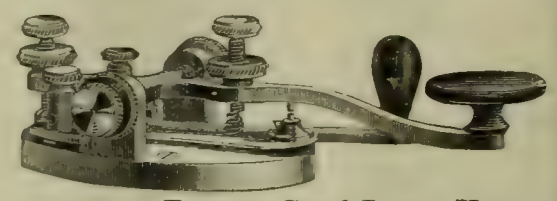


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THE SUBWAYS INJUNCTION.

Judge Andrews, in Supreme Court Chambers, heard, on the 5th inst., the argument upon the injunction which the Manhattan Electric Light Company asks for, to restrain the Mayor and the Board of Electrical Control from authorizing the Consolidated Telegraph and Electrical Subway Company to transfer its subways, and its right to build subways, to the Standard Electric Subway Company.

Counsel were present for the Manhattan Company, the North New York Company and the East River Company, all of which, with the Harlem Company, pray for the injunction. Counsel represented the Consolidated Company, the Standard Company, and the United States and Brush companies, which are united in opposing the motion.

Mr. Nicoll, in behalf of the petitioners, said that the Standard Company was owned by corporations which were hostile to the companies he represented. The proposed transfer, he said, would be simply a freezing out process. The rules provided that the Subway Company should hold the keys to the subways and have the right to fix rentals. Mr. Nicoll continued that the Board of Electrical Control had no power to make a new contract. It was deliberately proposed to relieve a company which had agreed to furnish $3,000 000 to the city, and to give its property to a company which doesn't propose to give up a cent.

William N. Cohen, for the Consolidated Company, said that his company had orders for thirty miles of electric light subway and ten to fourteen miles of telephone, telegraph, and Edison subways all to be completed within the year 1890. This work the company is unable to do.

W. Bourke Cockran said that his clients, the Brush and United States Lighting Companies and the United Electric Light and Power Company, had been absolutely forced to suspend operations by the raid on the wires last year. The three companies, deprived of the opportunity of going on with their business and refused the opportunity of repairing or replacing their wires overhead, had to take advantage of any chance offered to do their business. The United Light and Power Company pledged its own means to build a subway. Then the Manhattan appeared with a proposition to be bought out. It wanted $1,200,000 for what was not worth half that sum. That was the origin of the present proceeding.

The argument on the injunction was continued on the following day and Mr. Elihu Root took exception to what Mr. Cockran had said the day before as to the Manhattan Company's offer to sell out for $1,200,000. He read an affidavit denying that such an offer had been made, and stating that what the Manhattan Company had proposed was that all the companies should make advance payments of rental to the subway company then existing, in order that it might have sufficient capital to pursue its work

Mr. Cockran asked leave to submit affidavits showing that this offer had been made "to make us pay about forty per cent. more than the property was worth for the privilege to go on and exist."

Mr Cohen, for the Consolidated Subway Company, contended that in case the old subway company were unable or failed to do the work required of it, the Board had the right to make new contracts with other people or corporations.

William H Peckham appeared for the Mayor and Board of Electrical Control, and said he was also counsel for the Standard Company, which had not been made a party to the suit.

Mr. Peckham said that the plaintiff virtually asked that the Court should insert in the statutes a provision that the subway company must be a company, the stock of which is owned by no party which is in control of electric lighting. The defence set up the statement that it was necessary to build the subways now, this year. The old company was not able—the Standard Company stood ready to give the facilities. The company had ample capital, and was contemplating an increase from $1,500,000 to $3,000,000.

Mr. Root pictured the Standard Company as the representative of Westinghouse interests, and said, that with it as the landlord of the subways, those interested would have practical control of the conduits.

The motive of the transaction was found in an agreement of the Standard Company to pay the Consolidated $1,800,000 for its high tension plant. It was simply a money consideration that made the Consolidated change its front and conclude that it thought it couldn't finish the work this year. The Standard was simply a mask for the Westinghouse.

RESTORING THE ELECTRIC LIGHTS.—The Electric lights in the streets of this city are being gradually restored. This is being done in a much quieter and more decorous manner than was their destruction some months ago. The subways are being utilized to their fullest capacity, and every day workmen may be seen in various parts of the city placing cables into the subways through the manholes. The sooner the subway system is extended the sooner will all the electric lights be restored. Without discussing the wisdom of dividing or not dividing the subway work between two companies, there is one thing certain, and that is, if two companies were to carry on the work, industriously and sincerely, electric lights would again be shining in our streets in a much shorter space of time than if only one company is to be depended on.

ELECTRIC MOTORS TRIED ON A LONDON UNDERGROUND RAILROAD.

LONDON, Eng., March 6.—The running of a train by electricity was tested to-day on the underground railway between the city and Clapham.

The Lord Mayor of London and a large party of civic and scientific gentlemen passed over the route on the train and pronounced the experiment a complete success.

The application of the new motive power is peculiarly suitable to the underground roads, absorbing the plagues of smoke and smell. The company will at once take steps looking to the permanent adoption of electricity as the motive power.

This road is not in any way connected with the Metropolitan District Railway, but a separate scheme. It starts from "The Monument" on the Middlesex side of London Bridge, passes through a tunnel under the Thames to the Surrey side of the river, and after stopping at several stations, among which is the well-known "Elephant and Castle," terminates at Clapham, the whole distance being about four miles. The cars are more on the American plan, being light and commodious and all lit by electricity.

The underground tunnel (or rather tunnels) through which the train passes is divided so that the up and down trains are entirely separate. This idea, of course, tends to ventilate the tunnels by causing a greater draught. The scheme has been looked forward to in London for some time with much anticipation, and according to the above cablegram it has met with much success. It is stated that a speed of twenty-five miles per hour was attained and the motors proved their excellence by holding well up to their work.

MAKING ELECTRIC LIGHT WIRES SAFE.—Just before the new year THE ELECTRIC AGE sent out circulars to the prominent electricians throughout the country containing a series of questions on the subject of making electric light currents safe to life and property. The replies to these questions were given with commendable promptness, and for a period of five or six weeks each issue of THE ELECTRIC AGE gave its readers the benefit of the valuable suggestions contained in these replies, which were published in full. The subject attracted a great deal of attention, and was discussed in the daily press very extensively. The London *Electric Review*, appreciating the importance of the subject and the value of the opinions expressed thereon, in its issue of February 14th devoted more than two pages to the tabulation of these inquiries and replies. The whole subject is epitomized, and at a glance one may learn just what views any of the electrical experts named entertain on any of the points covered by our questions. The table will be of value to those interested in the subject of making electric light wires safe, and we congratulate our esteemed contemporary on its successful and commendable enterprise.

PATENT DECISION.—Commissioner Mitchell, of the Patent Office on the 7th instant rejected an application for a patent for an air ship. The principle involved is an important one. The Commissioner held that the alleged invention was wholly theoretical, and that so long as every-thing rested wholly on theory, and so long as every-thing remains to be demonstrated, nothing has been done which is patentable.

WATER POWER.—The new electric light companies in Washington, D. C., propose to utilize the water power of Great Falls, 16 miles above the city, on the Potomac river. It is estimated that there is an available horse-power of 20,000. One plan contemplates the operation of dynamos by compressed air forced to the city from the falls.

THE THEORY OF ARMATURE REACTIONS IN DYNAMOS AND MOTORS.

BY JAMES SWINBURNE.

It seems to be generally supposed that electrical engineers are in full possession of means for calculating out and designing a dynamo or motor. This is no doubt the case as regards very small machines, and as regards large machines when considered with reference to no load. The effect of the armature current is mentioned in the classical paper of Drs. J. and E. Hopkinson, the excitation necessary at full load being given in terms of the armature current turns and the lead of the brushes: but as the lead of the brushes is determined after the machine is made, that paper gives the first step towards a solution of the armature reaction, but does not go farther. As not only the excitation necessary at full load, but also the best dimensions of the magnets and the proper shape of the pole-pieces, depend on the armature reactions, and as the armature reactions are of immense importance in large machines, such machines cannot be designed with accuracy unless the armature reactions and position of the brushes at full load can be foretold. The

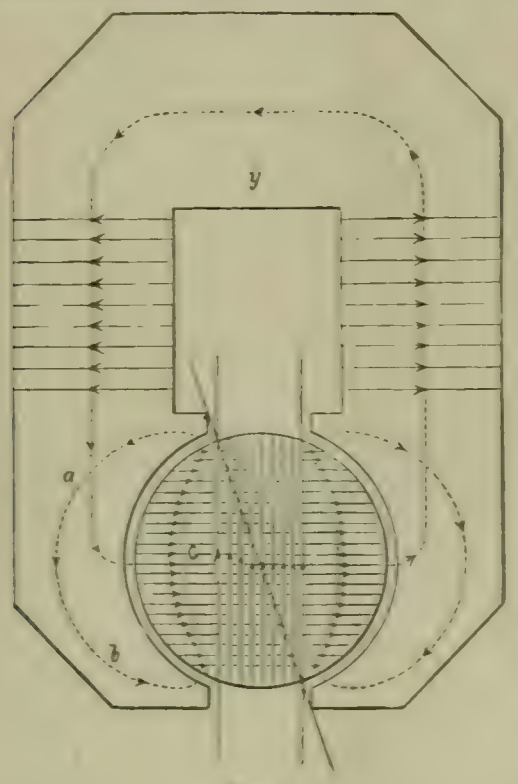


FIG. 1.

armature reactions are often regarded as obscure and unimportant phenomena, but, except in very small dynamos, the error due to neglecting them would be much greater than that due to neglecting the waste field, which has, of late, received so much more attention.

As most engineers are now in the habit of using C. G. S. measure, the C. G. S. system will be used in this paper. The only new importation into dynamo work will be the idea of magnetic potential, as it is exceedingly convenient for explanation. The magnetic potential is, of course, the line integral of the magnetic force, and is 4π times the current turns. As it is cyclic, we must take the line integral once round a circuit interlinked with the exciting circuit. Any point of the circuit may be assumed as of zero magnetic potential, but generally difference of potential is alone considered. The magnetic potential may be thought of as ampère-turns, or might be measured in ampère-turns; but as such a method is unusual, it will be taken in C. G. S. measure, being denoted by the symbol Ω; and for want of a unit of its own, it may be measured in ergs. An ampère-turn thus gives a magnetic potential of $4\pi/10$ ergs, or 1·26 ergs.

MAGNETS AND WINDING.

As single-magnet machines are very largely used now, and a type can be taken which is approximately that used by most of the large representative makers, such a machine may be taken as an example. A formula which gives the size of iron, and the excitation needed, will then be worked on.

The vertical line through the centre may be taken as at zero magnetic potential at no load. Assuming the length of the core to be the same as that of the pole-pieces, and calling the external radius of the core r, and the radial depth of the discs b, and the length of core a, and the armature induction B_a the surface integral of the induction, or what may be for shortness called the total armature induction, is $2\,a\,b\,B_a$. The desired armature induction is here assumed. In practice different makers prefer different inductions, and to discuss the various considerations would take too much room, and would be outside the subject of this paper. The distance, l_a, which represents the length of iron that has



FIG. 2.

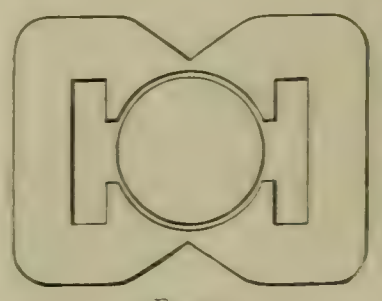


FIG. 3.

to be magnetized to the induction B_a, depends on the arc of embrace of the pole-pieces; but a large error in the estimate of this length causes a very small error in the design of the machine, as very little of the excitation is spent on this part of the magnetic circuit. The fall of magnetic potential over $\frac{1}{2}\,l_a$ is $\frac{1}{2}\,l_a\,B_a\,u$, and may be written $\frac{1}{2}\,\Omega_a$. The induction in the air gap depends on the armature induction, the radial depth of the discs, and the pole-face angle. It will be written B_g. The line integral of the induction across the gap is $\frac{1}{2}\,g\,B_g$, where g is the distance across the gaps. $\frac{1}{2}\,g\,B_g$ may be written $\frac{1}{2}\,\Omega_g$. The fall of potential from the middle of the yoke to the pole-piece depends on the length of the circuit and the induction. It may be written $\frac{1}{2}\,l_m\,B_m\,u_m$ or $\frac{1}{2}\,\Omega_m$. The induction that can best be used in the field magnets depends, again, on many things that can-

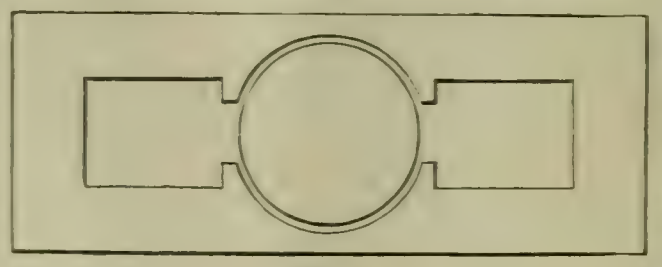


FIG. 4.

not be discussed shortly. As it is generally best to use a lower induction in the yoke, that must, of course, be taken into account. As the other half of the magnetic circuit is similar at no load, the line integral of the magnetic force needed in the shunt is $\Omega_s = \Omega_a + \Omega_g + \Omega_m$. As to the length of the field magnets, it depends on the total excitation needed. Different makers allow different lengths per thousand ampère-turns on the fields.

At full load the armature induction has to be increased to allow for the resistance of the armature and series coils, and sometimes for the leads also. A higher value is therefore taken for B_a, and therefore for Ω_a. The effect of the armature current itself may be divided into two components; and in the case of a drum armature, which may be taken for the sake of simplicity, the electrical effect is the same as if the external conductors were connected across the ends as shown in Fig. 1. There is thus a belt of current-turns, opposing the field excitation, and another belt acting at right-angles to it. These may be called the back and the cross-ampère turns, and the induction produced by them, the back and the cross induction respectively. The breadth of these belts or the number of turns in each, depends on the lead of the brushes. For the present the lead of the brushes may be assumed. The extra difference of magnetic potential between the pole-pieces due to the back current-turns is $\pi\,C\,n_b\,10$, where C is the armature current in ampères, and n_b the number of external armature conductors in the belt of back turns, n_a being the number of external armature conductors. This may be written,

$$\Omega_b = \pi\,C\,n_b\,10 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The difference of potential of the pole-pieces at full load is thus $\Omega_a + \Omega_b + \Omega_g$; and Ω_a and Ω_g are greater than at no load, because the armature and gap induction are higher. The difference of potential between the pole-pieces may be shortly written, Ω_m. In a given type of dynamo the percentage of waste field varies directly as the difference of potential of the pole-pieces, provided the field magnets are not strongly magnetized, and is independent of the linear dimensions, or as the diameter of the armature. If the armature cross-sectional area is $2\,a\,b$, and the armature induction is B_a, and if the field induction desired is B_m, the cross-section of the field-magnets must be

$$A_m = 2\,a\,b\,\frac{B_a}{B_m} + \frac{r\,\Omega_f}{M\,B_m} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where M is a coefficient depending on the type of the machine. This coefficient can be readily determined from another machine of the same type but of different size, and an error in its estimation makes comparatively little difference in the dynamo.

In ordinary single-magnet machines M is generally about .08 to .085; in double-magnet machines it is less. Of course a great deal depends on the mounting of the dynamo. A machine let into a bed-plate, as is often necessary in the case of direct-coupled engines has more leakage.

An equation for the shunt and series excitation is now to be found. From (1) the field induction is found—

$$B_m = \frac{2\,a\,b\,B_a}{A_m} + \frac{r\,\Omega_f}{M\,A_m} \quad . \quad . \quad (3)$$

Giving the value of B_a and Ω_f at no load, the value of B_m at no load is obtained. The shunt excitation is thus

$$\Omega_s = l_a\,B_a\,u + g\,B_g + l_m\,B_m\,u_m \quad . \quad . \quad (4)$$

in ergs, or this number divided by 1·26 in ampère-turns. By giving the full-load values of B_a and Ω_f the total excitation,

$$\Omega_s + \Omega_m = l_a\,B_a\,u_a - \pi\,C\,n_b\,10 + g\,B_g + l_m\,B_m\,u_m \quad (5)$$

is obtained, and, of course the difference gives the series excitation. Of course the full-load field induction has already been assumed in finding the size of the magnets.

It must not be forgotten that all this time it has been assumed that the lead of the brushes, and therefore Ω_b, is known.

Returning to Fig. 1, a closed line, $a\,b\,c$, may be drawn which is interlinked with all the armature conductors under the pole-piece. The magnetic potential round this circuit is

$$\Omega' = \pi\,n\,C\,10 \quad . \quad . \quad . \quad . \quad . \quad (6)$$

when n is the number of armature conductors, and C is the armature current as before, and θ is the angle of embrace of the pole piece. As the permeability of the iron, both in the part of the armature and of the pole-piece through which this line passes, is great, the whole difference of potential may be taken as being between the core and pole-piece. The induction under the leading corner, due to cross current-turns only, is then $-\frac{n\,C\,\theta}{2g \times 10}$, and under the trail-

ing corner it is $+\frac{n C \theta}{2 g \times 10}$. The field is thus weakened under one corner, and, provided the permeability of the iron is practically infinite, equally strengthened under the other, being at its normal value half way down. The cross induction has in this case no direct effect in increasing or lessening the E. M. F. of the machine. If a dynamo were enlarged to scale, the field excitation would increase as the linear dimensions, but the armature current-turns, assuming the same current-dens ty, would increase as the square of the linear dimensions. If the electromotive force of the machine were kept the same, they would increase faster, as the insulation would take proportionately less room. It is thus evident that a size would soon be reached when the cross induction under the leading corner would be equal to the normal induction due to the field excitation, and there would be no field to reverse the current in the section being commuted. The size at which this takes place varies according to the practice of makers, and is generally above the size in common use, as the output of a given armature is generally much smaller than might be taken from it. Machines with single magnets, and fairly large outputs for the size of their armatures, become difficult to design when they have armature above 35 to 40 cm. diameter. The fault can to some extent be corrected in single-magnet machines by making the polar angle—that is, the area of the pole-face—small. There are then fewer cross current-turns, and the induction in the gap is greater, so there is less chance of reversal of induction under the leading corners. This demands more field excitation and larger field magnets, as the difference of magnetic potential between the poles is greater, and so the waste field is greater. If the pole-pieces are made small, so as just to carry the induction due to the field coils without saturation, one side will be to some extent saturated by the additional induction due to the cross current-turns. In Fig. 2 the pole-piece is small across *a–b*, and the iron may need some magnetic force there, so the whole of the magnetic force of the cross-current turns will not be spent on the gaps, and the cross induction will thus be less. On the other side, of course, the cross induction is not lessened, as the iron is less magnetized. The resulting field will not be symmetrical. If the armature is Gramme-wound, the lower brush will need more lead than the upper. Sparking at the lower brush in single-magnet Gramme machines has been frequently noticed by dynamo makers. Of course, it may be partly due to the poles being too small in section, so as to throttle the main induction of the field magnets, but it is much more often caused by the cross induction. If the armature is drum-wound, throttling the cross induction on one side will do some good in lessening the cross induction ; but it is difficult to throttle the cross induction without also throttling the field induction proper and wasting field exciting power.

Fig. 2 may be taken as a diagram of a 30 cm. or 12 in. armature machine of about the usual type, with the magnets rather close.

If there were no cross induction the pole-pieces would not be strongly magnetized anywhere, but when the cross induction is superimposed, the neck reaches a high magnetization, the induction in this case amounting to about B = 15,800 there, and to about B = 17,200 a little higher up. If it were not that the cross induction is lessened by the saturation of the iron, the neck would rise to B = 17,500, and in the region 5 cm. or so above the centre line to B = 18,600. The difference of magnetic potential between a point a little below the middle and the top of the pole-piece comes to about 1,880 ergs. The effect of this is that more than 1,000 extra ampère-turns are required on the field-magnets. In a Gramme machine the effect is very easily observed by the use of a pilot brush. A resistance of, say, 100 ohms is connected between the terminals of the machine. The pilot brush is connected to one terminal of a detector, and the other terminal is connected successively to points in the resistance corresponding, say, to 95, 90, 85 ohms, and so on. The positions of the brush for the zero readings are noted. This avoids errors due to slight variations of speed, which give trouble in the first instance, and errors due to bad contacts. With a drum this method does not give the distribution of the field, as each convolution is on both sides of the armature ; but if one pole-piece is highly magnetized by the cross induction, the half of the armature under the upper left and lower right-hand halves of the pole pieces (in Fig. 2) gives a lower electromotive force than the other. This effect is sometimes very marked in machines with cast-iron pole pieces.

A double magnet two pole machine can be made up to a larger size than a single by shaping the pole-pieces so as to throttle the cross induction. Two common types of machine are shown in Figs. 3 and 4 with the pole pieces so cut. If it be assumed for the moment that the armature section current can be reversed with no appreciable field, the largest pole-angle that can be used is when the gap induction due to the field excitation is equal and opposite to the cross induction under the leading corner—that is, when

$$\theta = 2\sqrt{\frac{b\, g\, B_a \times 10}{n C (r + \frac{1}{4} g)}} \quad . \quad . \quad . \quad . \quad (7)$$

As the armature sections need a sensible field to reverse them, the pole-angle must be less than this.

A BIG ROAD GOES IN FOR ELECTRICITY.

The week before last, Mr. Thos. Lowry, president of one of the largest street railway combinations in the world, showed his confidence in the electric system of street railway propulsion by deciding to equip all the lines of St. Paul and Minneapolis by electricity. The electric company to whom this contract was awarded is the Sprague Electric Railway and Motor Company, and the investment called for from the Street Railway Company is said to be in the neighborhood of $2,000,000.

Before deciding upon any system to be used upon these roads the president of the company, together with the directors, made a careful inspection of all the different methods of operating street cars in large cities, and investigated the merits of each. As a result of this investigation the contracts for the partial equip ments of the road, by cable, were cancelled, and negotiations were entered into with the Sprague Company for the entire electrical equipment.

By the terms of the contract the Sprague Company is to fully equip and put into working order the entire mileage owned by the railway company, the work to be completed by June 1st, and the first delivery of electric railway apparatus, which will include 400 Sprague improved motors for the equipment of the rolling stock, will be made shortly.

This is probably the largest order which has ever been given for electric railway motors, and evinces the confidence which prominent street railway managers feel in the electric system.

Proposed Electric Railway Between St. Petersburg and Archangel.—*La Lumière Electrique* reports that a scheme is on foot in Russia for connecting Archangel and St. Petersburg by an electric railway. The estimate cost of the proposed line, including rolling stock, is $20,000 per mile, or 30 per cent. less than that of an ordinary railway. As the distance between Archangel and St. Petersburg is considerably over 500 miles as the crow flies, the Archangel merchants, who are said to have originated this project, must possess a remarkable degree of enterprise.

HOW EDISON INVENTS.

Mr. George Parsons Lathrop, in his article recently published in *Harper's Magazine*, recites a talk he had with Thomas A. Edison as to the manner in which the great inventor developed his ideas. The following is interesting, inasmuch as he makes emphatic the difference between discovery and invention :

"Discovery is not invention, and I dislike to see the two words confounded. A discovery is more or less in the nature of an accident. In my own case but few, and those the least important, of my inventions owed anything to accident. Most of them have been hammered out after long and patient labor, and are the result of countless experiments, all directed toward attaining some well defined object"

The electric light gave him more difficulty than any of his other inventions. He spent years over it, and is still experimenting. He says of the light :

"I was never myself discouraged or inclined to he hopeless of success. And yet, through all those years of experimenting and research, I never once made a discovery. All my work was deductive, and the results I achieved were those of invention pure and simple. I would construct a theory and work on its lines until I found it was untenable. Then it would be discarded at once, and another theory evolved. This was the only possible way for me to work out the problem, for the conditions under which the incandescent light exists are peculiar and unsatisfactory for close investigation. Just consider this : we have an almost infinitesimal filament heated to a degree which it is difficult for us to comprehend, and it is in a vacuum, under conditions of which we are wholly ignorant.

"You cannot use your eyes to help you in the investigation, and you really know nothing of what is going on in that tiny bulb. I speak without exaggeration when I say that I have constructed 3,000 different theories in connection with the electric light, each one of them reasonable and apparently likely to be true. Yet only in two cases did my experiments prove the truth of my theory. My chief difficulty, as perhaps you know, was in constructing the carbon filament, the incandescence of which is the source of the light. Every quarter of the globe was ransacked by my agents, and all sorts of the queerest of materials were used until finally the shred of bamboo now utilized by us was settled upon."

Edison's strongest mental characteristic is an intense desire to find out the causes and nature of things.

The Sperry Electric Company's New Quarters.—The Sperry Electric Company of Chicago has just moved into their new quarters, 203 South Canal street. Their rapidly increasing trade necessitated more commodious quarters, and their new manufacturing plant is one of the most complete and efficient that can be found anywhere. They occupy the 6th and 7th floors of the building, each floor being in dimensions 75x175 feet. The dynamos are manufactured on the sixth floor, and the present capacity of this department is four plants per week. The arc lamps are manufactured on the seventh floor, and 100 of these are turned out per week. The Sperry dynamo is such an excellent and well-known machine that it is hardly necessary to enumerate its special points. It may be said, however, that this dynamo is one of the most efficient made, and most economical to operate and maintain. The regulator is a very valuable feature of the Sperry system, and is the only regulator that will maintain a steady light through all changes, from one light to a full load, without the necessity of maintaining a resistance coil. The Sperry lamps are simple and efficient, and entirely automatic in operation. The complete system is one that produces excellent results, and one in which the company justly feel proud.

SCIENTIFIC USE OF THE PHONOGRAPH.

Mr. Geo. M. Hopkins, in the *Scientific American*, gives some very interesting facts concerning the use of the phonograph for scientific investigation. The character of the phonographic record interpreted by vibrating flames was the subject of his investigation and we give the article in full, as follows:

The phonograph in its perfected state, although a scientific triumph and a model of mechanical and electrical skill, is designed for commercial and social purposes rather than purely scientific use. Still it has within itself all the elements necessary for several very interesting physical experiments. These are obviously related to sound or vibratory action, some of them being illustrative of the phenomena of the phonograph itself.

Mr. Edison in the multitude of his cares finds no time to develop the purely scientific applications of this most interesting invention. He has, therefore, delegated this pleasant task to the writer, who has given the subject considerable attention, and has devised a series of phonographic experiments, one of which is shown in the annexed engravings. This is given first, as it seems best calculated to illustrate and explain the action of the phonograph.

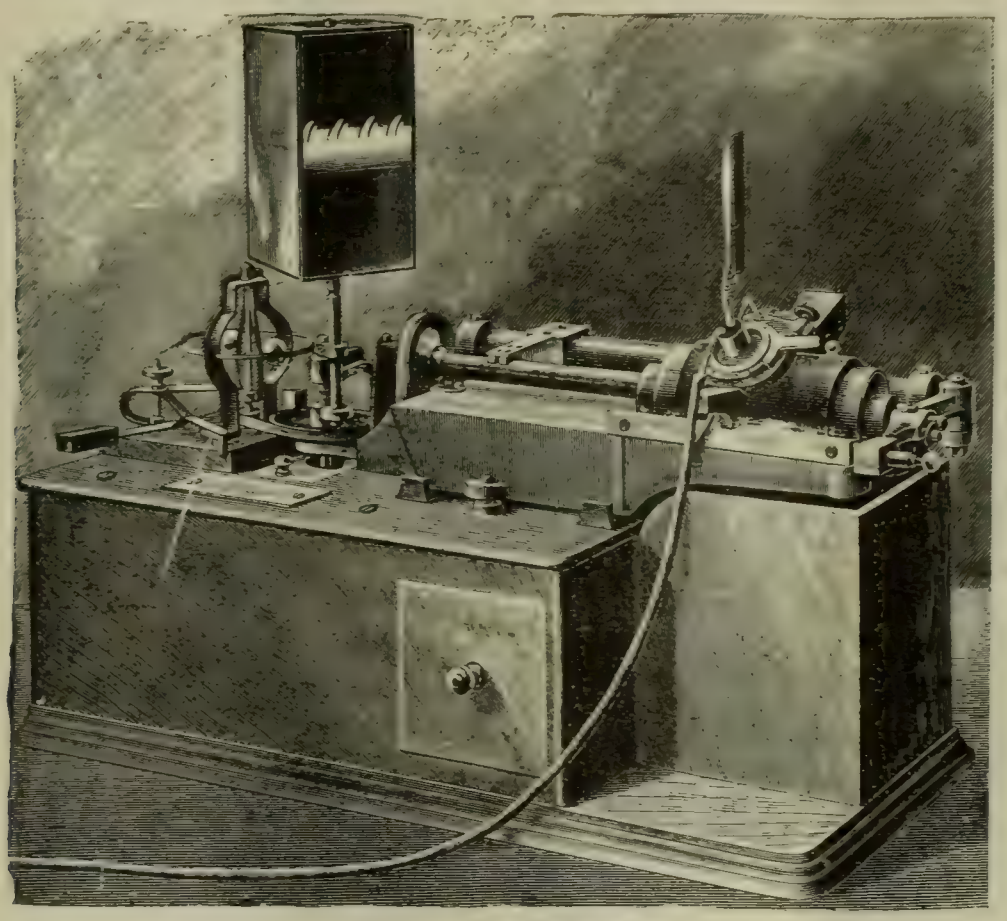


FIG. 1. THE PHONOGRAPH.

The instrument shown contains all the recent improvements. The phonographic record is made on a hollow cylinder of wax-like material. This cylinder is fitted to a cone mounted on a screw shaft. This shaft turns on two pointed bearings, one of which is fixed, the other being supported by a swinging arm, seen at the right hand end of the machine in the engraving. This construction permits of placing the record cylinders on the cone and removing them quickly and without the necessity of making any adjustments. The screw shaft is provided with a loose central bearing, which holds it up when the end bearing is swung around.

On a fixed rod arranged parallel with and behind the screw shaft is placed a sleeve which carries at one end a spring arm provided with a segment of a nut, which rests upon the threaded portion of the screw shaft. To the other end of the sleeve is attached a curved arm, which reaches over the record cylinder and supports the diaphragm cell. The latter is fitted to a socket in the arm, and is arranged so that it can be turned in its own plane through a few degrees to bring the recording and reproducing styluses into the position of use. An arm projecting from one side of the diaphragm cell is used to effect this change of position, and an adjusting screw, located above the arm, is used for securing a fine adjustment of the reproduction stylus. The enlarged sectional view, Fig. 2, shows the diaphragm cell and parts connected therewith.

The diaphragm is a glass disk about 1-200 inch in thickness. This is clamped at the edge between two thin soft rubber rings. To the centre of the diaphragm is connected a stud, to which is pivoted one end of the lever, *a*. The opposite end of the lever is forked. One arm of the fork carries the reproducing stylus, *b*, and the other carries the recording stylus, *c*. These styluses are made of sapphire, a material which ranks next to the diamond in the scale of hardness. The reproducing stylus is a microscopic sphere or knob, perfectly smooth and highly polished. The recording stylus is cup-shaped upon the end which cuts the record cylinder, and is provided with a very keen edge.

The lever, *a*, is pivoted at or near its centre in a stud projecting from the weighted lever, *d*, which is delicately hinged to the upper part of the diaphragm cell, its lower end being free to move within certain limits. This construction permits the recording and reproducing styluses to follow the surface of the cylinder whether it is perfectly true or not. It also allows the recording and reproducing apparatus to adapt itself automatically to cylinders of different diameter.

It will be seen that the lever, *a*, is one of the first order, with a movable fulcrum. and that whenever the free end of the lever is moved upward by the projections of the record cylinder, it tends to lift the weighted lever, *d*; but owing to the inertia of this weighted lever it is unable to follow all the movements of the lever, *a*. As a consequence the motions of the latter in the reproduction of speech are imparted to the diaphragm. In making a record, the reverse of this occurs, *i.e.*, the rapid motions of the diaphragm are imparted to the reproducing stylus, which cuts in the record cylinder a groove with depressions and elevations, which taken together correspond in form to the sinusoidal curve which would represent the sound waves by which the vibratory movements of the recording mechanism were produced.

The arm carrying the diaphragm cell also supports an adjustable turning tool of sapphire, which is arranged to turn off the cylinder simultaneously with the production of the record. This tool is arranged to automatically disengage itself from the cylinder when the reproducing apparatus is thrown in place.

The phonograph cylinder is rotated by a very perfect electric motor, regulated by a sensitive governor. To the perfect regularity of the motion of this motor much of the success of the phonograph is due, especially in the reproduction of music where the slightest acceleration or retardation would reveal itself in changes of both pitch and time.

By applying to the phonograph two very simple attachments, the vibrating flames of Koenig may be produced by the movements of the diaphragm, so that the character of the phonographic record may be readily understood. One of these attachments consists of two glass tubes inserted in a perforated cork, one of the tubes terminating in a slender nozzle, the other being connected with a gas supply by a flexible rubber tube. The perforated cork is inserted in the opening of the mouthpiece, so that gas may flow into the diaphragm cell, and out through the small nozzle, at the point of which it is ignited, forming a long, narrow flame. In front of the nozzle is arranged a screen of sufficient height and width to hide the flame.

The other attachment consists of a prism carrying on each of its four sides a plane mirror and mounted on a spindle having upon its lower end a friction wheel, which is revolved by contact with the boss of the pulley on the main shaft of the electric motor. The spindle of the mirror is journaled in a sleeve supported by an arm connected with the pointed rod forming the upper bearing of the motor shaft.

Arranged in this manner the mirror revolves whenever the phonograph is operated. So long as the diaphragm of the phonograph remains quiescent the slender flame is undisturbed, and the revolving mirror reflects only a plain band of light; but when the diaphragm is vibrated by the contact of the reproducing stylus with the face of the record cylinder, every projection of the record pushes the diaphragm outwardly, thus forcing the gas outward, accelerating its flow through the nozzle, thereby elongating the flame, while every depression of the record allows the diaphragm to move inward by its own elasticity, thus drawing the gas inwardly, effecting a retardation of the flow of gas through the nozzle, thus causiug a sinking of the flame. These changes in the length of the flame take place with such rapidity that no change in the character of the flame is observable with the unaided eye, unless the eyes are quickly turned from side to side, when the vibratory nature of the flame will appear; but no satisfactory analysis of the flames can be made in this way. They must be viewed in the revolving mirror to determine their true form and the relation of the crests and hollows of the flame waves. These flames represent, in a greatly exaggerated form, the shape of the projections and depressions of the phonographic record. Every vowel produces a characteristic series of waves or flames, the images of which are spread out by reflection from the revolving mirror. Musical sounds from different instruments yield flames differing from those formed by vocal sounds. A song produces a rapid succession of flame images, which constantly vary in form and size.



FIG. 2.

As an aid to the understanding of the phonographic record and the action of the phonograph, nothing can excel this device.

DISTRIBUTION BY COMBINED ALTERNATING CURRENT AND STORAGE SYSTEMS.

Mr. R. Frederick Yorke, in the London *Electrical Review*, writes as follows on the above subject:—It is generally conceded that electricity can be more effectually distributed—especially in districts where the consumers are scattered—by means of the alternating current system than by any other methods.

On the other hand, those who advocated the adoption of a low pressure continuous current system rely on the advantages of storage and the facility of supplying current for motive purposes, to more than compensate for the greater cost of supplying current for electric lighting.

It has occurred to the writer that if a system could be devised which, while retaining the distributive powers of the alternating current, would also possess the many advantages of the low pressure continuous current, a distinct advance would be made in the commercial distribution of electricity.

The following is a brief description of a method which claims to accomplish this result:

The district or town to be supplied by electricity is provided with one or more generating stations. These supply alternating currents at high pressure direct to a number of sub storage stations. Each sub-station contains apparatus for converting the high pressure alternating current into a low pressure continuous current, and it is the latter only which is supplied to consumers for electric lighting or motive purposes.

The requisite plant in each of these substations consists of an alternating current machine (or alternator) coupled mechanically direct to a continuous current dynamo. A set of storage cells is also provided, and the field magnets of both alternator and dynamo are excited from the battery, the strength of magnetizing current being regulated by adjustable resistances.

In order to start the apparatus the accumulator is first switched on to the dynamo, which runs as a motor, driving the alternator. As soon as the speed is sufficiently high, the alternating current from the high pressure mains is switched on to the alternator, which now in turn becomes the motor driving the dynamo, and by regulating the resistance in the circuit of the field magnets of the latter the desired continuous current for charging the accumulator is obtained.

It is not intended that the full current shall always go through the accumulator. It will probably be advisable to provide storage for an output of 20 to 30 per cent. of the maximum demand. During the chief lighting hours the dynamo will supply the low pressure mains direct, and the accumulator will only discharge during the period of maximum demand, and also late at night, when the machinery at the generating station is stopped.

One noticeable feature is the great ease with which the output of the continuous current is regulated by adjusting either automatically or by hand the magnetizing current of the dynamo. This is due to the good regulation of the alternator, which drives the dynamo at a constant speed independently of variations in the load.

It was at first thought that when starting the converting apparatus it would be necessary to introduce some device for showing when the alternator was in synchronism with the external current. Experiments, however, carried out at Messrs. Siemens' works in December, 1888, showed that it was only necessary to run the alternator at approximately the right speed before switching on the alternating current.

It may occur that a consumer is at too great a distance to make it pay to carry the low pressure mains so far. In that case he would be supplied from the alternating mains, a transformer being employed in the usual manner.

There would still be no necessity for keeping the generator running on this account, as by still further weakening the magnetic field of the dynamo the accumulator will discharge, driving the dynamo as motor. The alternator now becomes a generator, supplying alternating current to the high pressure mains.

This system of distribution, therefore, possesses great flexibility; for instance, in the case of a company already supplying alternating current over an extended area, there will probably be districts where the consumers are numerous and fairly close together; or again, where current for motive power could be supplied advantageously, it would then be perfectly easy to supply such district with a storage station to supply continuous currents in that neighborhood, and without necessarily increasing the plant at the generating station.

Briefly stated, the following are the chief advantages of the combined alternating current and storage system:—

1. Less powerful generating machinery required, since both dynamo and accumulator supply current during the period of maximum demand

2. Greater economy in the supply of current due to—

(*a*) The useful employment of machinery in the day time, the engines never remaining idle.

(*b*) The saving effected in wages, the generating station being shut down for six to eight hours every night.

(*c*) No transformers being employed (save in the remote contingency before mentioned), there is consequently no waste of current when the lamps are not alight.

3. Facility of supplying current for motive purposes

4. Maintenance of constant pressure throughout the district, ensuring absolute steadiness and regularity of the light and consequently longer lifetime of the lamps, and greater satisfaction to consumers.

5 Security against extinction of the light in the case of a breakdown at the generating station.

Mr. Edison Gets More Patents.—Mr. Thos. A. Edison has been granted a patent on some telephone apparatus. The object of the invention is to overcome the evil effect of self induction, and it is accomplished by providing non-magnetic shields for the magnets, which are in circuit during the transmission of articulate speech. The non-magnetic shields absorb the induced currents.

Mr. Edison has also been granted letters-patent on two telephone repeaters. In one system the receiving instrument of one telephone line operates the transmitting instrument of the other, inductively. The induction coils used have three circuits each—primary, secondary and tertiary. The receiving instruments are of high resistance. In the other system the electro-motograph receiver is used as the repeating instrument in combination with an induction coil having three circuits.

Inventor of the Trolley.—Mr. William F. Sherman, of Lowell, Mass., claims that he is the inventor of the overhead trolley system, both single and double. It is intimated that he proposes to establish his claim in the courts, and has a syndicate with a capital of $1,000,000 to back him.

The German View of Wanamaker's Telegraph Proposal.—The *National Zeitung*, of Berlin, considers Postmaster-General Wanamaker's proposal for a government telegraph simply a clever political scheme for increasing the amount of Republic patronage.

A Useful Lighting Fixture.—A patent has been granted on a very artistic and useful lighting fixture which will be manufactured by the well-known house of Bergmann & Co. Two pipes are combined in an artistic manner, one for a gas conduit and the other for a conducting-wire conduit. The two pipes separate and each becomes an arm of the fixture, the whole resembling the letter T inverted. At the end of one arm is an ordinary gas jet, which, of course, connects with the gas conduit, while at the end of the other arm is fixed an electric incandescent lamp in connection with the wires conveyed through the other pipe. The two pipes may be combined spirally, in the form of chain links, and in many other fanciful ways. The fixture is very ornamental.

Information about Sprague Motors.—The Sprague Electric Railway and Motor Company have just issued a pamphlet giving facts about the Sprague electric stationary motors. The facts are ones well worth the consideration of business men in whose establishments power is used. The same company has also just issued an enlarged edition of their pamphlet giving information to managers of street railway companies. Both pamphlets are liberally illustrated, and the information contained in them is valuable.

Underground Wires in Cleveland.—The work of putting electric wires underground in Cleveland, Ohio, is progressing favorably. The Electrical Commission are a determined set of citizens. They instructed the clerk to refuse all applications from electric companies to string wires over the roofs of buildings, and to ask property owners not to aid in efforts to defeat the purposes of the underground ordinance.

Storage Batteries for Car Lighting.—The Union Pacific and the North-Western Railroad Companies propose to conduct some experiments with storage batteries with a view to introducing electric lights on some of their trains. The announcement of their intention to take this step has awakened considerable interest in railroad and electric circles

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Celebrating Washington's Birthday.—The celebration of Washington's birthday in Tallapoosa, Ga., this year was marked by an unusual event which was of great material interest to the Tallapoosians. The lighting of the city by electricity was inaugurated on that day amid great enthusiasm.

The Edison United Phonographic Co.—The Edison United Phonographic Company, has been incorporated at at Newark, N. J. The capital stock is fixed at $1,000,000. The incorporators are S. B. Eaton and Edward J. Kavanagh of New York, and A. O. Tate, of Orange, N. J., private secretary of Mr. Edison.

Opposed to an Electric Road.—The owners of property on Niagara street, Buffalo, are strongly opposed to the erection of a trolley system of electric cars on that street.

Publication Note.—The journal of the Franklin Institute, for March, is out. In the chemical section the manufacture of chlorates by electrolysis is considered.

Personal.—Mr. Thos. F. Flanagan has been elected Superintendent of the Electrical Department of the Portsmouth, (N. H.) Gas Light Company.

Electrical Executions in Austria.—The Sanitary Commission of Vienna has recommended that electricity be substituted for hanging at executions.

The electric current renders incandescent lamp filaments flexible and metallic.

THE DEADLY WIRE.

Under the above caption the *Pittsburgh Leader* in its issue of Feb. 23d, sounds a loud and timely note of warning on the dangers of fire and accidents arising from the careless workmanship and poor quality of wire being used in the wiring of public buildings and private residences. It protests vehemently against the employment of other than first-class electricians—men who are entitled to that name from having undergone a thorough course of training in this profession—where wiring is to be done, and shows strikingly the eminent danger invited by using a poorly insulated wire. This, it asserts, is what is generally done by plumbers and other so called electricians, because of its cheapness. It states that in a number of buildings so wired in Pittsburgh, it has been found necessary to warn the owners not to have the current turned on for fear of an accident that might result in the loss of life. This is a most deplorable state of affairs truly, when it is remembered that there is a safe wire available. The *Leader* prints a lengthy interview with Mr. George O. Morse, of the Morse Supply and Construction Company, Pittsburgh, from which we quote the following remarks: "Time alone will develop the fraud that has been practiced in this city by so-called electricians. Men who were well aware of the dangers of the deadly current have, for the sake of a few dollars, placed in jeopardy thousands of lives. The public knows nothing whatever of electricity and it has been imposed upon by such men as I have spoken of. * * * Poor workmanship is exceedingly dangerous, especially in electrical appliances and methods. But far worse is the material that is being put into the houses. One might as safely put a red hot coal in a pile of shavings and expect it to be safe, as the wire that is used in one out of every three houses that have been wired in this city. The basis of proper house wiring is the insulation of the wire. A wire that electricians have found to be absolutely safe and lasting is the "Okonite." The so-called weather and fire-proof wire which has been pronounced safe by the Board of Underwriters is nothing but bare copper wire wrapped with cotton, then covered with a poor braid, and finally soaked in coal tar. It is far from being fire-proof, for it will burn almost as readily as a match, even when it is new. When it is dried out it is as ignitable as a tinder box. This is the quality of wire that is used by a number of the construction companies and has been put in two-thirds of the buildings that use electricity in this city. * * * It costs only about one-third as much as 'Okonite' and the profits from wiring a house with such material if fully twice as large, so one can readily understand why it is used so extensively. It is made of a poor grade of copper and the insulation is so poor that the covering pulls off easily leaving the wire bare. This is how so many houses have grounded wires. The moment the wires come in contact with each other, or with a gas pipe, they ignite and the fire flies. The covering on the wire takes fire readily, and if close to inflammable material there is bound to be a conflagration. * * * There is another cheap wire that is used almost as extensively as the underwriters wire. It is such a good imitation of 'Okonite,' that it takes an expert at the time it is put in to tell the difference. But after the current has been turned on for a few months the insulation peals off and leaves the wire exposed. The composition that forms the insulation is not rubber as represented, it has no elasticity whatever, and when the insulation lets go an accident is bound to occur.

The people themselves, however, are largely to blame, for they will not pay the price for good work. A customer asks for an estimate for wiring a house in first-class style. Basing the figures on genuine 'Okonite,' a price is furnished. It is expensive because the wire costs from three to eight cents a foot. They will tell you that they can get the work done for one-half from another electrician. The result is that no electrician can remain in the business in this city and do first-class work. I have seen bids for wiring houses that called for 'Okonite' wire, that the price was not sufficient to pay for the bare wire. * * Not only are the dangers increased from using cheap wire, but the light obtained is of a very poor quality. I can wire a house with 'Okonite' and another with the so-called fire-proof wire, and the difference in the quality of light will be as great as between 10 and 25 candle power light. The cause of this is that when the insulation is poor the wire sort of sweats and part of the force of the current escapes. With 'Okonite' the wire is first insulated with tin, then a heavy coating of pure rubber, and on the outside of this, not as an insulator, but as a protection to the insulator, a heavy and closely woven covering of braided cotton. This is not fire-proof nor is any wire such. If exposed wires come in contact with each other you can depend upon it fire will result. Thus you see that the protection lies altogether in the insulation. * * * * * * I have until the last month refused to wire any building except with 'Okonite,' but I had to fall in line with the others or give up the business. I could not begin to compete with those who used an inferior quality or an imitation of 'Okonite.' For over six months I have been carrying as dead stock several hundred dollars worth of 'Okonite.' The people would not pay the price, and I could not use it. I now use the 'underwriters,' but before beginning the contract I inform the owner of the building that I will not guarantee the work in any particular. If they are satisfied to take the risk, all right; if not some one else gets the job."

Just as long as the people allow the difference in cost between a cheap and a good wire to influence their selection, when wiring is to be done, just so long will we continue to hear of "The Deadly Wire." A good article at a fair price is far cheaper than a poor article at any price.

LIGHTING THE NATIONAL CAPITOL.—The question is now being considered of lighting the Capitol and grounds at Washington by electricity. Under instructions from a Senate committee, the architect of the Capitol has inquired into the matter, and has handed in an extended report. Any low voltage system of lighting now in use is deemed suitable. It is estimated that 7,000 lamps of 16-candle power will be required, the estimated cost of the necessary plant being placed at $169,470. The running expenses are placed at $7,200 per annum for employés, $12,190.50 for fuel and waste, and $12,000 for renewal of lamps and repairs. This is for the Capitol and terrace alone. The grounds he thinks could be more conveniently lighted by a local lighting company. The cost of running wires and subways for the grounds is placed at $40,000, with an additional ¾ of a cent per lamp per hour for lighting. The aggregate cost would be considerably more than is now paid for gas, but of course the service would be more than as much better in comparison with the present system.

BROWNING AND THE PHONOGRAPH.—Browning was at dinner at the house of a friend last summer, when he saw the phonograph for the first time. He was greatly interested in it, and started to repeat to it "The Ride from Ghent to Aix." When half through he stopped suddenly and exclaimed. "I've forgotten the rest!" The phonograph dutifully repeated all he had said, including the exclamation at the end, and the film upon which the poet's language was impressed is now preserved as a precious relic.

CONSOLIDATION.—The National Gas, Electric Lighting & Gas Light & Coke Companies, of Indianapolis, have been consolidated by an eastern syndicate at a capital of $4,000,000.

THE EDISON ORE SEPARATOR.—It is said that Mr. Edison has taken offices in Charlotte, N. C., for the year, his object being to put to a practical test his ore separator.

SAFETY AND SAFETY DEVICES ON ELECTRICAL INSTALLATIONS.

EXTRACT FROM A PAPER READ BY PROF. ELIHU THOMPSON AT THE ELECTRIC LIGHT CONVENTION.

"Outside of these factors just mentioned, safety in such circuits rests in insulation and maintenance, avoidance of leaks, or crosses, proper placing of wires and lamps, avoidance of partial contacts or partial ruptures of the circuit at joints, binding posts or switches. In series circuits the main object is to avoid a concentration of, or establishment of, large differences of potential at points in the line where the currents find or can find a path; in low potential, multiple arc systems as used in direct incandescent work, the object is to avoid concentration of current at points where such currents cannot find a sufficiently low resistance path. Hence there are required cut-offs for an excessive current in any part of the system. Short circuits of accidental character must be provided against. If the safeguards are not ample, a more potent fire producer than a short-circuited section of an extended multiple arc system is hard to find. Take out your fuse wires and replace them with copper wires, a practice, instances of which were not difficult to find in times past, and a short circuit may quickly heat a long line of wire in a building, so as to set fire to the insulation of the wire and surrounding woodwork. Another risk in such systems is that of creeping of current from main to main over moist surfaces, or partial conductors, in amount insufficient to blow a fuse, but sufficient to convert enough energy into heat to set a fire. Good waterproof insulation of wires avoids this risk *if* the insulation remains *intact* I consider the plan of running the *two branch wires*, excepting the larger ones of the system, *near together or close together*, as excellent in avoiding this risk, provided the wires are encased in insulation and covered in or *run in a tube*. In case of a leak from main to main, the more quickly the fuses blow the better, and the proximity of the wires assists this speedy action, while between the wires there is not at any time enough combustible matter to set afire by the short circuit. *Enclosure in a tube effectually shuts off possibility of flame reaching combustible matter before the fuse blows.* This does not apply to the heavier mains, capable of carrying thousands of ampères, so well as it does to the smaller branches. I am glad to note here that the tube or conduit system appears to be well worked out for inside wiring by the INTERIOR ELECTRICAL CONDUIT COMPANY.

AN ELECTRICAL ROMANCE.—Earl Russell is a partner in the electrical works at Teddington, England, near where Lady Scott lives, and is an enthusiastic worker in the business, which he constantly supervises. Lady Scott ordered some electrical fittings from the Earl's works, and clad in a mechanic's suit, the Lord went to superintend the work. His bearing impressed Lady Scott's daughter, and, by her intercession, he was invited to lunch in the parlor, while his men lunched with the servants. The result was that the couple fell in love. Lady Scott learned of the affair and was furious. She went to the electrical works to annihilate the presumptuous mechanic. In making inquiries she learned that the gentlemanly foreman was Earl Russell, and her anger cooled. Then the couple that loved in secret were betrothed openly, with Lady Scott's assent, and a wedding soon followed.

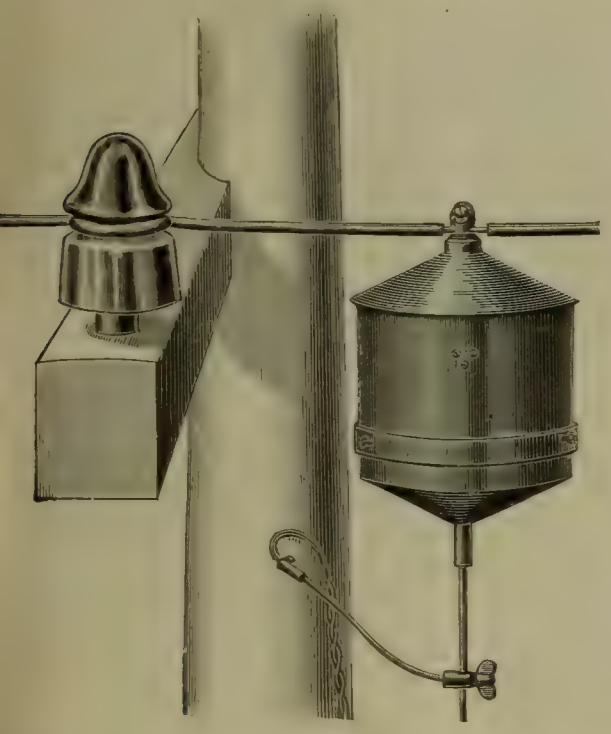
ELECTROMOTIVE FORCE.—If the zinc in a Daniels cell is substituted by any of the following metals the electromotive force of the cell will be of the values represented:

Zinc, 1.08 volts; Cadmium, .79; Aluminum, .65; Iron, .64; Cobalt, .40; Nickel, .1; Lead. .58; Copper, .07; Silver—.02: Antimony, .09; Bismuth, .17.

AUTOMATIC POLE LIGHTNING ARRESTER.

The accumulation of static electricity on electric light wires during a thunderstorm very frequently does serious damage to the circuits by rupturing lamp filaments or subjecting them to such a strain that they are very materially weakened and soon collapse. Not only are incandescent lamps exposed to divers dangers, but the arc lamp too. A heavy charge of static electricity is liable to burn out the shunt coils or otherwise destroy the usefulness of the lamp. Several attempts have been made to devise some effectual means of avoiding these dangers, but with very poor or indifferent success. The Electric Supply Company, of Chicago, however, has at last solved the problem, and has produced an invention which will dispel one charge after another from arc or incandescent wires effectually and very simply. The principle employed is an entirely new one.

As will be seen in the cut the case, which is moisture proof, is attached to a line which is freed from insulation at this point for such purpose ; at the bottom of the case is an insulated rod and a flexible conductor running to a ground wire which passes down the side of the



pole to a gas or water main or other suitable ground connection near the base of the pole. The ground connection is very important and great care should be exercised when putting the apparatus into position. Two strands of No. 8 galvanized iron wire are sufficient to carry the current to the ground ; three strands may be employed for the smaller incandescent circuits. The apparatus being near the cross arm, it is easily gotten at for inspection.

Each arrester will protect from one-half to three-fourths of a mile of line wire, depending upon the extent of the net work ; one arrester is necessary for each wire, positive or negative. Should the lightning strike the line, it will run to the nearest lightning arrester and be grounded automatically without interference in any way with the operation of the lamps and without grounding the line. The dynamo current, following the static discharge, severs all ground connection and at the same time places in position new discharge plates, which operation is repeated for successive discharges.

The advantages of this ingenious device are apparent; as the static electricity comes on the line exterior to the station, it is instantly taken off therefrom at a point near to the point struck, but very little damage can be incurred in the more delicate portions of the lamps, motors or other translating devices upon the circuit, and but a small percentage of them can be influenced at all. It is adapted for use with both arc and incandescent circuits of any length ; its use upon an incandescent circuit does away entirely with the wink and constant strain upon the filaments of the lamps during thunder storms.

This arrester has the following advantages over the ordinary station lightning arrester.

1. It is self-acting and there is an entire absence of any element of self-induction (magnets, solenoids or coils), which element has recently been shown to be so destructive to the rapid conduction of the discharge current.

2. There being no catch, ratchet or similar device in the mechanism of the arrester, the parts will not become displaced by the action of the wind, or any other ordinary jar.

3. It requires no constant consumption of energy to keep it in operation. There is no circuit through it and no energy enters it excepting at the instant that the static discharge is passing.

Business Notice.—Mr. J. H. Mason, 120 Park Avenue, Brooklyn, N. Y., who has recently placed upon the market a primary battery to furnish electric lights for home lighting, is in receipt of the following unsolicited testimonial :

"Allow me to extend to you my heartiest appreciation of the success with which your new primary battery and solution has been attended. I have had eleven of your No. 9 cells in constant use for over two months, and eighteen in use about a month, and must candidly admit that I am more than pleased with the results obtained from them, they doing far more than you claim; also one of the principal features most especially noticed, since I have been using your cells, was the absence of fumes, low resistance and the very constant depolarizing qualities. Of all the primary batteries I have ever used heretofore, I do not know of one that would hold a candle light alongside of your improved cell. One of the trials I gave your battery, was in the electrical exhibit I placed and operated in Lee Avenue Congregational Church Fair, held during the evenings of February 11th, 12th and 13th. I had in operation eleven of your No. 9 cells, nine of which were used in lighting 36 incandescent electric lights varying from ½ to 6 c. p. and working alternately from one to five at one time. The other two cells I used in operating the motor, which turned the tree and worked the music box in connection with same, the average working of the lighting and motor was six hours each night or an aggregate of eighteen hours total for the three nights, and must mention here that the throng of people who witnessed the exhibit were under the impression that the whole was operated from a current taken from the street main, [until otherwise informed] on account of the number and brilliancy of the lights and the perfect working of the motor, &c. I wish to also add that with this same charge of solution used in the above exhibit I operated in my own laboratory a 4 c. p. lamp eleven hours, and a standard 16 c. p. lamp, 18 volts, three hours, from ten cells. This you will no doubt find to be far in excess of what you ever claimed for your No. 9 cells. In closing, will mention again that I am more than pleased with your battery and at an early date will replace your No. 9 cells with your large No. 11, as I am confident I can work your large cells for domestic electric lighting about as cheap as gas, and for country homes I think it is the cheapest light yet produced. Wishing you abundant success with your battery, which you so richly deserve, I remain, Sincerely yours,

Wm. T. Knox,
Electrician.

Electric Light in Windsor Castle. — The grand corridor at Windsor Castle has been lighted electrically, and with such good results that the illuminant will probably be extended to the dining-room and the drawing-rooms.

FOR POSTAL TELEGRAPHY.

MR. BATES PRESENTS ARGUMENTS IN FAVOR OF IT.

D. H. Bates, of New York, representing, he said, a party of gentlemen interested in postal telegraphy, addressed the House Committee on Post-Offices and Post-Roads on March 4th. He analyzed some of the statistics presented by President Green, of the Western Union Telegraph Company, with the result of establishing, he asserted, that the average rate on Western Union messages for distances over 500 miles was 49 cents He said that the Baltimore & Ohio Telegraph Company was the only opposition company that ever paid expenses. It had been the pioneer in cheap rates. Owing to the fact that it was confined to the great commercial and populous centres, it had handled one-sixth as much business as was handled by the Western Union, notwithstanding the fact that the proportion of miles of wire is very much less. The natural result of the low rates was longer messages. The Baltimore & Ohio Company was very popular with the public, as they sympatized with the under dog and desired to foster competition. Now the people wanted the government to step in and compete to a certain extent. The Postmaster-General's bill would do this. It did not propose to put the government under any expense, nor would it require additional employés.

Chairman Bingham remarked that the bill would require the contracting companies to maintain the lines, but the government was to furnish the operative, delivery and collection services.

Mr. Bates said that the bill by implication only provided for a government staff. At the proper time gentlemen would undertake to contract for the service—probably at 13 cents on a 15-cent message. Of course the business would probably not at first be of large volume, and could be made remunerative only by using as an adjunct a "fast-speed" system which would encourage the public patronage. A uniform rate for the entire country would be desirable, but was impracticable. The rate he would suggest on the basis of the telegraph company doing all of the service except collection and delivery, and including operators (no other basis would be possible) would be : under 500 miles, 15 cents ; above 500 miles and east of the Mississippi, 25 cents or 30 cents ; between 85th and 105th parallels, 25 cents or 30 cents with 50 cents as a maximum. So large a contract could not be undertaken for a shorter period than ten years. No guarantee of a paying volume of business would be required from the government. In fairness, however, the government should be required at the expiration of the lease to renew it or buy the lines from the company.

Chairman Bingham inquired what inducement there was for a new company to undertake this contract at lower rates than those of the Western Union.

Mr. Bates replied that the Western Union had made $100,000,000 in twenty years; the new company would have facilities in post-offices ; it would have a good standing commercially, and it would use improved means of telegraphy.

At the conclusion of Mr. Bates's statement, the chairman read a letter from Dr. Green, in which he thanked the committee, and expressed his confidence in its fairness and impartiality.

Electric Ore Separator.—The electrical process has been successfully adopted in South Australia for the recovery of the minute gold dust that has hitherto been lost in the work of separating the metal from the ore. The economical value of the process has been abundantly proved, and the returns are sufficiently good to compensate for the somewhat high expense of the process.

NEW PRIMARY BATTERY FOR LIGHT AND POWER.

A test exhibition was given at 94 Liberty street, on March 6th, of the Aluminum Battery, Electric Light and Power Company's battery, which has just been placed on the market. A large party of experts were present and various tests of the battery were made. The results of the exhibition were highly satisfactory to the promoters of this new enterprise, and they were even better than had been anticipated. The solution u ed is an aluminum compound, and the elements of the battery are carbon and zinc, or rather a compound of zinc, tin and aluminum. When the battery is at rest, that is when no lights are in use, metal aluminum is deposited on the zinc alloy plate, and the plates actually increase in size. When the battery is working the metal on the zinc plate is re-decomposed and precipitated instead of saturating the solution. This action is one of the peculiar and most valuable features of the battery, and it will at once strike the reader that there is a great similarity in action between this and a storage battery. It is said that in the development of this battery some phenomena were observed that were never before met with, and the result was not only a highly efficient battery but the opening up of new fields of investigation which may lead to important discoveries.

The electromotive force per cell is 2 volts, and the internal resistance less than .03 of an ohm. Another peculiar thing about this battery is the fact that the electromotive force increases in a greater ratio than the increase in the number of cells would warrant. Thus, for instance, at the test 40 cells of battery were used, while the E. M. F. was 87 volts, an increase of 7 volts over the E. M. F. of one cell multiplied by the number of cells. The current delivered was 40 ampères, and 8 16-candle power lamps were used. These, however, were run up to 25-candle power. The light produced was magnificent in its purity and steadiness and was very favorably commented on. The battery was short-circuited for two hours, and at the end of that time tested. The test showed that the current had not fallen in the slightest degree, which was a remarkable performance.

The company installs plants and maintains them. Thus, the user of the light is spared the trouble of looking after the battery. The lights cost half of one cent per hour, per lamp, and its quality is unsurpassed. An arc lamp was exhibited, which gave a beautiful and steady light. A battery of the size used during the test—40 cells—will give an arc light for ten hours with one change of solution, and the light produced is unquestionably an excellent one.

The company reports a lively demand for their goods, and they now have over eighty orders to fill.

SPRAGUE ELECTRIC MOTORS IN FOREIGN COUNTRIES.—The Sprague Electric Railway & Motor Company has just received an order from Berlin for some motor cars. The cars are to be used on the Berlin General Electric Company's line, which is about two miles in length, and it is understood that this order is the forerunner of a large one.

The Firenzi and Fiesole Electric Road in Italy has been completed and is now about ready to go into practical operation. This line runs between Florence and Fiesole, and is about six miles in length. Its equipment consists of twelve Sprague motor cars and unusual work will be required of them, as the grades on the road are as great as eight to ten per cent. This is the first electric railway of any magnitude that has been established in Europe.

Two Sprague motor cars have just been shipped to Tokio, Japan. It is said that the Japanese are enthusiastic over electric railroads

The Sprague company report business increasing enormously. They have sold over eight hundred motors in sixty days, and orders and contracts are coming in every day.

Which age is the greatest? THE ELECTRIC AGE.

DEPARTMENT OF INQUIRIES.

Editor ELECTRIC AGE: How many cells of the James H. Mason battery are necessary to light three 1-candle power lamps (four volts) and for how long a period will one charge of solution last for this work?

Answer.—A battery of two of Mr. Mason's No. 11 cells will run these lamps continuously for 80 hours with one charge of solution. This lifetime is the minimum. One hundred hours would probably be nearer the actual time. When it is remembered that there is no consumption of material in this battery when it is not doing any work, the 80 hours will be understood to mean that the lights may be used 80 hours continuously, or they may be used at intervals, the aggregate time of such use being 80 hours. It will last 80 hours in either case The cost of the light under the conditions named will be ½ of one cent per hour for the three lamps. The same battery will light one 3-candle power lamp the same length of time, or two 3-candle lamps for half the time and so on.—Ed. ELECTRIC AGE.

Editor of the ELECTRIC AGE.—Please give me a rule for calculating the mechanical work of an electric current.

Answer.—The mechanical work of a current may be calculated as follows:—A current whose strength is C conveys through the circuit in t seconds a quantity of electricity = Ct. But the number of ergs of work, W, done by a current is equal to the product of the quantity of electricity into the difference of potentials through which it is transferred, provided these latter are expressed in "absolute" C. G. S. units or

$$Ct\,V = W.$$

Now, if W ergs of work are done in t seconds, the rate of working is obtained by dividing W by t; whence

$$C\,V = \frac{W}{t}$$

If C and V are expressed in ampères and volts respectively, and it is desired to give the rate of working in horse power, it must be remembered that 1 ampère $= 10^{-1}$ C. G. S. units of current; that 1 volt $= 10^{8}$ C. G. S. units of E. M. F., and that 1 horse-power (as defined by Watt) = 550 foot-pounds per second = 76 kilogramme-metres per second $= 76 \times 10^{5}$ gramme-centimetres per second $= 745 \times 10^{7}$ ergs per second, whence

$$\frac{\text{C ampères} \times \text{V volts}}{745} = \text{rate of doing work in horse-power.}$$

For example to find the rate at which actual work is consumed in an electric lamp, measure the whole current in *ampères*; measure the difference of potential between the terminals of the lamps in *volts*; multiply them together and divide by 745; the result will be the number of horse-power used up in the lamp.—Ed. ELECTRIC AGE.

THE EMPIRE CITY ELECTRIC COMPANY.—At the annual meeting of the stockholders of the Empire City Electric Company, held on March 6th, the following officers and trustees were elected: O. E. Madden, President; E. T. Gilliland and L. Storke, Vice-Presidents; Fred'k Lines, Secretary; W. T. Black, Jr., Treasurer; F. C. Timpson, H. G. Madden, J. A. Seely and J. C. Tomlinson.

The financial reports showed the year 1889 to have been a prosperous one, and that the company is in excellent condition.

The changes in their offices at 15 Dey street have just been completed. The erection of a handsome brass railing separating the treasurer's and manager's offices from the store room, and the installation of electric lights, with numerous other minor improvements have added very much to the handsome appearance of their store, as well as materially enlarged their facilities for handling a constantly increasing business.

GOOD CONDUCTORS.—Flames and currents of very hot air are extremely good conductors of electricity.

EFFICIENCY OF ELECTRIC MOTORS.

If a galvanometer be included in a circuit with a battery, a dynamo and an electric motor, it is found that the current is weaker when the electric motor is not in operation, and that the faster the motor runs the weaker does the current become. This is due to the electromagnetic induction between the moving and fixed parts of the electric motor, which, as the former spins round, generates a back current The electromotive force due to this inductive action increases with the speed of the motor, so that the back current is strongest when it runs fastest. If the motor be loaded so as to do work by moving slowly against considerable forces, the back current will be small, and only a small proportion of the energy of the current will be turned into useful work. If it be set to run very quickly, so as to generate a considerable back current, it will utilize a larger proportion of the energy of the direct current, but can only run fast enough to do this if its load be very light. Jacobi calculated that the practical efficiency lay between these two extremes, and that an electric motor would turn the energy of a battery or dynamo into work in the most effective way when it was allowed to do its work at such a speed that the current was thereby reduced to one-half its strength. This is true if it be desired to do the work at the quickest possible rate. But where economy in working is desired, and when it is not needful to get through the work as rapidly as possible, then a higher economic efficiency will be attained by making the electric motor do lighter work and revolve at a greater speed; for then the back current may be made nearly equal to the original current, and the original current may be reduced thereby to a small fraction of its strength. If the current is generated by a battery the materials will be more slowly used, and it will take a longer time to do the total amount of the work, but the percentage of energy of the currents turned into work will be higher.

THE HEISLER SYSTEM OF LIGHTING.—The best evidence of the success of any apparatus is the fact of repeated orders from the same customers. One of the earliest Heisler Electric Light plants installed was put in by the Leavenworth Coal Company, Leavenworth, Kansas, being operated from their coal pits in the suburbs of that city. For some years they have been operating two large Heisler machines, and have just added a third. A short time ago the Tampa Electrical Illuminating Company, Tampa, Florida ordered an outfit, and before starting up found such a demand for lights that they placed an order for additional apparatus, doubling the original capacity. The Heisler plant at Orange, New Jersey, has also found it necessary to add another large machine. The following new Heisler plants have just been started and are reported as operating with entire satisfaction: Holden Water Company, Holden, Mo.; Bonham Electric Light and Power Company, Bonham, Texas; H. H. Williams & Co., Wauseon, Ohio. At Holden and Wauseon these plants are doing the city lighting.

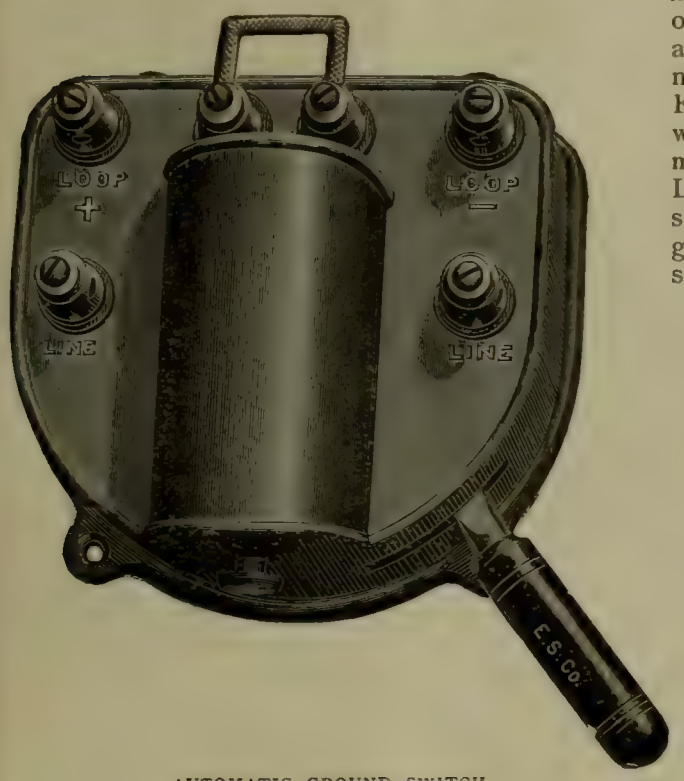
NEW CONTRACTS FOR HEISLER PLANTS. — The Heisler Electric Light Company of St. Louis, report recent contracts from the following companies for their long distance incandescent electric lighting apparatus: Staten Island Light, Heat and Power Company, Port Richmond, Staten Island, New York; Johnstown and Gloversville Gas Light Company, Johnstown, New York; Germantown Electric Light and Power Company, Germantown, Pa.; The Electric Light Company, Milledgeville, Georgia; Messrs. Rheubottom & Bond, Union City, Michigan; Pierre Electric Light and Power Company, Pierre, South Dakota.

ELECTRIC MOTORS IN DULUTH.—The Motor Line Improvement Co. of Duluth, Minn., has been incorporated with a capital of $150,000.

AN AUTOMATIC GROUND SWITCH.

Shutting down an electric light circuit on account of grounding on some loop is one of the most exasperating difficulties that has to be contended with on many light circuits. Such stoppages mean general complaint of inefficient service, if nothing worse. In order to overcome this evil, the Electrical Supply Company, of Chicago, have produced an ingenious device which works perfectly. It is an automatic ground switch, and the superintendent of a large arc light company in the United States says it is the greatest income saving device for electric light companies that has ever been brought out. The accompanying cut shows the external appearance of the switch.

Wherever a loop is required the main line is led into the automatic switch, the wire then leads from the switch to the first and last lamp of the loop circuit as in the case of any ordinary cut out switch. It performs every function of the best hand switches, its operation being instantaneous. Whenever a ground occurs upon this loop, the switch automatically cuts off the grounded loop, and prevents a general "shut down" of the circuit. The location of the defect or ground is thus *pointed out*, and



AUTOMATIC GROUND SWITCH.

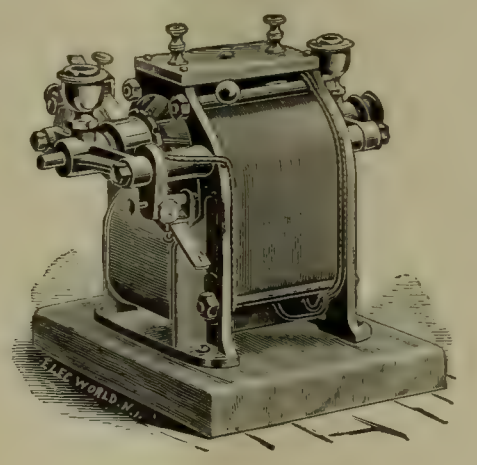
saves thereby a long search, delay, and consequent loss of rental. During the time repairs are going on the connection between the loop and main line is completely severed, thus there is not the least danger to workmen. So long as the defect exists on the loop the switch cannot be set. The impossibility of grounds existing upon service lines where these switches are employed render the lines almost absolutely harmless to life and property. Insurance authorities who have looked into the switch and its application recommend its use in the strongest terms.

In the operation of motors, upon either arc or incandescent circuits, the use of this switch renders the operation perfectly reliable and safe. The switch may be manually operated, and whenever thrown disconnects the motor entirely from the system from which the current is derived Both positive and negative terminals being simultaneously severed, the motor is perfectly harmless to the touch for purposes of repairs, adjustment, belting or the like. Its use upon incandescent circuits serves a purpose that has been long unsupplied. It is well known that the fusible plug serves perfectly to counteract bad effects from short circuits, but a device for preventing such defects, resulting in case of grounds, has not until now been produced. The present switch is wound for any ampère current desired, and when placed at the intersection of the service wires and mains where such service wire goes into a building. and where there is liability to ground, or where the wiring passes through combination fixtures. The operation of the switch is to entirely sever the connection from both positive and negative leads, and prevent thereby the bad effects resulting where only one plug "blows," leaving the system still in connection with the ground through the other, as is usually the case.

Where lights are operated or run through damp places, such as packing houses, steaming rooms, slaughter houses, breweries or other chemical establishments, the placing of these switches at the point where the main circuit brahches to run into various departments will entirely overcome the shutting down on account of grounds which are liable to occur from the dampness, and render the operation of electric lights in such places practical and commercial.

THE A. B. C. MOTOR.

We illustrate herewith a small motor recently brought out by the A. B. C. Motor Company of this city. This motor was designed so as to obtain the greatest amount of magnetism from a small current, and to meet every requirement demanded of a machine of this class. Every mechanical detail has been worked out with great care, and the construction of this motor presents some new and valuable features. Laminated field magnets are used, and the several sections are bound together by an ingenious arrangement of rods. As the laminated sections are constructed entirely of one piece of



THE A. B. C. MOTOR.

metal, no yoke pieces are necessary. The field magnet is constructed as one coil, and altogether the motor is made very compactly, and is very efficient. The field magnet, owing to its peculiar form, makes it possible to secure the very best magnetic results with a small current. The armature is very carefully constructed, and is readily removable. As shown in the illustration the armature and brushes are situated at the top of the motor, which is a very convenient arrangement. Actual tests have proved that this new motor possesses a remarkable capacity for doing work with a very small current, and in every way it performs its work in a most satisfactory manner.

Remarkable Electrical Phenomena are witnessed at the new observatory on the steep and isolated Säntis in northern Switzerland. Thunder storms are extremely frequent; thus in June and July last year only three days were without them. As a rule, thunder peals from midday till evening. The noise is short, partly owing to shortness of flashes and partly to the small amount of echo. The thunder storms come on quite suddenly, in a clear sky. One of the surest indications of their approach is the bristling of the observer's hair. During hail storms the iron rods of the house give a hissing sound, associated with luminous effects.

Electric Cars in Snow Storms.—Much interest has been manifested in Boston over the ability of the electric street cars in that city to perform efficient service, during and after a snow storm, when the ground is covered with snow. The snow storms of last week gave an opportunity to test their power and how they behaved may be learned from the following clipping taken from the *Herald* of that city: "The storm gave the first real test of the power of electricity to contend with the snow, and the result has been a most gratifying success to its most sanguine friends, and at the same time a sad surprise to those who have been predicting a sure defeat when the snow storm came. Although all horse cars have had four horses attached to them, they have had a hard time laboring through the drifts and heavy snow, and have crawled along at a snail's pace, even where the tracks have been cleared by the snow plows. While the poor horses have tugged and strained to pull the heavily laden cars, the electric cars have glided along with scarcely a noticeable diminution of speed, and even where the snow on the tracks has been up even with the pans under the motors, the cars have gone along as though such a thing as snow was unknown, the little rail ploughs cleaning the way in front of the wheels as readily and as cleanly as could be desired."

The Electric Light in Mexico.—Some notable shipments of electrical apparatus have just been made from St. Louis to the Republic of Mexico. The Heisler Electric Light Company recently forwarded two car loads of electrical apparatus, including dynamos, regulators, sockets, lamps, street and indoor fixtures, wire, insulators, pins, etc., for the complete installation of Heisler long-distance incandescent plants in the cities of Durango and Aguas Calientes. Both of these cities are to be lighted exclusively by the Heisler system, and sufficient dynamo capacity will be provided for a large amount of commercial lighting. It is expected that these plants will be in operation by May 1st On account of he high cost of fuel the steam plants will be of the most approved type, compound condensing high-speed engines being used.

Transformation of Electricity Into Work.—An electric current may do various kinds of work, chemical, magnetic, mechanical and thermal. These kinds of work are represented respectively by the storage battery and electroplating battery, the electro magnet, the electro motor and the electric light. In every case where a current does work that work is done by the expenditure of part of the energy of the current, and heat is generated. Electricity in motion is transformed into heat by resistance. A striking illustration of this is seen in the electric light. There the resistance to the flow of the current is so great that intense heat is developed, and consequently light.

Sprague Electric Railway and Motor Directors.—The following named gentlemen were, on the 4th inst., elected directors of the Sprague Electric Railway & Motor Company: H. Villard, J. H. Herrick, E. H. Johnson, F. J. Sprague, Samuel Insull, J. S. Wise, C. H. Coster, C. A. Spoffard, A. Marcus.

The Phonograph.—A curious use has been found for the phonograph. It was produced at the funeral of a clergyman in order that a sermon of the deceased upon himself might be heard by the mourners.

The March of the Motor.—The Citizens' Passenger Railway Co. of Norristown, Pa., are going to substitute electricity for horse power.

Germany Controls a Cable.—Germany has bought the Hamburg and Heligoland cable for $48,000, thus controlling a cable to England.

ELECTRICAL PATENTS ISSUED MARCH 4TH.

422,419. Armature. Charles D. Jenny, Indianapolis, Ind.

422,438. Automatic Switch for Regulating the Power of Electric Batteries. Geo. B. Pennock, Brooklyn, N. Y.

422,445. Supporting Frame for Electric Railway Motors. Edward D. Priest, Lynn, Mass.

422,446. Arc Lamp. George C. Pyle, Indianapolis, Ind., assignor to the National Electric Head-Light Company, same place

422,456. Carbon for Electric Lamps. Walter F. Smith, Philadelphia, Pa., assignor to the United Electric Improvement Company, Gloucester City, N. J.

422,457. Treatment of Storage Battery Plates. Charles Sorley, New York, N. Y., assignor to the Anglo-American Electric Light Manufacturing Company of West Virginia. Original application filed November 12, 1889 Divided and this application filed December 19, 1889.

422,504. Secondary Battery. Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Gas Improvement Company, same place.

422,505. Secondary Battery. Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Gas Improvement Company, same place.

422,511. Dynamo Electric Machine. Rudolf Eickemeyer, Yonkers, N. Y.

422,512 Electro Magnet. Rudolf Eickemeyer, Yonkers, N. Y.

422,524. Automatic Circuit Breaker. Marion C. Happoldt, Providence, R. I.

422,533. Secondary Battery Plate. Wm. P. Kookogey, Brooklyn, N. Y., assignor to the Kookogey Electric Company.

422,550. Compound Insulating Layer for Electric Coils. Elihu Thomson, Lynn, Mass.

422,556. Electric Motor. Henry E. Walter, Schenectady, N. Y.

422,577. Apparatus for Speaking Telephones. Thomas A. Edison, Menlo Park, N. J., and Ezra T. Gilliland, Boston, Mass.

422,578. Telephone Repeater. Thomas A. Edison, Menlo Park, N. J.

422,579. Telephone Repeater. Thomas A. Edison, Menlo Park, N. J.

422,591. Suspension Device for Incandescent Lamps. Hiram W. Hayden and Charles S. Dikeman, Waterbury, Conn., assignors to the Holmes, Booth & Haydens, New York, N. Y.

422,592. Reflector for Incandescent Lamps. Frank Holman, Brooklyn, N. Y.

422,604. Printing Telegraph Receiver. Henry Mahnken, New York, N. Y., assignor to the Commercial Telegram Company, same place.

422,645. Electric Railway. Sidney H. Short, Cleveland, Ohio.

422,654. Electric Time Alarm and Annunciator. Nathan H. Suren, Fort Worth, Tex.

422,672. Galvanometer. John Waring, Manchester, Conn.

422 681. Armature for Electric Machines. John C. Wray, Peoria, Ill.

422,705. Switch. Adolph Berrenberg, Somerville, and Jacob Umbehend, Cambridge, Mass.

422,722. Automatic Telephone Call. Henry L. Carpenter, Minneapolis, Minn.

422,730 Method of Electric Welding. Chas. L. Coffin, Detroit, Mich.

422,732. Magnetic Separator. Gurdon Conkling, Glens Falls, N. Y.

422,746. Electrical Induction Apparatus or Transformer. Michael Von Dolivo-Dobrowolsky, Berlin, Germany, assignor to the Allgemeine Elektricitäts-Gesellschaft, same place.

422,755. Electromotor Engine. Sebastian Z. de Ferranti, Hampstead, County of Middlesex, England. Patented in England, September 13, 1887, No. 12,418; in France, August 2, 1888, No. 192,192, and in Belgium, August 3, 1888, No. 82,780.

422,765. Telephone Switch System. Claude C. Gould, Batavia, assignor to the Eastern Electrical Manufacturing Company, Wheatfield, N. Y.

422,773. Electro Magnetic Annunciator. Cornelius J. Hamilton, Philadelphia, Pa., assignor to the Novelty Electric Company, same place.

422,811. Lighting Fixture. Paul C. J. Lemaire, New York, N. Y., assignor to Bergmann & Company, of New York.

422,855. Pulsating Electric Generator. Chas. J. Van Depoele, Lynn, Mass.

422,857. Alternate Current Pulsating System. Charles J. Van Depoele, Lynn, Mass. Original application filed March 23, 1889. Divided and this application filed October 4, 1889.

422,858. Converting Continuous into Pulsating Electric Currents. Charles J. Van Depoele, Lynn, Mass. Original application filed March 23, 1889. Divided and this application filed October 4, 1889.

422,859. Pulsating Current System. Charles J. Van Depoele, Lynn, Mass. Original application filed March 23, 1889. Divided and this application filed October 4, 1889.

422,860. Multiple Current Pulsating Generator. Charles J. Van Depoele, Lynn, Mass.

422,862. Regulating Electric Motors. Geo. A. Washburn, Cleveland, Ohio, assignor to Ford & Washburn, same place.

422,863. Armature for Dynamos, etc. Geo. A. Washburn, Cleveland, Ohio, assignor to Ford & Washburn, same place.

422,895. Manufacture of Carbons for Electric Lamps. Walter F. Smith. Philadelphia, Pa., assignor of the United Electric Improvement Company, Gloucester City, N. J.

THE VOLTAIC ARC.—If two pointed pieces of carbon are joined by wires to a generator of electric currents, and are brought into contact for a moment and then drawn apart to a short distance an electric arc is produced between the points of carbon, and a brilliant light is emitted by the white hot points of the carbon electrodes. This phenomenon was discovered in 1809 by Sir Humphrey Davy, and its explanation seems to be that before contact the difference of potential between the points is not sufficient to produce a spark across an air space of over one-ten-thousandth of an inch, but when the carbons are brought into contact a current is established. On the separation of the carbons the momentary extra-current due to self-induction of the circuit, which possesses a high electromotive-force, leaps across the space and in so doing volatizes a small quantity of carbon between the points. Carbon vapor being a fair conductor, permits the continuance of the flow of the current across the gap, if it is not too great; but as the carbon vapor has a very high resistance it becomes intensely heated by the passage of the current, and the carbon points also grow hot. Since, however, solid matter is a better radiator than gaseous matter, the carbon points emit a light of much greater intensity than the arc itself, though they are not so hot. The most refractory substances, such as flint, diamond, etc. melt, and gold and platinum are actually vaporized by the intense heat of the arc. When the arc is produced in the air the carbons are slowly consumed by oxidization. It is observed, also, that particles of the positive carbon are torn away and some of these are deposited on the negative carbon. By this process the positive carbon becomes shorter, and convex at the arc end, while the negative carbon by the constant accretion is added to in length. The resistance of the arc may vary, according to circumstances, from 0.5 ohm to 100 ohms. To produce a satisfactory light a minimum electro-motive-force of 40 to 50 volts is necessary, and the current must be at least from 5 to 10 or more ampères. Arc lights of an illuminating power of less than 100 candles cannot be maintained steady in practice and are uneconomical.

CITY ELECTRICIAN.—The Omaha City Council has recently created the office of electrician for that city.

ELECTRIC MOTORS.

VARIOUS PLEAS ABOUT THEM EXPRESSED IN LETTERS AND LECTURE BEFORE THE BUFFALO ELECTRICAL SOCIETY—A PAPER ON THE SPRAGUE SYSTEM BEFORE THE ELECTRICAL SOCIETY—ANSLEY D. WHITE HAS MORE TO SAY ABOUT STORAGE BATTERIES.

Mr. E. E. Higgins delivered an interesting talk March 3, before the Buffalo Electric Society on a subject which is at present attracting much attention, namely: "The Sprague Electric Street Car Motor."

After describing the manner in which the car is propelled by electricity, he defined the heaviness of a current necessary to produce death. The danger line was 750 volts; below that it was impossible to kill a human being unless special artificial means were taken to increase the effectiveness.

Mr Higgins then went back to the time when electric cars originated, and traced their improvement to the present time. The first was a storage battery, then came the central station motor with three rails, the current being conducted along one rail and returned on the others. The trolley came next, but difficulties were experienced in continuing connection with the ove head wires, as two were used at first. This was overcome later when the underwire connection was invented. The modern road dated from the time the Richmond road was put in operation, in February, 1888. Improvements were gradually made in placing the motors and many other particulars. The Sprague feeder system maintained an even pressure along the line by inoculating strength at intervals The chief points of difference between the Sprague and the Thompson-Houston system were the manner of stopping the car, and the feeding process, which was not practiced by the latter company as a rule.

There are 194 overhead wire lines now in existence in 134 cities, Mr. Higgins said. In speaking of the storage battery, he said everyone hoped that would soon be perfected. At present it was unreliable, although it gave excellent service at times. The Beverly & Danvers road, which so much has been said of, was the property of the Union Car Company, and was used by it for experimental purposes, and it must be remembered that reports of its success comes from the Union Car Company. The Sprague Company was working as hard as anyone to make a success of the storage battery, but it must be confessed that at present it was impracticable.

The discussion which followed, more concerned the strength of the electric current than the serviceability of the system. To Mr Higgins was given a vote of thanks for his entertaining talk.

DISAPPEARANCE.—Mr. Frank McGowan, who was connected with the Edison laboratory in Orange, N. J., suddenly disappeared from his home in that place and has not been heard from since January 15th last. Mr. McGowan is the person whom Mr. Edison sent to South America some years ago to find a certain plant, the fibre of which was to be used in making the filament for the Edison incandescent lamps. McGowan, after severe hardships, finally found the object of his mission, although he contracted a fever during his search in the unhealthy climate. He was very ill for a time, and was cared for by a wealthy Spaniard. During his illness he was nursed by the Spaniard's daughter who was reported to be a very beautiful woman. Their acquaintance developed into a love affair, and Mr. McGowan's friends suspect that he has gone back to South America, and will return with the young lady as his bride.

PERSONAL.—Mr. W. H. Markland, the electrician of the Pennsylvania Railroad, is the proudest man in his State. The boy was born on the morning of Feby. 27.

NEW BOOKS.

"How to Preserve Health" is the title of a book just issued by the Exchange Printing Company, of New York. The object of the book, according to the introduction, is to instruct its readers what to do that they may preserve and enjoy health and avoid sickness, in so far as human foresight can accomplish these ends.

Dr. Louis Barkan, the author, has ably covered a great deal of ground, and the volume is full of information on this important subject—the one that concerns the human race more than any other. "It is easier to prevent disease than to cure it" is the key-note to the work, and anyone following the advice contained in its pages cannot fail to enjoy the greatest of all blessings to the human race—good health. Dr. Barkan is an advocate of the electric light on account of its being better for the eye than any other light, and from a hygienic point of view. It is well known that the electric light is the healthiest of all. The volume also gives directions for treatment in case of lightning striking a person, and states that recoveries are on record after an hour of supposed death from lightning.

Mr. George C. Hale, Chief of the Fire Department at Kansas City, Mo, makes the statement that no fire there has ever been able to extend beyond the four walls His system of reporting fires is a unique one. He relies entirely upon private and public telephones to convey the alarm to station houses. He claims that by these methods of communication more prompt results are obtained than by having an organized system with boxes separated several blocks apart.

INDUCTION TELEMETER.—An arrangement called an induction telemeter, comprising induction coils and a telephone, is used in Germany for registering the indications of a distant thermometer. It is so arranged that when there is silence in the telephone the indications of the recording instruments are identical.

LIVERPOOL DOCK RAILWAY.—It is expected that the Liverpool Docks (Overhead) Railway will be entirely completed by July, 1891. Electricity will be the motive power; but no definite system will be adopted until the last possible moment, in order that the best may be obtained.

SPRAGUE ELECTRIC RAILWAY AND MOTOR DIRECTORS.—The following named gentlemen were, on the 4th inst., elected directors of the Sprague Electric Railway & Motor Company: H. Villard, J. H. Herrick, E. H. Johnson, F. J. Sprague, Samuel Insull, J. S. Wise, C. H. Coster, C. A. Spoffard, A. Marcus.

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THE CANADIAN ATLANTIC CABLE.—The act to incorporate the Canadian Cable Company, says the Montreal *Herald*, has passed the committee on railways and canals, etc., and that journal adds, little time will probably be lost "in supplying that much-felt want, an independent Canadian cable." The promoters are stated to be "good and substantial men," and it is added that the money needed will be forthcoming without much urging. The cable is to be laid from Clew Bay, Ireland, to a point not yet decided upon, on the north shore of the St. Lawrence, and will there be connected with other lines over the American continent. It is only a wholly independent, non-amalgamative, non-leasable and non-purchasable line which would have any influence in reducing cable rates.

ELECTRICITY ON THE ALPS.—The proposed railway up the Jungfrau, which is to be almost entirely underground, will, when completed, be lighted by electricity.

The Youngstown, Ohio, council has decided not to establish a municipal lighting plant.

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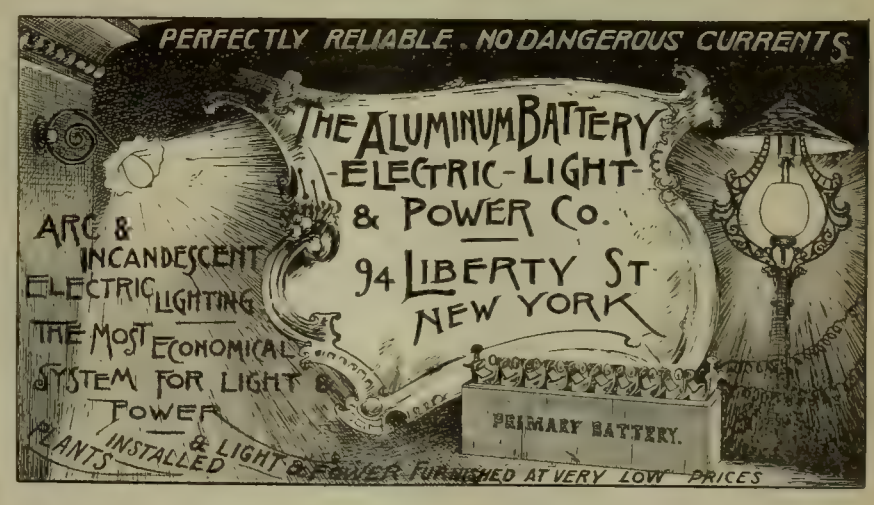
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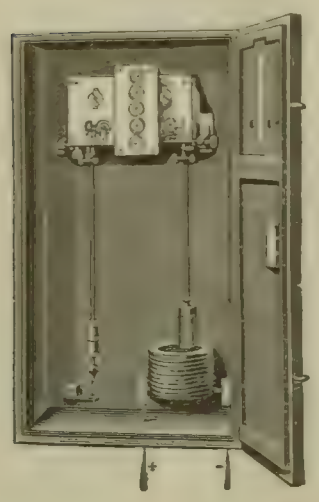
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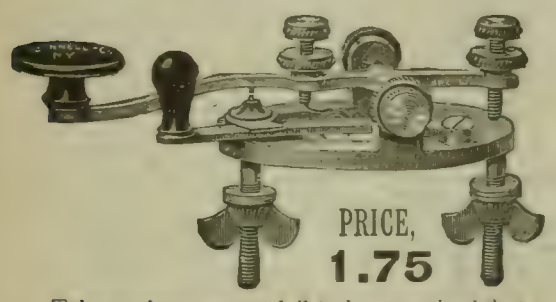
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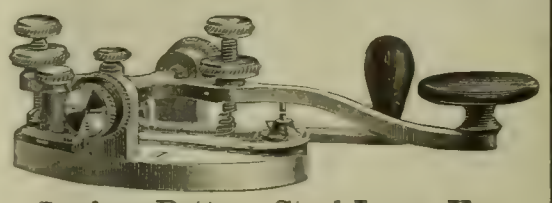


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NEW YORK, MARCH 22, 1890.

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THE ELECTRICAL INVESTIGATION.

The Committee on General Laws in the State Senate continued their investigation into electrical matters on March 14th. A. D. Van Gisen, who said he was Inspector of Electric Wires for the Board of Fire Underwriters for New York, Brooklyn, Jersey City, and smaller cities named, thought that proper insulation would prevent fire.

He could not say positively that he knew of any case where a fire had been the result of accident to electric light wires. He did not think that it was possible for anybody to tell that electric wires had caused the fire unless he had seen the actual beginning of the fire.

In regard to his method of examining buildings after wires had been put in, he declared that he had endeavored to keep all high tension wires out of buildings. His experience was that converters were safe. The companies made no difference in the rate charged for insurance whether the current used was high tension or low tension. He did not know what "underwriters wires" were.

William A. Anderson, Superintendent of the Survey Department of the New York Board of Fire Underwriters said the Board had never made any reduction on account of the introduction of electric light into a building. In regard to the safety of electric light wires Mr. Anderson thought that they were as safe as gas if the rules of the Board were obeyed.

He knew of no great fire which had been caused by electric lighting wires. In answer to the expert, Mr. F. W. Jones, Mr. Anderson said that the wire known as "Underwriters wire" was not sanctioned by the Board of Fire Underwriters.

Why the manufacturers used that name he did not know, unless it was done to sell the wire. The Board exercise no authority over wires in the street. The insurance companies frequently charged higher rates in buildings adjoinining electric lighting stations. In general, he was of the opinion that properly conducted electric lighting was as safe as any other method. Electric lighting was increasing rapidly in New York.

Colonel Bliss then tried to find out whether a re-examination was made of buildings when electric wires had been put in after policies had been written, and the fact was brought out that there was no regulation in regard to it. Then there was a discussion on the system of examination for insurances, and Colonel Bliss said that his house had been lighted by electricity for a year or two, and that no inspector had been near it.

Senator Brown—"Is it not true that companies insure houses without making inquiry as to the manner in which the house is lighted?"

Mr. Anderson—"No sir; it is not."

Senator Brown—"I know that it is; for my house has been insured and no one has been there to make an examination."

Henry Morton, President of the Stevens Institute, of Hoboken, testified that he was of the opinion that if all the forms of currents were properly taken care of there was no danger. The high tension current unprotected was more dangerous to life than the low.

In regard to the feasibility of subways for electric wires, Professor Morton said that up to two years ago he had believed that the time had not come for it, but having seen the action of subways in Chicago since then, he, in common with many other electricians, had come to the conclusion that insulation for underground purposes was possible. Consequently underground wires were possible, and the subway could be and should be used for safety.

On Saturday the 15th Messrs. George A. Hamilton, of the Western Electric Company; George H. Benjamin, Prof. George W. Plympton, of Brooklyn; E. W. Martin, chemist of the Health Department; Wm. Maver, jr., of the Consolidated Telegraph and Electrical Subway Company, and Schuyler S. Wheeler, expert of the Board of Electrical Control, testified, and Paul D. Cravath read letters from Sir William Thomson, of Glasgow, Scotland, who is recognized as one of the leading electrical authorities of the world; Prof. Geo. Forbes Dr. J. Hopkinson, W. H. Preece and E. Fesquet, of London, all high authorites. The witnesses as well as the letters all agreed that high tension continuous or alternating currents can with perfect safety be transmitted underground, and can also be carried with almost absolute safety overhead if properly insulated. They also agreed that underground was much the better place for electric light wires in large cities.

In Europe, it appears from the letters that alternating currents of 2,500 volts are carried on the underground and overhead wires with safety. Prof. Forbes in his letter said he had been in New York recently and noticed the condition of electric lighting after the raid on the wires, and he remarked this would all have been prevented "if the Board of Electrical Control had been composed of able and unbiased electrical engineers or if the civic authorities had not lost their heads."

Chemist Martin said ten thousand million cubic feet of gas was manufactured in this city last year, and nearly 10 per cent., or one thousand million feet, leaked into the ground, and a large part of this comes out again, to the injury of health.

In reference to this inquiry a Philadelphia paper gave utterance to the following: "Insurance companies in New York appear to conduct their business in the happy-go-lucky style. A Legislative investigation committee has developed the fact that no examination is made of insured buildings in which electric wires have been strung. The Philadelphia companies are more careful, and it is largely because of the work of Mr. McDevitt, of the Insurance Patrol, that Philadelphia has enjoyed almost complete immunity from electric light fires since the destruction of the Temple Theatre."

CRIMINAL CARELESSNESS.—A good deal has been said in recent times in the English press, to the effect that electric light accidents, such as those which occurred in New York last year, were quite beyond the range of possibility in England, on account of the careful manner in which the lines in that country were built, and the close inspection they afterwards received. How is it, then, that such a condition of affairs as that in a case described by the London *Electrical Review* can be accounted for in the face of all that has been said to the contrary. A complaint was made to the Board of Trade in London, of the condition of a transformer fixed on the wall of an ironmonger's shop, in close proximity to the public entrance to the place. The transformer was supplied with a 2,000 volt alternating current, and had no covering of any sort. The terminals and connections were exposed in such a manner that even a child might accidentally or purposely come in contact with the exposed parts and receive a fatal shock. This state of affairs at this particular locality had existed some time, notwithstanding the fact that the danger had repeatedly been pointed out.

Such criminal carelessness and neglect would not be tolerated one moment in this country, and we doubt if such a flagrant violation of common sense ever occurred anywhere in the United States.

OPPOSED TO ELECTRIC ROADS.—Senator Vest, of Missouri, is a non-believer in electric railways. His remarks in the Senate the other day on the question of permitting the Eckington and Soldiers' Home Electric Road to extend its lines would indicate that he is either not posted on the subject, or is impelled by some other motive to oppose the measure. He has doubts about a current of 500 volts potential not being dangerous to life. We would respectfully call his attention to the fact that recent tests in Buffalo have settled that question beyond doubt. A horse received a current of 515 volts through its body and afterwards walked off, with no trace of any ill-effects. The horse kicked some while the current was on, but that, of course was to be expected. A man went through the same test and suffered no permanent ill. Other instances could be cited of men receiving even greater shocks than that produced by a 500-volt current and suffering no ill-effects, and it is generally conceded that a current of such a potential is not sufficient to suspend life. Beyond the shock, which of course is severe and decidedly unpleasant, there is nothing to fear from a current of 500 volts potential.

MUNICIPAL LIGHTING.—In reference to the question being discussed in Philadelphia, of the establishment of a municipal electric light plant in that city, a Philadelphia daily paper suggests that "if an electric light station is ever to be built by the city it ought to be constructed with money derived from the proposed city loan. The city is not likely to borrow again for a long while, and it would be exceedingly difficult to get a large appropriation for such a purpose out of current revenues which are always too small to do all the work projected by city departments."

AN ENGLISH VIEW OF IT.—A London contemporary commenting on Postmaster-General Wanamaker's scheme to establish a postal telegraph system, says: "That the scheme is only of a limited character will probably lessen the support it might otherwise receive, and would not increase its popularity even if accepted. Notwithstanding that the tendency in the United States is towards State, or municipal, control for all public services, the acquisition of the telegraphs is a project of such magnitude that at present we can hardly regard it as within the sphere of practical politics.

THE ELECTRICAL INDUSTRY IN THE CENSUS.

Mr. Allen R. Foote, Chairman of the Committee on Data, of the National Electric Light Association, writes as follows:

My understanding of the present position of the movement to secure an authorization and an appropriation by Congress, to make the Census investigation of the Electrical Industry thorough and complete in every detail, is as follows:

1. The Committees of the Senate and House have received the resolutions adopted by the National Electric Light Association, also a good many petitions signed by those directly interested in the industry, and many other responsible persons who regard the subject entirely from the standpoint of public interest. In addition to these, petitions have been received, signed by the prominent underwriters of the country, notably those of Boston, Philadelphia and Chicago. That the interests of underwriters will be served by having this investigation the most thorough possible, is evident. Through the underwriters, the interests of every person who is a user of electric currents, or has property adjoining that where such currents are used, are touched and served. In short, the interests of the entire urban population of the United States will be served in a most important manner by the investigation requested to be made by these petitions.

2. The fact that some of these petitions are signed by persons not directly interested in the industry may be construed by the Committee as an attempt on the part of those interested to bolster up their requests, instead of an indication of the general public interest in the subject, unless they give a hearing to persons thoroughly familiar with it, who can explain its importance and meaning.

3. Hon. M. H. Dunnell, Chairman of the House Committee, referred the resolutions of The National Electric Light Association to Hon. Robert P. Porter, Superintendent of Census, at the same time asking Superintendent Porter if he had any suggestions to make in regard to the subject, and if it is desirable that his office be clothed with power in the matter which it does not now possess under the law.

To these inquiries, Superintendent Porter has replied as follows:

"I have the honor to state in reply, that the scope of the inquiry as at present outlined does not contemplate going into an investigation of so comprehensive a nature as that proposed in this petition, because I am in doubt if the law as at present framed gives this office authority to make an investigation covering the points in this proposed legislation, and even if authority was now vested in me, I should not feel justified in spending so large an amount of money out of the present appropriation as appears to be necessary to make a complete and accurate report covering this ground."

"I can readily see the importance to those engaged in the electrical and allied industries, as well as to the general public, of securing the data asked, and shall cheerfully undertake the work, should Congress make the necessary appropriation, and empower this office to institute such investigation, believing that it is entirely practicable to secure the information petitioned for."

4. In this reply, Superintendent Porter extends the co-operation of the Census Office to those desiring the special investigation, and very properly leaves the procuring of the authorization and appropriation therefor, to those whose interests are involved. It is not his place to interest himself in securing the authorization of any special investigation, any more than it is his place to use the Census Office to sustain a special economic or social theory. It is the place of those interested to do this thing.

5. To accomplish this, in view of the necessity for quick work, the most effective measures will be:—

First. For those interested, to write a personal letter to the Senator or representative with whom he may be acquainted, urging him to request the members of the Committee on the Census to appoint a day on which they will give a hearing on the subject to those who can and will appear before them when notified to do so. Such letters should furnish the full address of persons whom it is desirable that the committee should hear.

Second. A joint resolution should be introduced in every State Legislature now in session, requesting Congress in behalf of the people of the State, to authorize the investigation to be made in accordance with the petitions presented.

6. Questions pertaining to the uses of electricity are now more frequently the subject of State legislation than those pertaining to any other industry. The importance of reliable data relating to the industry, is attested by the fact that nearly every State Legislature now in session has appointed a special committee to investigate the uses of electricity. These investigations, while expensive to the State undertaking them, owing to their comparatively restricted scope, cannot compare in value, as a basis of legislation, with the investigation which the petitioners seek to have the Census Office authorized to make.

7. The Legislatures of about thirty States will be in session in 1891. The census report can be ready for their use. If the investigation of the electrical industry be made as contemplated by the petitioners, the report will be of the very greatest value to all State Legislatures as a guide to legislative action. It will render unnecessary a multitude of investigations by State and municipal authorities, whose work, in comparison with that of the Census Office, must necessarily be incomplete and partial. The investigation desired will be of enormous value to the people of every State.

8. With these explanations and suggestions I leave the subject in the hands of those who have, or should, interest themselves in it, believing that they can easily carry the effort to a successful issue.

The following is a list of the members of the Senate and House Committees on Census.

SENATE COMMITTEE ON THE CENSUS.

Eugene Hale, of Maine, Chairman; James F. Wilson, of Iowa; Francis B. Stockbridge, of Michigan; Cushman K. Davis, of Minnesota; Gilbert A. Pierce, of North Dakota; James H. Berry, of Arkansas; Joseph C. S. Blackburn, of Kentucky; Rufus Blodgett, of New Jersey; David Turpie, of Indiana.

HOUSE COMMITTEE ON THE CENSUS.

Mark H. Dunnell, of Minnesota, Chairman; Joseph McKenna, of California; Joseph D. Taylor, of Ohio; Charles A. Boutelle, of Maine; Henry H. Bingham, of Pennsylvania; George E. Adams, of Illinois; Nathan Frank, of Missouri; James S. Sherman, of New York; James H. Blount, of Georgia; William S. Holman, of Indiana; George H. Tillman, of South Carolina; Joseph E. Washington, of Tennessee; James W. Owens, of Ohio.

Mr. Foote further says:

I think the preamble and resolutions adopted by the National Electric Light Association, with one or two modifications, will be a suitable and effective form for drafting the resolutions to be passed by the State Legislatures.

It may be well to recommend the committees of the Senate and House to give notice to the following persons of the date on which they will give a hearing to this subject: J. F. Morrison, care Brush Electric Light Co., Baltimore, Md.; A. J. DeCamp, 123 South 11th street, Philadelphia, Pa.; T. Carpenter Smith, 608 Chestnut street, Philadelphia, Pa.; E. A. Armstrong, care Electric Light Company, Camden, N. J.; H. K. Thurber, care New York Safety Wire Co., New York City; H. Ward Leonard, 65 Fifth avenue, New York City; John C. English, 28 Elm street, New Haven, Conn.; Marsden J. Perry, 70 Weybossett street, Providence, R. I.; F. A. Gilbert, 17 State street, Boston, Mass.; S. E. Barton, 85 Water street, Boston, Mass.; George W. Davenport, 620 Atlantic avenue, Boston, Mass.; Alonzo Elliott, Manchester, N. H.; William R. Wood, Portland, Me; F. W. Jones, 5 Dey street, New York; M. J. Francisco, 23 Washington street, Rutland, Vt.; E. A. Maher, 71 Trinity place, Albany, N. Y.; C. R. Huntley, 257 Washington street, Buffalo, N. Y.; Charles F. Pease, care Westinghouse Electric Co, Pittsburgh, Pa.; A. R. Foote, Box 432, Washington, D. C.

BALL ENGINES.—The Northwestern Electrical Supply & Construction Company of Seattle, Washington, have closed a contract with the Willamette Bridge Railway Company of Portland, Oregon, for a complete steam plant to consist of one 150 horse-power Ball automatic cut-off engine, two 100 horse-power boilers, with heaters, etc.

The Field Engineering Company of New York City have placed an order with Charles F. Vincent & Co., agents for the Ball Engine Company of Erie, Pennsylvania, for two 150 horse-power automatic cut-off high speed engines. These engines are to be used in an electric street railway at Winston, N. C., now being constructed.

The Pennsylvania Normal School at Lock Haven, Penn., have placed an order with H. M. Sciple & Co., Third and Arch Streets, Philadelphia, for a 50 horse-power Ball automatic cut-off high speed engine.

The Denver Electric Illuminating Company, of Denver, Col., have recently purchased from the Ball Engine Company of Erie, Penn., one 125 horse-power Ball engine, making ten engines of this manufacture, aggregating 1,000 horse-power, sold them by the Ball Engine Company.

The First Cincinnati Edison Electric Illuminating Company, of Cincinnati, Ohio, have recently purchased a 150 horse-power Ball automatic cut-off high speed engine.

The Rittenhaus Manufacturing Company, of Passaic, N. J., have just bought a 25 horse-power Ball automatic cut-off engine.

THE ELECTRICAL EXHIBIT.—The Woman's Exchange Exhibition, which is to be held in the Lenox Lyceum in this city next month, will include a very large electric display. This will include the Edison exhibit from the Paris Exhibition, a miniature electric railway, magical electrical contrivances, twentieth century department *a la* Bellamy, long-distance telephone and a phonograph. The plan for the arrangement in the auditorium proposes to turn it into a veritable fairy palace, with the centre tower entwined with 5,000 variegated colored lamps, and streamers of incandescent light therefrom, like ribbons from a Maypole, 10,000 lights in all. Mr. Edison himself is greatly interested in the Woman's Exchange, and besides having made a present of $5,000 in cash to the charity, donates to it the entire exhibit above-mentioned, at a cost to him of over $20,000. E. W. Hammond, and his five assistants, who were in Paris, have already arrived to take charge of the technical display, and prepare for the opening of the six weeks exhibition.

BARNUM'S FAREWELL ON THE PHONOGRAGH.—The voice of Barnum, uttering his grateful farewell to the British public, has been treasured up in Edison's phonograph and will doubtless record the sound of the falling tears and sobs of all who were present. He says, "My voice, like my great show, will reach future generations."

NEW APPLICATION OF ELECTRIC MOTORS.

The displacement of steam engines and other engines by the electric motor for general work has become so common an occurrence that it is now looked upon as a matter of course, and it is only the application of electric power to work which could not be done by any other means that elicits more than ordinary attention. A case in point is the movement and control of hydraulic gates at a distance of several miles from the point of operation. The Elektron Manufacturing Company of Brooklyn have recently built two Perret motors for this purpose, one to be used at Marion, O., at a distance of three miles, and the other to be used at Decatur, Ala., at a distance of a mile or more from the operator. The dynamo used in each case is a small constant current machine. By changing the direction of the current at the dynamos, the motors, which are series wound, are run in either direction at will. It is of course well known that with an ordinary series motor, a change in the direction of the current on the line does not change the direction of rotation of the armature, because the current in both field and armature is reversed at the same time. In the case in point, the reversal is effected by an ingenious automatic device, invented by Mr. Frank A. Perret, the electrician of the Elektron Manufacturing Company, which is attached to the motor, and keeps the polarity of the fields unchanged, regardless of change in direction of the current on the line, while the current in the armature, and consequently its direction of rotation is reversed with each change in the main current. The water gates are thus controlled and placed in any desired position at the will of the operator, miles away, by simply throwing a switch lever.

A Novel and Simple Form of Electric Battery Has recently been invented in Italy. As described in the *Rivista Technica Science* says it consists of conical vessels of cast iron and porous earthenware, with nitric and sulphuric acid. An iron cone is placed point downwards in a stand, and is partly filled with strong nitric acid. Into this there is placed a cone of porous earthenware, containing dilute sulphuric acid. Then follows an iron cone surmounted by an earthenware one, and so on in a series, each vessel containing its respective acid. It follows that the inner surface of each iron vessel is bathed in nitric acid, and becomes passive, acting the part of the platinum or carbon in an ordinary cell. The outer surface is attacked by the dilute sulphuric acid, and takes the place of the zinc. There are no connections to make, the simple building of the pile putting all the parts into union. The earthenware cones are eight inches in diameter and four inches in height, and contain 550 cubic centimetres of ten per cent. sulphuric acid solution. The iron vessel contains 110 cubic centimetres of nitric and sulphuric acids, the latter being three times the volume of the former. Sixty elements, arranged in two piles, have a resistance of 10½ ohms, an electro motive force on open circuit of eighty-one volts, and on closed circuit of forty-five volts, with a current of 4 4-10 ampères. After five hours the difference of potential falls to twenty-eight volts and the current to 2 7-10 ampères.

To Utilize a Large Water Power.—While in Chicago a few days ago Mr. Thomas Lowrey, the Minneapolis street railway magnate, said that Henry Villard would go to Minneapolis to take the first steps toward turning the immense force in the Falls of St. Anthony into electricity to furnish motive power, heat, and light for Minneapolis and St. Paul. Mr. Lowrey said that Villard is in a position to utilize for this purpose an enormous amount of American and German money, and that the English syndicate controlling Meeker Island is with him also.

SUBMARINE CABLE BORERS.

At a recent meeting of the Zoological Society, Captain D. Wilson-Barker, of the Silvertown Company's staff, gave a very interesting description of various forms of boring molluscs met with during some cable repairs he had been engaged in. He also exhibited several specimens of these molluscs, as it is supposed that among them are two or three new varieties, these specimens have been placed in the hands of the British Museum authorities for classification. Captain Barker says:

"The presence of the teredo in submarine cables has for many years been well-known to telegraph engineers, but so far as I am aware, the attention of zoologists has not been drawn to this particular habitat of the boring mollusc. With the permission of Major Wood, managing director of the Western & Brazilian Telegraph Company, I am able to lay some specimens of the teredo before the Society. They were taken from the cable between Rio de Janeiro and Bahia in lat. 22° 11′ S., long. 40° 22′ W., at a depth of 20 fathoms.

"It may be of interest to remark that several teredo faults were discovered in this particular neighborhood, thus rendering localization a very difficult matter, the more so since there existed on the outside of the cable no sign indicating the presence of the borers.

"The specimens of cable exhibited illustrate the exact positions of the teredoes, and it will be observed that they must have penetrated between the sheathing wires when in the embryo state, thus planting themselves on the jute into which they afterwards bored. The jute is tanned by a special process before it is laid on the core, and it is therefore remarkable that these molluscs should be able to bore through this tough material impregnated with a chemical solution and then scoop pieces out of the gutta percha core.

"Together with the teredo I found another bivalve, and the minute hole in one of the teredo valves shows the presence of some other boring molluscs, which apparenty fed upon the teredo itself.

"I may mention that in another cable I have found specimens of a small Pholas, but in this case the sheathing wires were bird-caged out, thus affording free communication with the jute covering."

An Excellent Record.—The reputation that the Bishop Gutta Percha Company has made for itself during its forty-three years of existence is one of which they may well feel proud. The first submarine cable across the North River was made by this company. The conductor consisted of No. 9 iron wire. In 1854 the same concern laid a cable across the Harlem River. Pieces of this cable were taken up recently and found to be in good condition, after being immersed thirty-six years. Bishop Gutta Percha insulated cables are used by the Lay Torpedo Company and for the Sims-Edison torpedo boats. The Bishop Company are the pioneers in any new field in which goods in their line are to be used. Their cables are used for lighting buoys by electricity. The first cables put into the New York subways for electric light were of their make, and they were the only ones in use for that purpose up to Feby. 1st. The wire used in 1876 and in 1885 for the blowing up of the Hell Gate excavations was of the Bishop company's make, and taking it altogether the company's record stands to-day unapproached. During some recent tests in New York it was desired as a part of the same to ignite the insulation of the wire used. Some of it would not take fire. It was afterwards learned that it was some of the Bishop Gutta Percha Company's wire that had so stubbornly resisted the heat.

Electric Light in Cologne.—The authorities in Cologne have, after thorough investigation and consideration of the different electrical light systems, decided to use alternating currents.

A REMINISCENCE OF THE EARLY DAYS OF THE TELEPHONE AND PHONOGRAPH.

BY THOMAS R. TALTAVALL.

One evening during the summer of 1877 or 1878 business on the usually very active Washington wire of the Associated Press was very dull, and for the time being the sounder had ceased its clicking. All was quiet along the line and I sat at my desk in the New York office, reading. The soft notes of Trinity's chimes had hardly died away after striking the hour of nine, when the silence on the wire was broken. The sounder clicked spasmodically for a few moments, and my discriminating ear told me at once that there was a stranger on the wire. First a few dots were made, then there was a pause as if the stranger was trying to make up his mind what to say or do. Presently he began to call "N Y," as if to get his bearings, for he evidently did not know what wire he was on. I broke in and informed him he could not get "N Y on this wire," adding that he was on the Associated Press wire Up to this time I had had no clue as to the identity of my unseen correspondent, so I asked him who he was. Distinctly and promptly came back the reply, "Edison, Menlo Park."

Edison, at that time, was located at Menlo Park, and, through his inventions in connection with the telephone and phonograph—both of which were still in their swaddling clothes, and only read of—his name was a household word. Everybody was talking about Edison and his wonderful inventions, and Menlo Park. Hence, on the occasion mentioned, it was with considerable interest that I exchanged compliments with the man whose fame had already spread to the widest limits of Christendom.

"Would you like to hear some music?" he asked.

Replying that I would be pleased to be so entertained, I was puzzled to know how he would accomplish his object.

"Screw the armature of your relay up tight," he said, "and move the magnets up as close as possible, without touching; then listen."

I did as he directed, and in a few moments the notes of a cornet, as soft and sweet as the summer breezes, broke the silence. They had a far-away sound, which made them all the sweeter, but they were quite audible to those in the office, notwithstanding the crude apparatus on which they were translated. Every one turned with open ears to locate the direction of the sounds, and in a few moments my desk was the center of attraction.

After a tune on the cornet the entertainment was varied, and some vocal music was given, then some whistling, all of which was well reproduced considering the character of the receiving apparatus.

The instruments were then restored to their normal condition, and Mr. Edison inquired how it reached us. After informing him, and assuring him of the extreme pleasure his novel entertainment had afforded us all, he bade me "Good Night," and disappeared, leaving us with the notes of the charming music still ringing in our delighted ears.

Burglary Under an Electric Light. — Electric lights are generally accounted pretty good policemen, but some burglars in Kansas City are said to have broken open a safe in a jewelry store directly under the glare of an electric light and carried off $4,000 worth of jewelry. Perhaps, however, the use of these powerful lights has given rise to an undue sense of security, leading the real policemen to neglect their duties. The most that the lights can do is to expose the operations of thieves to watchmen and other passers-by. But if no one is to look after property because it is well lighted, the extra illumination is of advantage to the thieves.

WHEATSTONE BRIDGE TESTING.

On page two of our issue of February 15th last, we described the Wheatstone Bridge or Balance. We now give some of the uses to which this very valuable device is put. In testing with the Wheatstone bridge it is very desirable that all contacts should be perfect, in order that the results obtained may be as accurate as possible. The plugs should be clean and bright, and ought to be inserted into their plug holes with a twisting movement, so as to insure good connection. The battery power employed for all ordinary line testing is generally one hundred cells. In applying this power, care should be exercised to depress the battery key K' (see illustration in issue mentioned) for a moment prior to closing the galvanometer key K, which should make momentary contacts only. This is done in order to prevent injury to the coils of the galvanometer from the inrush of sudden and intense currents. Neither should the battery key be kept depressed for any length of time as the balancing coils would be apt to become heated.

In measuring resistances, the arms of the bridge should (when practicable) be arranged with a view to making all four sides equal, as the galvanometer is then in its most sensitive state. The greater, therefore, the resistance to be measured, the greater should be the resistance in the arms of the bridge.

Insulation and conductivity tests are made invariably with the zinc and copper poles of the testing battery put alternately to the line. This is necessary because, in the former test, the current flowing in the line produces an electrolytic action at any defective points along the wire, which practically increases or decreases the resistance of the wire according to the polarity of the current. In conductivity tests, readings are similarly taken with opposite poles in order to eliminate errors arising from earth currents (which either aid or oppose the testing battery), or from the existence of other disturbing elements due to the different effects of the copper and zinc currents upon defective portions of the wire. In either of these cases the mean of the two readings is accepted as the most accurate result.

The connections necessary to insulation testing will be understood by reference to the theoretical sketch of Fig. 1 in the diagram. One end of the line to be tested is attached to the bridge at *D* and the further end left open.

The + or copper pole of battery *B*, and one of the binding posts of rheostat *G* are grounded at the testing station, while the — or zinc pole of *B* and remaining post of *G* are connected with the bridge at *A* and *E* respectively. In this test the resistance of the arm *AD* is generally made to bear to the arm *AE* a ratio of 100 to 1 by inserting 1,000 units in the former and only 10 in the latter. *G* is then adjusted until the galvanometer remains unaffected by the depressions of *K' K*, when the total insulation resistance of the line will equal the unplugged resistance in *G* multiplied by 100. The mileage resistance of the wire is then obtained by multiplying the total insulation resistance by the distance in miles between the testing stations.

The connections for a conductivity or wire resistance test are the same as in the preceding case, except that the distant end of the wire is grounded instead of being left open (Fig. 2). The arms of the bridge are now made equal, and as near the resistance of the wire to be measured as possible. *G* should then be adjusted until the needle is brought to zero, when the resistance unplugged in the rheostat will be exactly the same as the resistance of the line.

Methods of ascertaining the location of faults:

A cross: The wires Nos. 1 and 2 (Fig 3) are crossed at *x*, and it is desired to know the distance to the fault. Three tests are necessary for determining this. Fig. 3 represents the connections requisite for ascertaining (1) the loop resistance of the two wires through the cross. No. 1 wire is opened and No. 2 is grounded at the nearest station beyond the cross. The adjustable resistance *G* is then varied until a balance is effected, when the resistance unplugged will be the same as that of the loop formed by the crossing of the two wires. If the fault itself offered no resistance whatever, then half the loop resistance divided by the resistance per mile would be the distance to the fault; but as the junction of the two wires almost invariably offers some resistance, the second test (Fig. 4) is made for the purpose of ascertaining its value. One end of the testing battery is put to earth, other connections remain the same as in Fig. 3. The testing current now divides between the two wires, and, assuming each wire to be of exactly the same resistance, No. 2 will balance No. 1 as far as the fault, but at that point No. 1 is, as it were, lengthened out by an amount equal to the resistance of cross connection *x*. This must be allowed for by inserting resistance in *G* until the needle is balanced. The added resistance in *G* is therefore equivalent to the resistance of the cross, and most be subtracted from the resistance of the loop. The remainder, divided by 2, or

$$\frac{\text{Loop} - \text{added resistance}}{2} = \left\{ \begin{array}{c} \text{Distance to cross} \\ \text{in ohms.} \end{array} \right.$$

The third test, represented in Fig. 5, and similar to that of Fig. 2, is next made, in order to find the conductivity resistance of No. 2, by which the distance to the cross may be calculated. For this purpose No. 1 is thrown out of circuit and No. 2 takes its place in the bridge. Its resistance having been determined, is then divided by the number of miles between the testing offices, and the result gives the resistance per mile of No. 2. This mileage resistance, divided into the number of units of resissance to the fault, will be the distance in miles to the cross.

When imperfect contact is made at the junction of the two wires, causing a resistance too changeable to be measured, it is better to treat the fault as a ground, and test in the manner now to be explained.

To locate a ground: This is best done by the application of the loop test, which is not affected by any variation in the resistance of the fault. The defective wire is looped at the nearest available office beyond the fault with a clear wire, both being connected with the bridge at the testing office in the manner shown in Fig. 6. The resistance in *G* is then altered until the needle is balanced, when the resistance in *G* will give the resistance of the loop. The next test is made by grounding the positive pole of the battery, as per Fig. 7. The positive current now enters the two wires by way of the fault *F*. The route via No. 1 being longer than that via No. 2, the balance will be disturbed and the galvanometer needle deflected. Enough resistance is therefore inserted in *G* to counterbalance the deficiency in the shorter path, after which the galvanometer will no longer be affected. Then, as in the case of a cross, the distance to the fault, in ohms, will be .

$$\frac{\text{Loop—added resistance.}}{2}$$

The conductivity resistance of the defective wire is next determined by first grounding the clear wire No. 1 at the distant station and ascertaining its resistance in the usual manner. (Fig. 8.) This resistance, subtracted from that of the loop, represents the resistance of the faulty wire, from which its mileage resistance and the distance to the fault is calculated in the manner before described.

In locating a ground or cross by means of the loop test there are times when it is not possible to obtain a balance on the galvanometer. This happens when the defective wire connected to the rheostat side of the bridge is longer in resistance than the companion wire forming part of the loop, and connected to the line side of the bridge. In such an event the wires should be reversed, which will transfer the shorter wire over to the rheostat side; then it can be made in the ordinary way to balance the longer wire. The unplugged resistance necessary in this case to secure a balance is added to, instead of being subtracted from, the resistance of the loop.

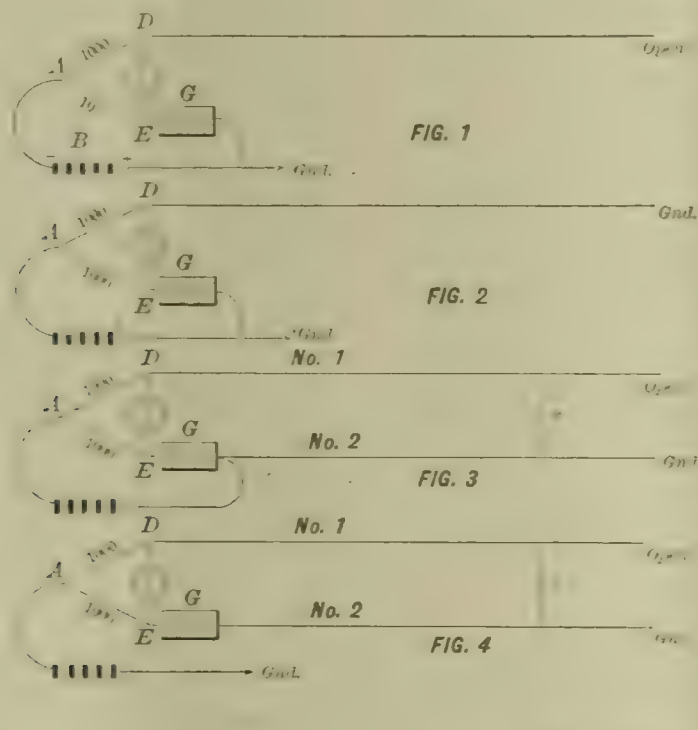


FIG. 1

FIG. 2

FIG. 3

FIG. 4

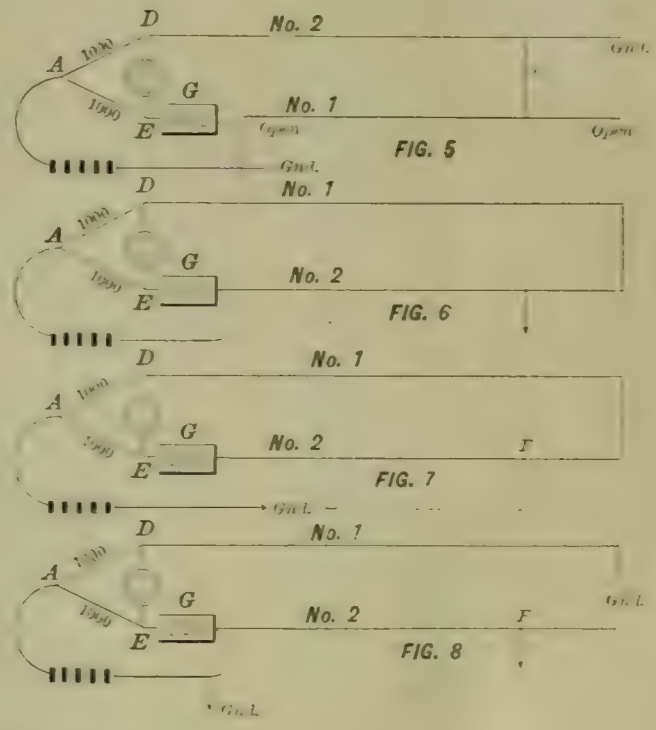


FIG. 5

FIG. 6

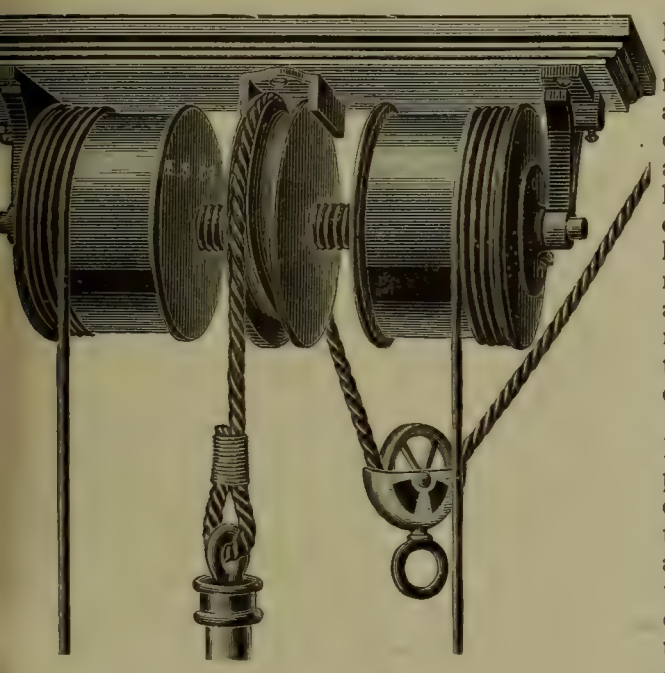
FIG. 7

FIG. 8

WHEATSTONE BRIDGE TESTING.

ARC LAMP HANGER.

The practice of allowing the weight of hanging arc lamps to be supported by the circuit wires is a dangerous one as well as troublesome. The wires become more and more weakened by the twisting action incident to raising and lowering the lamp, and in time a fracture results. Any device calculated to obviate these dangers, by relieving the wires of the strain, would obviously be of value. The adjustable independent support arc light hanger, made by The Electrical Supply Company, of Chicago, is designed with this end in view, and that the device is efficient as well as simple can be readily understood by a glance at the illustration.



ARC LAMP HANGER.

The valuab'e feature about this arc hanger is that the lamp is not supported by the circuit wires Thes: wires will not therefore crystallize and break off as is so often the case with other hangers The weight of the lamp is supported independent of these conductors. The device is simple and has no catches to wear out or break. It is positive in its action and can never get out of order; there being no loose parts, nothing but what can be seen in the cut. The lamp can be supported at any desired height, and raised and lowered at the will of the operator. The conductors are automatically coiled about the reels. The hangers are durable and will support five times the weight required.

THE PHONOGRAPHIC TOY COMPANY.—The Edison Phonographic Toy Company has been organized in Boston, and its shares have been listed on the Stock Exchange in that city. The capital stock is $1,000,000, in shares at $10 each. This company will control the phonographic doll trade, for which the Edison Company has contracted to put out 500 dolls per day. The Doll Company is about to put the dolls on the market, and to begin with there are 100,000 of these articles ready at the Edison laboratory in Orange, N. J.

ELECTRICITY DID IT.—An old man having recovered from an attack of rheumatism, was asked by a friend what he had done to find relief. He replied that he had found a piece of electric light carbon, and carried it around in his pocket. "There was enough electricity in the carbon," said he, "to knock the rheumatiz higher'n a kite."

SAND ON THE RAILS.—By a recent ordinance, the West End Street Railway Company, of Boston, is required to equip all of its electric cars with sand boxes, so that the driver may use sand on the rails when necessary by pressing a lever with his foot.

ELECTRIC RAILWAY CURRENTS SAFE.

In order to allay the fear that existed in the minds of many citizens of Buffalo as to the safety of the current used on the street railway line, some tests were made a few days ago. The tests proved beyond question the harmlessness of these currents. On the occasion the test was made on a horse and was witnessed by Superintendent Hornung, Mr. R. R. Hefford, Mr. Humphrey of the Brush Electric Light Company and other gentlemen interested in the subject. Mr. Frank Kitton, chief operator of the W. U. Telegraph Company, had charge of the test, and Mr. Madison Buel was selected by Mr. O. P. Letchworth to verify the readings.

A Buffalo paper in describing the tests, says: "The horse was encircled with wires in three places and the wires were connected and the whole charge of electricity, with a pressure ranging from 505 to 515 volts, was sent through all the wires into the animal during the contact of 15 seconds. The horse was shod with iron and stood on iron plates. The shock terrified him and he struggled to free himself from the crib he was in. Had he been standing alone he would doubtless have fallen, but in three minutes after the current was off he was quiet, and walked off a little later unhurt. Mr. Buell remarked that the test was a very severe one, as the conditions were all most favorable for receiving the charge effectively.

After the horse-test was finished Mr. E. E. Higgins, electrician of the Sprague Motor Company, assisted by F. S. Drake, conducted some experiments designed to measure the speed of the electric cars and to show how easily they are controlled. A speed of 22½ miles per hour was attained and the stops made with brakes only in 155 feet. Mr. Higgins called attention to the fact that the tracks were wet. At a speed of 12 miles an hour the car was stopped by reversing the motor, in 44 feet. At the rate of 6 miles an hour, horse-speed, the car was stopped in about its own length. It is said to be possible to stop a car going 10 miles, by reversal, in one quarter of its own length, but such a test would never be made except to save life as it is apt to burn out the motor."

An affidavit was made and sworn to by Mr. Frank Kitton, who certified to the measurements of the current used during the test on the horse. Mr. F. S. Drake, Electrician of the Buffalo Street Railway Co., also made an affidavit to the effect that the voltage used in propelling cars on his line varied from 425 to 475 volts, and that the tests on the horse proved that current to be harmless. Mr. Drake, in another affidavit, tells how he accidentally received the full charge of the railway current in his body and no ill effects resulted. Mr. James E. Price, an employe of the same company, deposes to substantially the same story.

These tests will have the effect of breaking the back of all opposition to any extension of electric street railways, and our Buffalo friends show great wisdom in demonstrating the lack of any element of danger in these currents in the manner in which they did. It was the most natural and most certain way to determine the safety or danger of such a current.

A LONG ELECTRIC ROAD.—An electric road between Kansas City and Independence, Mo., a distance of 20 miles, is to be constructed. The cost will be $1,000,000.

LIGHTNING.—Death by lightning is due sometimes to the sudden discharge of electricity *from* the body which has been inductively charged by the clouds, and sometimes by the direct stroke.

The Western Union Company is suing the city of Philadelphia to compel it to allow its wires to be strung along one of the streets for the purpose of establishing a branch office.

DISCUSSING ELECTRIC ROADS IN CONGRESS.

In the United States Senate on March 14th, the House amendment to the Senate bill to amend the charter of the Eckington and Soldiers' Home Railroad Company was taken up in the Senate and discussed. Messrs. Vest and Hale argued against the permission of overhead wires as dangerous to life, and Mr. Harris asserted that a force of 500 volts, which was sufficient for motive power, was innocuous.

Mr. Vest moved an amendment providing that no overhead wires shall be used within the city limits.

Mr. Sherman opposed the amendment. He spoke of the existing line as the most beautiful specimen of electric railroad in the United States, and said the extension for which the bill provided was in the suburbs, except as to two squares, where there were hardly any buildings.

Mr. Paddock spoke of an electric street railroad that had been built in Omaha a year ago, and said that, although there had been much opposition to it at the time, there was not a citizen of Omaha now who would not be glad to have an electric line on every street in the city. There had not been a single accident on that road.

Mr. Edmunds argued in support of the amendment. He spoke of the whole thing as a land speculation. He offered a substitute for Mr. Vest's amendment, and Mr. Vest accepted it, providing that the right of the company to erect or use overhead wires within the District of Columbia should absolutely cease and terminate on Juty 1, 1893.

Mr. Harris said that the electric power used by the company had never exceeded 500 volts, and there was no danger to animal life from that force. For the year and a half which the company had been in operation no accident had occured.

Mr. Manderson concurred with his colleague's remarks as to the electric road in Omaha, and declared his belief that the best system of street railways was the electric system.

Mr. Vest questioned the statement as to a force of 500 volts not being dangerous to human life. He also referred to the electric street railroads in Kansas City and Des Moines as failures and nuisances, so that the case of the one in Omaha proved nothing. He declared his belief that the cable system was superior to any other, and said that if Congress did its duty it would force all the street railway companies of the District to adopt it.

Mr. Platt said he was opposed to the amendment because he did not regard overhead wires as dangerous; but he was also opposed to the bill as being merely speculative, without any public necessity back of it.

The House amendment as thus amended was then agreed to.

SPRAGUE MOTORS IN KEARNEY, NEB.—The citizens of Kearney, Nebraska, are jubilant over their electric street railroad. The work of construction is going rapidly forward, and the motor cars have arrived. The cars are fitted with Sprague motors, and are lighted by electricity. They are the objects of great admiration by the inhabitants.

FAVORABLE TO AN ELECTRIC ROAD.—A favorable report has been made on the project to build an electric road from Franklin to Wrentham, Mass.

More than 100 linemen employed by the Western Union & Postal Telegraph Companies, the Thomson-Houston Electric Light Company, the Omaha Motor Railroad Company, and the NebraskaTelephone Company, of Omaha, Neb., struck for an increase of wages on March 8th. Not a lineman in that city is at work.

The Crosby Electric Company, with offices in this city, filed with the Secretary of State, on the 10th inst., a certificate of increase of its capital from $100,000 to $1,000,000. The trustees are William L. Muller, W. J. Arkell and Somner C. Chandler.

THE WYNNE SYSTEM OF ELECTRIC TRAMWAY.

A committee of English electrical engineers recently examined Mr. Frank Wynne's system of applying electricity to the working of urban tramways, and have rendered their report. They say:

We have lately had an opportunity of examining a scheme which bids fair to solve the problem of electric traction on tram-cars without the use of open conduits or accumulators. Mr. Frank Wynne is the inventor of the new system, in which power is transmitted from the engine to the car as directly as by rope traction, without the objectionable necessity of cutting a continuous slot in the roadway.

Mr. Wynne has been engaged in endeavoring to solve the problem of urban electric tramways for upwards of four years; his efforts have been watched with keen interest by engineers and electricians in England, and the skill and foresight with which he has approached the subject have met with general recognition.

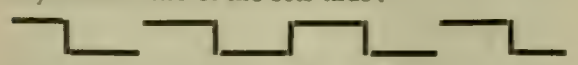
While electricians and tramway companies in this country have been experimenting with accumulators and slotted conduits, tram lines, with overhead conductors, have been carrying all before them in America, and excellent commercial results have been obtained.

The method of transmitting power to a tram-car by an overhead conductor, though well suited to new and rapidly developing districts, is absolutely inapplicable to English and most Continental cities, and no serious attempt has ever been made to introduce them in this country.

Mr. Wynne's new system secures all the advantages of an overhead conductor system without any of the constructive disadvantages of an open conduit.

Among the chief advantages of the overhead system are that it enables ordinary permanent way to be utilized without reconstruction for heavier weights, and it allows of existing cars being used with some modifications. These advantages hold to the fullest extent in Mr. Wynne's system, the object of which is to enable the electric current to be transmitted direct from the generating station to the car motors through an insulated cable laid underground, after the manner of electric light cables, with absolute safeguards against the possibility of including any of the ordinary traffic of the street in the electric circuit. The current used is that known as a low tension continuous current.

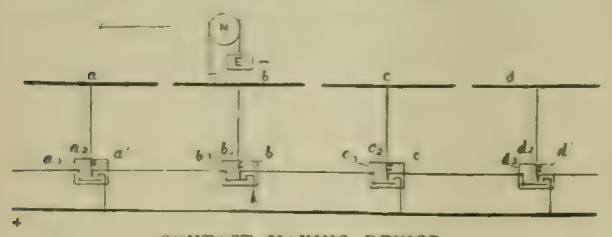
In the centre of the track is laid a crenellated contact plate or rail in short sections, this contact plate or rail is not straight, but is formed to follow the junction line of the sets thus:



It is half an inch wide on the surface and about 4½ inches deep, it offers no obstruction to carriages crossing the track, and affords a good foothold for horses.

Mr. Wynne has invented a remarkably simple device whereby the sections of the centre rail are successively put in connection with the main insulated conductor as the car passes over them, and are disconnected again as the car proceeds.

The only sections in connection with the main are those covered by the cars and its platforms; two sections are always in circuit, and a third section may be momentarily so connected as the contact brushes carried by the car pass over one of the separating spaces. The sections are necessarily short, and the inevitable leakage is therefore reduced to quite a negligible quantity.



CONTACT MAKING DEVICE.

The device for making contact with the sections of the central rail is shown in the above diagram. *a*, *b*, *c*, *d* are four sections of the sectional contact rail, a^1, b^1, c^1, d^1 are electro-magnets traversed successively by the current passing from the main conductor + to the car motor M.

a^2, b^2, c^2, d^2, are armatures and contact makers actuated severally by the electro-magnets, a^1, b^1, c^1, d^1, and are severally contained in the contact boxes a^3, b^3, c^3, d^3.

It will be noticed that as the car passes over section *b*, the current passing through the magnetic coil, b^1, not only closes the contact in connection with its own magnet, b^1, but also puts the magnet, a^1, in circuit in parallel with b^1.

This arrangement effectually obviates sparking, and provides that one section shall always be charged in advance of the contact brush. The contact pieces assume their original position by gravity, thus connecting the sections as the cars leave them.

The contact boxes may be placed in any convenient position, as, for instance, in the footway or curbs, but their construction is such as to render them suitable for fixing in the tramway track. The boxes themselves are of cast iron or steel, with a grooved or "diamond" surface, and are constructed on the diving-bell principle, so that the enclosed air will absolutely debar water from rising into the interior.

It is obvious that it is an essential part of the scheme that the current should never be cut off entirely from the magnets, for under such circumstances they would break contact with the sectional rail, and the car could not proceed. Mr. Wynne has provided thoroughly practical devices both for maintaining the circuit and for remaking it in the event of accidental disturbance, as for instance, by reason of the car leaving the rails.

Under ordinary circumstances, a small percentage of the current is kept on, or when the car may be going down hill.

In the event of contact being accidentally broken, the driver, by moving a lever, brings down a supplementary contact brush which closes the circuit of a single cell battery, and so re-establishes the current through the contact boxes.

There can be no doubt as to the great engineering skill displayed in Mr. Wynne's proposals, the details of which are eminently practical. The contact boxes are numerous, but there is no difficulty in adapting them to work under the conditions of a tramline, and the mere fact of the necessity of their manufacture in large quantities will reduce their cost and tend to simplify their details. This tendency is well illustrated by Lancashire cotton mills, in which 40,000 spindles are often found working all the year round with scarcely any repairs.

We are much impressed with Mr. Wynne's scheme, and consider that it is the only practical attempt that up to the present has been made to grapple with the real difficulties of urban electric traction.

Batteries are ruinous at present prices, overhead conductors inadmissible in English towns, and open conduits are an aggravation to all the evils attendant on the use of straight rails in crowded streets. Mr. Wynne's invention has none of these drawbacks. We do not think that his crenellated contact rail would be in any way objectionable in well-laid roads such as are usually found in London and the principal provincial towns.

On the question of capital cost and cost of power, we have carefully examined the accompanying estimates laid before us by Mr. Wynne, after comparing them with data derived from our own experience; and we are of opinion that they are formed on a good commercial basis, a sufficient margin having been allowed for extras which are inevitable in carrying out a new scheme.

The estimate of capital expenditure for applying this system to an existing tramway amounts to $10,600 per mile of single track; this leaves out the items of real estate and buildings, which will be much less for a line worked by electricity than for one worked by horses in which the area of ground and the buildings required for stables and granaries are very large.

Against this capital expenditure of $10,600 per mile, (including, as it does, boilers, engines and dynamos, for twice the maximum power required at any one time), must be set the capital cost of horses and of horse cars, amounting respectively to $7,300, and $2,400 per mile on then North Metropolitan tramway, or altogether to a sum nearly equal to that for applying electricity.

The large figure of 7½ electrical horse power per car has been introduced with these estimates to cover a line with steep gradients, and so make the estimate of safe general application. American experience shows that this is an ample allowance for the not very marked effect of gradients in increasing the aggregate power required.

A system somewhat similar to this one, the invention of Mr. Wheless, of Washington, was described last year. Mr. Wheless' system was adapted to series working. Messrs. Ayrton & Perry, of England, also have a patent on a system of this class.

GLOBULAR LIGHTNING.—D. Ernesto Caballero, professor of physics, and director of the electric lighting manufactory in Pontevedra, Spain, recently wrote to the authorities of the Madrid Observatory giving details of a remarkable meteorological phenomenon which appeared at 9.15 p. m. on January 2d. In a clear sky there appeared suddenly a ball of fire of the apparent size of an orange, which, after falling upon the conducting wires stretched across the city, entered the manufactory, struck the apparatus for distributing the light, from which (after raising the armature of a magnetic circuit closer) it struck the dynamo at work. It rebounded twice from the dynamo to the conductor, and from the conductor to the dynamo, then fell and burst with a sharp detonation without leaving any trace of its existence. Outside the building, and at the moment of falling upon the conducting wires, the ball was seen by the Professor of Natural History and others, and from various effects observed on the wires during the following day, there were undoubted manifestations of its electrical origin.

AN ELECTRICAL SOCIETY FOR BROOKLYN.—The Brooklyn Institue, at a recent meeting, decided to establish an electrical department, to be known as the Brooklyn Electrical Society. Its relation to the parent body will be similar to that of the New York Electrical Society to the Cooper Institute. It is proposed to provide a room where twenty persons could meet every week night for the purpose of carrying on electical experimentation. At the next meeting to be held shortly, the organization will probably be effected. There is much interest taken in the new movement and the success of the Society is assured.

THE PHOTOPHONE.—A photophone is an instrument by which sounds may be transmitted to a distant point by means of a beam of light reflected from a thin mirror thrown into vibration by the voice. The beam at the receiving point is made to fall upon a receiver of selenium connected in circuit with a small battery and a Bell telephone. The varying intensity of the beam of light upon the selenium, caused by the vibration of the mirror, varies the current, and thus reproduces the original sounds.

LIGHTNING HELPED THEM TO ESCAPE.—During a thunderstorm a few days ago the jail at Moulton, Ala., was struck by lightning and a hole torn through the roof. The jailer neglected to repair the damage, and two days later five prisoners escaped through the opening.

HOW SHALL WE MAKE OUR WIRES SAFE.

BY M. D. LAW.

I have read with great interest and pleasure the article in the February number of THE ELECTRIC AGE, by Mr. Markland, on "How Shall we Make Our Wires Safe," and am glad to see that he is a man after my own heart and not afraid to put his views on paper. The safe handling of electric wires is the keynote of success to all central station lighting and had there been more care taken, in line construction throughout the country, there would not have been such a cry against overhead wires. With first-class construction, frequent inspection, and ground tests made at least every three hours, there need be but little danger to the public from overhead electric light wires.

I have always been a believer in good insulation on aerial wires; in fact the first lines ever constructed for rental lights from a central station were by myself in San Francisco, September 20, 1878, and at that time I used a rubber covered wire, braided on the outside; and if my memory serves me right, the American Electric Works, of Providence, made that wire to my order. The same class of wire has been in use on Chestnut street, Philadelphia, since November, 1881, and is about as good to-day as when put up. But still this class of insulation should not be entirely depended upon without frequent testing, and all of the men around the station should be instructed to be vigilant and report every wire that is down or likely to come down, or even swing against the electric light wires.

A good way to patrol the wires is to offer a cash prize to Trimmers and Inspectors for all dangerous wires that they report, as there is but very little of the aerial wires that they do not see every day and night. Mr. Markland's idea of guard wires is good, but they cannot always be relied on, I use them only in particularly bad places. Mr. Markland has also touched one point which is a bad fault in all arc line construction, and that is, that not enough room is left between the wires next the pole. This space should not be less than three feet, to allow men to pass through without touching the wires.

I find it difficult to make men realize the amount of danger that lurks in an old iron wire hanging down over an arc light wire. It should be cleared as soon as possible and great care should be used in clearing them, to thoroughly insulate yourself from the ground. In fact such wires should never be touched by the hands, and do not under any circumstances use rubber gloves, but use a dry hand line, or shears, with long wooden handles. I find a very handy tool for clearing wires is a pair of pruning shears on the end of an extension pole that can be run up to forty feet. This will allow the cutting of the tramp wires on a level with the lines, without the need of going on a building, which is at times very difficult and cannot be done at night, or Sundays.

I see that Mr. Markland mentions the word "cleat." They are the most expensive fastening that can be used for inside wire, and are good for nothing. I have had several fires from cleated work where a leak has occurred in the roof, and have condemned their use for over two years. The cheapest and best insulator that can be used for that work, is a small porcelain, with a groove in the centre, around which is closed a screw-eye, which can then be screwed in the ceiling or wall and the wire threaded through the hole in the center of the insulator. This gives a porcelain insulation all around the wire and holds it entirely clear of the plaster or woodwork; is easy to put up and can be taken down without marring the ceiling.

"The people who control wires know very well how to make wires safe, and that it is really only a question whether or not they are willing to go to the necessary expense."—Thos. D. Lockwood, Boston, Mass.

MODERN THEORIES OF ELECTRIC ACTION.

Had the world remained in ignorance of the existence of the phenomena of electricity, the civilization of to-day would have been impossible. This may seem a rather sweeping and perhaps startling statement, but if we stop a moment and consider the benefits that have accrued to mankind through the development of electrical science, we will perforce acknowledge its simple truth. The reader, glancing over his morning paper, and finding there items of vital importance that occurred the night before in London, St. Petersburg, Zanzibar, or Rio de Janeiro probably does not stop to think that were it not for electricity that news would be a week, a month, or several months old before he saw it, if indeed it ever reached him. It might be said that he could readily exist without it. So he could, but there will be no one brave, as well as narrow, enough to say that the millions of messages that are flashed daily over the wires, connecting town to town, city to city, county to county, state to state, and nation to nation, bringing men and governments in as close communion as though they were all under the same roof, has not given civilization an impetus that nothing else could have done. The thousands of uses to which it is put—the production of the beautiful white light, its use in thereapeutics, and in the mechanical and fine arts—render it a factor in the civilization of to-day that, perhaps, we could, though we would not, live without. The modern theories of electrical action differ very materially from those of a few years ago. Indeed, it is now known that the former theories had no foundation in fact, though we are not yet prepared to say that those advanced to-day even approach accuracy. But popular interest in the development of electricity is so great that scientists are not now content to study the application of its mysterious energy alone, but are striving to find its real cause. Its source can be placed in the dynamo, the battery or somewhere else, but why at the source the action of chemicals on metal plates or the moving of a conductor through a magnet field should produce that form of energy called electricity, is still as unfathomable as the remotest depths of space. One hypothesis endeavors to explain the phenomena of electricity by supposing two different electric fluids, tenuous and imponderable, called the positive and negative. The particles of the positive repel one another, as do also those of the negative; but the particles of the positive fluid attract the particles of the negative, and *vice versa*, and are strongly attracted by matter, producing when present in it electrification. The two fluids attract one another and unite, but the action of friction separates them, one going to each of the two parts of the frictional bodies. This is the double fluid hypothesis of the source of electricity. The single-fluid hypothesis assumes a single, tenuous, imponderable fluid, the particles of which mutually repel one another, but are attracted by all matter, and that every substance possesses a definite capacity for holding this fluid, no effects of electrification being manifest when this capacity is just satisfied. When that capacity is not reached, however, the body is negatively excited, and, when it has more than its capacity, it is positively excited. Friction causes a redistribution, giving one body a surplus, thus positively electrifying it, while the other has a deficit and is negatively electrified. Neither of these hypotheses is now accepted. Various other theories are offered. By some it is believed to be, like heat, a particular form of energy; by others an exceedingly tenuous form of matter. And then again the assumption is made that it is neither a phase of energy nor a form of matter. Professor Edwin J. Houston, in his Electrical Dictionary, attributes the phenomena of electricity to differences of ether pressures, electricity itself being the ether, and the electro-motive force the difference of pressure of the ether; that one form of electrification, possibly the negative, is caused by a "surplusage of energy" charged on the excited body, thus producing a greater ether tension, or pressure; and the opposite electrification by a deficit of energy, thus producing a smaller ether or tension. Faraday's discoveries, mathematically interpreted by the brilliant mathematician, James Clerk Maxwell, who demonstrated that the properties of the medium required to transmit electro-magnet action are identical with those of the luminiferous ether, have been experimentally confirmed by Professor Hertz, at Heidelberg. Hertz's experiments are the most advanced of those bearing on the theory of electricity. He has obtained electric oscillations of a very short period—several hundred million in a second—and has shown that electro-magnetic waves caused by them are propagated in the surrounding space, and are reflected and interfere with one another as do waves of light. Other hypotheses are being considered, but the views and experiments of Hertz are just now attracting the most attention.

FREAKS OF THE TELEPHONE.—Some telephones in Pittsburgh have lately been acting in a strange manner. "The residents from Fifth avenue to Hazelwood, three miles out," says a press despatch from that city, "have been annoyed by the queer freaks of their telephones, which mixed up conversations amazingly. The matter came to a climax the other day, however, when scores of telephone bells rang steadily. When an attempt was made to answer the call, a ball of electricity would prance around the machine for a moment and then explode. An investigation resulted in the Pittsburgh Telephone Company formally notifying the Second Avenue Electric Car Line that unless their lines are removed or insulated by the 10th inst., a suit will result. Insulation will cost the company some $15,000."

CURING CANCER BY ELECTRICITY.—A young physician has invented and used, it is said with success, a machine, which, in cases of cancer, will direct a current of electricity against a diseased cell strong enough to destroy it and at the same time will not injure a healthy cell. Those that are destroyed are said to turn into a hard substance, that remains without causing the patient any inconvenience.

THE HALIFAX-BERMUDAS CABLE.—It is announced that the English Government have prolonged the time originally allowed for the laying of this cable to the 24th of June. The company intend, it is also stated, to complete the scheme by telegraphically connecting the Bermudas with the Bahama Islands and Jamaica.

ELECTRIC LIGHTS IN A BALL ROOM.—The new ball room of Mr. W. C. Whitney, ex-Secretary of the Navy, the opening of which was celebrated recently in an elegant manner, is lighted by electricity. On the occasion mentioned, the electric light globes were covered with pink silk gauze, through which the light filtered softly, tinting the elegant decorations with a most beautiful effect.

PUBLICATION NOTE.—The Woodward Electrical Company, of Detroit, have just issued a neat little book describing and illustrating their storage batteries. This company are doing excellent work in this line.

UNDERGROUND WIRES IN ENGLAND.—English electrical experts say that all the main trunk and telegraphing wires in England could be put underground for $30,000,000, and that although the sum is a large one, the nation can well afford to expend it.

THE BROWN DUPLEX PIN AND INSULATOR.

As the number of wires increase on pole lines it frequently becomes a serious question how to arrange them without adding cross-arms, or without getting them too near each other. The Brown Duplex Pin and Insulator goes a great way toward the solution of this perplexing difficulty, and it is so simple, and yet so effective, that one wonders why it was not thought of long ago. By the use of these pins and insulators one-half the number of cross arms and pins are dispensed with, which not only makes a saving in material and labor, but relieves the poles of so many unsightly cross-arms, thus materially decreasing the cost in construction, and producing a practical line that presents a lighter, neater and less objectionable appearance, which will be appreciated by the public.

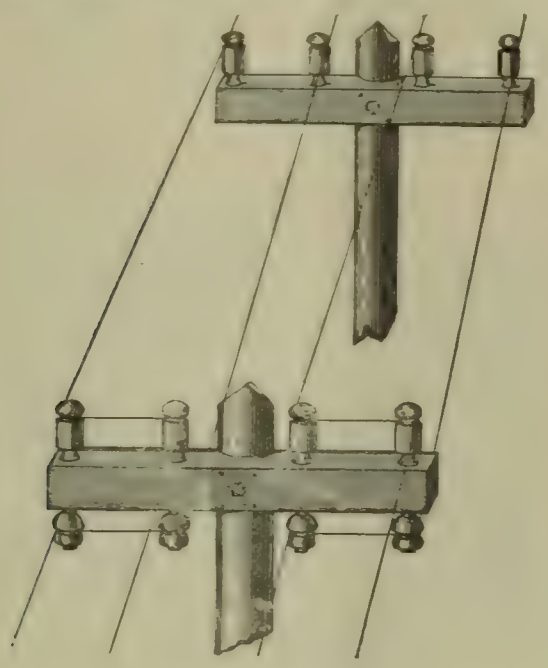


FIG. 1.

A general idea of the uses and applications to which these pins and insulators can be put may be obtained by reference to the following illustrations:

Fig. 1 represents the opportunities for changing the relative positions of the lines toward each other at every fourth or fifth pole, or as often as may be thought desirable, for anti-induction purposes on telephonic circuits, etc.

This is a very important feature, and anything tending to lessen the evils of induction is of value, and would be thoroughly appreciated by users of wires subject to these detrimental influences.

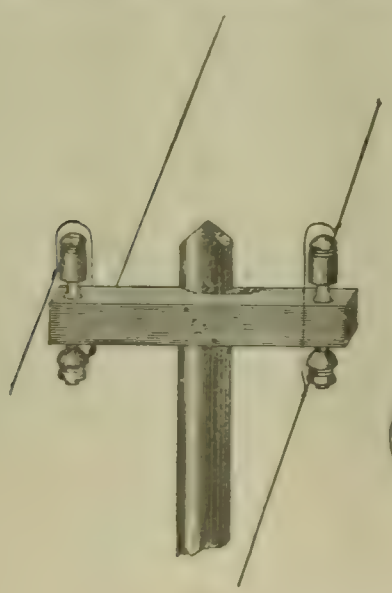


FIG. 2.

Fig. 2 shows the use of the device on a testing pole. The wire fastened to the top insulator and a continuation of it fastened to the lower insulator, being connected together by a short piece of soft copper wire, which can be readily removed for purposes of testing, and restored again to close the circuit.

Fig. 3 shows the device applied as a break-arm for the establishment of loops, while cut

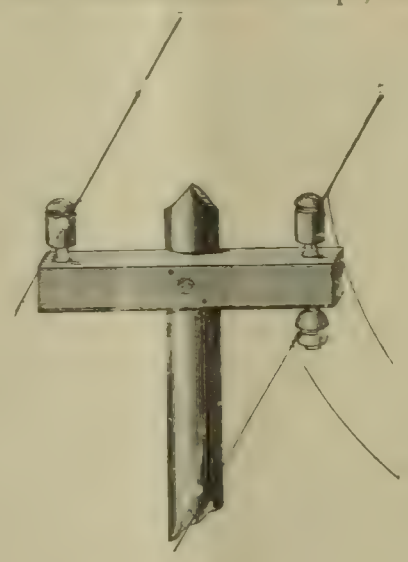


FIG. 3.

No. 4 shows the application of the system to elevated railway and similar structures.

A method of doubling the carrying capacity of cross-arms is shown in Fig. 5. The pin projects above and below the cross-arm, thus making it possible to string two wires in the space usually occupied by one.

While the cost of the new pins and their lower insulators is a trifle above that of the ordinary pin and insulator, the entire cost of the line still remains considerably below that of one built under the old system, besides reducing the unsightly appearance, as pointed out.

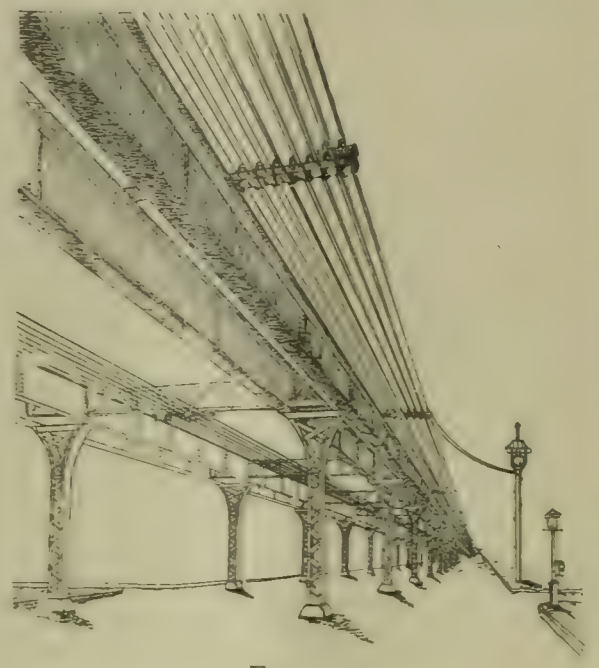


FIG. 4.

The duplex brackets are especially adapted for cases where it is desired to run a loop or two-wire line on the poles, on house-tops, or through the woods.

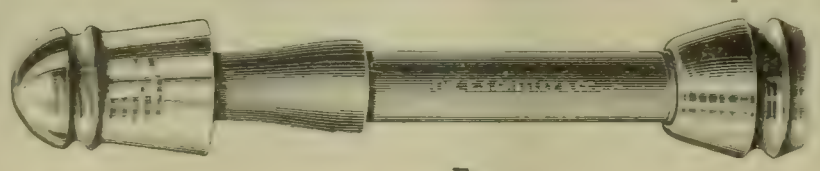


FIG. 5.

Both the pins and brackets will also be found very convenient for "cutting-in" purposes, "test stations," etc.

It will be noted that not only is the distance between the various wires precisely the same with the use of this device as when the old style of pin is employed with double the number of arms, but the strain of the wire is balanced so that there is no torsion, either vertical or perpendicular, upon the cross-arm itself.

The Duplex Pin and Insulator is the invention of R. G. Brown, and is sold by the well known house of The E. S. Greeley & Co., 5 and 7 Dey street, New York.

RETURN OF MR. INSULL.—Mr. Samuel Insull, general manager of the United Edison Manufacturing Company, returned from Europe on the steamer Britannic, which arrived at her dock at 11 A.M., on Saturday last. Mr. Insull reports a very stormy passage, having passed a large number of icebergs, and the last three days' run was in a dense fog. He is much improved in health, and little resembles the tired and worn out man who left New York last fall. He reports having had a very pleasant time traveling over the continent. The following named gentlemen were on the dock to greet Mr. Insull, who, by the way, was the first man to land; F. S. Hastings, J. Muir, J. P. Ord, H. M. Livor, J. Hutchinson, F. S. Gorton, W. S. Perry, F. S. Sargent, R. J. Gray and H. Chatterton. A delegation chartered the Laura M. Starin on Friday morning, and in a dense fog started out ostensibly to capture Mr. Insull at Quarantine, but, failing in that, we are informed they sailed about the Bay until nine o'clock that evening in search of a rainbow. Those on board were as follows: Messrs. J. H. Herrick, John Muir, F. S. Hastings, J. Kruesi, C. E. Chinnock, J. F. Kelly, H. Ward Leonard, C. Batchellor, A. E. Kennelly, T Butler, A S. Beves, E. V. Cavell, of *Street Railway Gazette*, Chicago, W. S. Perry, J. H. Wood, J. P. Ord, J. C. Henderson, S. D. Green, L. Steringer, C. F. Haddington and M. F. Adams.

THE SHAVER CORPORATION.—Mr. H. H. Warner, the millionaire "Safe Kidney Cure" man of Rochester, N. Y., has recently purchased a half interest in the capital stock of the Shaver Corporation and become its President. The corporation has recently secured control of the Gillette magneto call-bell, house door bell, door opener and magneto annunciator, and will soon be ready to supply the trade with these specialties. The Quartermaster's Depot, U. S. A., recently awarded contracts to the Shaver Corporation for the equipment of two short telephone lines. In the advertised proposals for bids the Shaver Corporation's goods were set up as the standard, and it was one of the conditions of the proposals that the material required was to be of that corporation's make, or of any other of equal high class.

This is a very flattering and merited testimonial of the excellence of this company's goods. The Shaver Corporation has removed its offices to No. 207 Broadway.

AN ENORMOUS BELT.—The well-known belting manufacturers, Messrs. Chas. A. Schieren & Co., have just secured a contract from the Louisiana Electric Light Company, of New Orleans, La., for 160 feet of 72 inch wide oak tanned double belt, and 550 feet of 48-inch wide, the same quality. This 72-inch belt will be the largest ever furnished an electric light plant, and will be the largest and heaviest in the world. It will be put together in the firm's new "Baby" hydraulic belt press. This "Baby" weighs 12 tons, is capable of making a belt 74 inches in width, and has a capacity of over 300 tons pressure.

ALTERION.—An English electrician has invented a material that he calls "alterion," for the prevention of corrosion in boilers. The interior of the boiler is coated with the material, and from time to time electrical currents are sent through it.

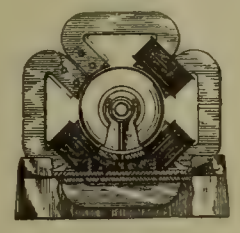
ELECTRICAL WIRE INSPECTOR.—An inspector of electrical wires is to be appointed by the City of Minneapolis, Minn. The city attorney is preparing an ordinance defining the duties of such an officer.

ELECTRICAL PATENTS ISSUED MARCH 11TH.

422,910. System of Arc and Incandescent Electric Lighting. Harold P. Brown, Chicago, Ill. Filed November 23, 1885. This system consists of a combination of an arc light circuits with electro magnets and shunts whereby the lighting or extinguishment of any of the lamps may be compensated for.

422,911. Electromoter. Henry R. Butterfield, Waterville, Me. Filed May 22, 1880. The principal feature of this invention is the commutator.

422,925. Zinc Electrode for Galvanic Batteries. Georges D'Infreville, New York, N. Y. Filed June 27, 1889. This battery is of the gravity type and is provided with two or more zinc plates with suitable devices for hanging.

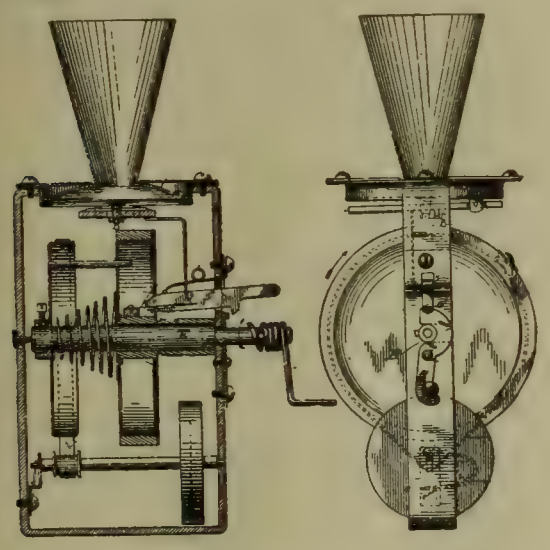


NO. 422,999.—FIELD MAGNET FOR DYNAMOS.

422,956. Electric Valve Controller. Ernst R. Malmborg, St. Louis, Mo., assignor of two-thirds to John M. Glover, same place, and Warren B. Martindale, Kenosha, Wis. This device consists of a valve or damper controlled by an electro magnet through the intervention of rack and pinion mechanism.

422,968. Electrically Controlled Elevator. Walter J. Paine, Boston, Mass. Filed June 5, 1889. In this invention the elevator car is moved by an electric motor which is controlled from the car by proper switches, etc.

422,975. Coupling Electric Motors. Edwin W. Rice, Jr., Lynn, Mass. Original application filed May 7, 1888. Divided and this application filed October 14, 1889. This provides for the joining together of two or more motors on the same work, each having its series field magnet coil connected to the armature of another.



NO. 423,039.—PHONOGRAPH FOR DOLLS.

422,976. Reversing Trolley. Henry P. Roberts, Rochester, N. Y. Filed November 14, 1889. In an electric railway the conducting wire supports are so arranged that the trolley arm has a tendency to assume a position perpendicular to the line of movement of the vehicle.

422,999. Field Magnet for Dynamos. Elihu Thomson, Albert L. Rohrer, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed November 25, 1889. The feature of this dynamo is the construction and shape of the field magnets. See illustration.

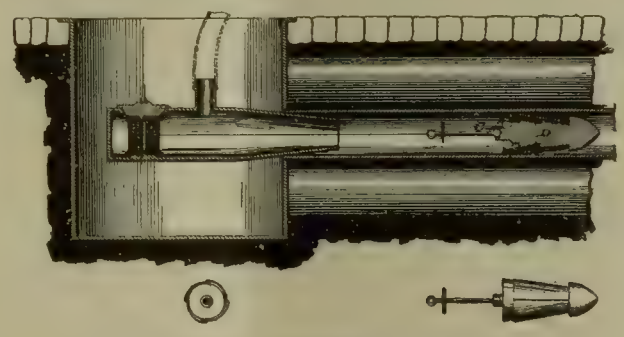
423,004. Overhead Electric System. Wm. Vogler, Somerville, Mass. Filed December 3, 1889. This consists of a re-enforcing insulated support to which the conductor is secured, and insulation interposed between the said support and trolley wire to electrically separate said wire and support.

423,005. Trolley Wire Supporting Apparatus. William Vogler, Somerville, Mass. Filed Jan. 8, 1890. This system consists of a combination of span wires and insulators to sustain the trolley wire.

423,014. Casing for Electric or other Apparatus. Leander S. Woodbury, Calumet, Mich. Filed May 22, 1889.

423,023. Underground Electric Conduit. Augustus Bruner, Indianapolis, Ind. Filed November 11, 1889. This is a process of constructing conduits by setting cores in a trench and filing in the space around the cores with cement or similar material. After this has set the cores are withdrawn. The cores are held in position by means of head boards at each end.

423,026. Armature. Robert L. Cohen, Camden, N. J. Filed June 19, 1889. A combination with armature shaft, of a sleeve of non-magnetic material thereon, said sleeve being provided externally with longitudinal ribs and a series of hollow spools mounted upon the sleeve.



NO. 423,134.—UNDERGROUND CONDUITS.

423,029. Regulation of Alternate Current Generators. Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Electric Improvement Company, Gloucester City, N. J. Filed December 5, 1889. A combination with an alternating generator and a storage battery included in a circuit with the exciter, whereby when the lamp load is light the exciter is run as a dynamo to charge the storage battery, and when the load is heavy the discharge from the storage battery drives or assists in driving the shaft of the generator.

423,039. Phonograph for Dolls or other toys. Thomas A. Edison, Llewellyn Park, N. J. Filed July 2, 1889. A small phonograph is placed within the doll or other toy.

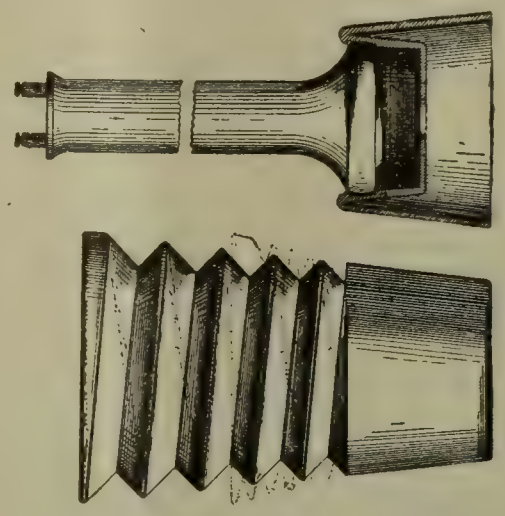
423,101. Process of Electroplating Non-Metallic Articles. Wm. H. Winslow, Chicago, Ill Filed October 28, 1889. This process consists of overlaying the surface of non-metallic articles with metallic strands or wires connected in the electric circuit of the electroplating apparatus and afterwards electroplating the article. Articles of wood are first given a coat of parafine.

423,102. Thermal Cut-Out. Jas. J. Wood, Brooklyn, N. Y. Filed October 21, 1884.

423,134. Laying Electric Conductors. Thomas J. Cope, Philadelphia, Pa Filed July 26th, 1889. This is a device for laying conductors underground, and includes a carrier or projectile, an air-tight plug containing a reel, and means connected with said plug for moving said projectile.

423,207. Portable Electric Lamp. Alexander H. Bauer, Chicago, Ill., assignor to the Pullman Palace Car Company, same place. Filed August 10, 1889. This invention consists of a socket or receptacle adapted to receive the end of a bracket arm and having spring clamps therein to engage said arm, lamp wires, having their ends secured in the hollow of binding posts.

423,210. Electric Meter for Alternating Currents. Otto T. Blathy, Buda-Pesth, Austria-Hungary. Filed October 7, 1889. This invention consists of two independent electro magnets, one of which is excited by the main current while the other is excited by a shunt current; a rotating body upon which the magnets act inductively or dynamically, and a registering apparatus.



NO. 423,299.—EAR-PHONE FOR TELEPHONES.

423,223. Electric-Heating Apparatus. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed December 13, 1889. This heater consists of parallel flat sheets of metal, one end of which are arranged to have a free movement longitudinally, and by the expansion and contraction of the metal, due to the current, the circuit is made and broken.

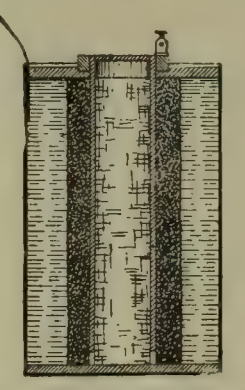
423,229. Telegraphic Repeater. Sidney S. Emery, Newton Centre, Mass. Filed April 27, 1889.

423,245. Electric Shaft-Controller, Anthony W. Hart, Boston, Mass. Filed June 29, 1889. This is an arrangement whereby a belt may be shifted from a stationary to a loose pulley, or *vice versa*, by means of an electro-magnet and weight operated by a push button at any convenient point.

423,299. Ear-Phone for Telephones. Julius J. Wolf, Kansas City, Mo, assignor of two-thirds to Max Weil and Aaron M. Sloss, both of same place. Filed Jan. 24, 1890.

The ear-phone is provided with a bellows as shown in the diagram. This bellows admits of variation between the ear and phone

423,310. Connecting Device for Battery-Terminals. Rufus N. Chamberlain and Jacob C. Chamberlain, New York, N. Y. Filed Nov. 12, 1889.



NO. 423,335.—DRY GALVANIC BATTERY.

This is a method of clamping flat battery electrodes.

423,324. Secondary Battery. William A. Johnson and James N. Smith, Toronto, Ontario, Canada. Filed June 27, 1889.

This is an improvement in the method of preparing the surface of the lead plates for the application and holding of the active material of the electrode.

423,335. Dry Galvanic Battery. Louis Moorthamers, Brussels, Belgium. Filed May 21, 1889. Patented in Belgium Aug. 11, 1888, in France Dec. 6, 1888, and Germany Dec. 8, 1888.

The exciting paste of this battery is composed of ammonium chloride, chalk and hydrochlorate of lime. The central cylinder is composed of carbon and is hollow. This contains a vapor-absorbing agent.

ON THE MECHANICAL ACTION OF VARIABLE CURRENTS.

Mr. M. J. Borgman has been making some investigations into the above-named subject and a London contemporary reports the results as follows :

A ring made out of thick copper wire was suspended in the place of the beam plate of a pair of scales and the balance maintained by means of weights ; below the ring was placed concentrically a vertical bobbin, containing a copper wire of 2·5 mm. diameter (the height of the bobbin wrs 120 mm., its interior diameter 43 mm., its exterior diameter 120 mm.). The bobbin may or may not be furnished with a massive bar of iron or formed of iron wire. The current was supplied by accumulators ; a commutator which was kept in motion at the speed of nearly 1,000 revolutions per minute by a Breguet electric motor, changed the current's direction twenty times per revolution. Even with a current of half an ampère the repulsion of the ring was clearly marked ; it was less so when the bobbin was without the iron bar. On substituting for the ring a horizontal disc of similar dimensions or by a tube of the same metal suspended in the cylindrical cavity of the bobbin, we observed considerable repulsion, much less, however, in the case of the tube than in that of the disc or ring.

On substituting for the commutator a simple interruptor, affording a number of interruptions per minute equal to that of the current's inversions, we noticed similar repulsions, but of less intensity. It was upon the liquid surface of a sheet of mercury that I observed the most interesting phenomena. The bobbin made use of was merely a coil of insulated wires, connected to each other by threads and deprived of the extraneous portions of metals which might interfere with the phenomena to be observed. A glass basin with a flat horizontal bottom, containing mercury was placed as concentrically as possible above the bobbin, and the surface of the liquid lightly powdered over with lycopodium. A few moments after the closing of the alternating or merely intermittent current, as the case may be, the motions of the particles of lycopodium plainly evinced the presence of two circular currents of mercury moving in opposite directions, which combined to form a single diametral current.

These eddies are most marked when the thickness of the mercury is least ; in fact, just sufficient to cover the bottom of the base. They are less marked with intermittent than with alternating currents ; the presence of the iron bar increases the intensity of the eddying movement.

If we bring about a want of symmetry in the field of the bobbin deprived of its bar, by inserting a thin copper disc beneath the basin excentrally as regards its centre, we notice two eddies, the current of which is towards the disc. By inserting two or three discs beneath the basin, we get four or six eddies whose lines of demarcation are directed along the diameters of the discs. By placing a metal band diametrically beneath the basin we obtain four eddies, one of whose lines of demarcation is normally directed along the band, the other being parallel to it ; the currents of mercury directed towards the centre flow along the first direction. We obtain two strong eddies in the direction of the centre of the bobbin by placing the basin of mercury slightly excentrally upon the bobbin containing the iron bar.

Generally speaking, the mercury currents flow towards where the metal is situated under the basin, and form eddies, the more intense of whose parts are situated nearest to this spot.

By placing beneath the basin a flat ring composed of three equal copper, brass, or zinc sections, we obtain six eddies of different intensities. The pair corresponding to the copper is the most energetic, that of the zinc being barely perceptible, even with a current of more than two ampères.

We obtain no movement of mercury if the basin, being smaller than the central vacuum of the bobbin, is placed concentrically above it.

The formation of the eddies above the bobbin alone, *i. e.*, without the bar or the metallic plates, is, according to my experiments, explained by the want of homogeneity of the wire and the imperfect symmetry of this bobbin's form.

By placing the bobbin horizontally under the basin, so that only a portion of the mercury is above the bobbin, we obtain two eddies with a line of demarcation above the bobbin's axis. We likewise obtain two eddies by placing the basin alongside the vertical bobbin ; but in this case the intensity of movement of the mercury will be very slight. The mercury need not entirely cover the bottom of the basin ; the same effects will be obtained with isolated drops.

If we sprinkle iron filings upon the mercury, we observe a tendency in the larger particles to conform to the direction of the lines of force while submitting slightly to the eddying movement of the mercury. The most minute particles splutter in all directions, like liquid drops in the spheroidal state.

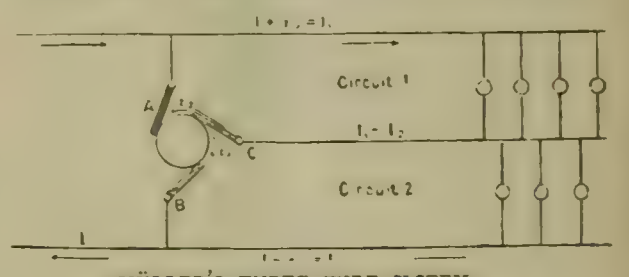
A Suggestion for the Compensating of voltmeters for Temperature.—Mr. C. J. Robertson, member of the English Electrical Engineers' Society, makes a timely suggestion in regard to certain difficulties experienced in using voltmeters.

He says :—"Having worked with voltmeters almost daily, for the past ten years, in testing and experimenting with glow lamps, I have constantly felt the inconveniences arising from changes of temperature in the neighborhood of the voltmeter, and also in the instrument itself. This has, for a long time past, led me to think that some simple adaptation of the old 'Gatehouse' method (of regulating the temperature of platinum lamps) could be adopted for this end : but I have had neither time nor opportunity to thoroughly try the same. The voltmeter could be wound with just a sufficient number of turns of copper, etc., wire, to obtain the necessary pull, and the rest of the circuit should include a carbon filament, etc , enclosed in a vacuum, and placed as near as possible to the metallic portion of the circuit. Such a carbon could be easily made of any required length or section, and could be further strengthened by treatment in hydrocarbons. The proportions between the length of the metallic and the carbon portions of the circuit could be respectively arranged so that the effects of increase or decrease of temperature in the metallic part of the circuit could be just balanced by the opposite effect in the carbon portion. This carbon could be made in the same manner as for a glow lamp, and of a resistance and length suitable to any voltmeter, wattmeter &c. ; and again, by using or leaving out the flashing process, its specific resistance could be adjusted to meet all requirements of space, diameter, strength, etc. Such a carbon compensator should be sealed into a well exhausted tube (to prevent effects of convection and conduction) and should be embedded in the windings or placed very near to them, and the whole would then supply a long felt want, *i. e.*, a voltmeter compensated for external and internal temperature variations.

A Large Induction Coil.—One of the largest, if not the largest, induction coils in existence gives a spark 42½ inches in length in air with 30 cells of Grove battery. The secondary coil consists of 280 miles of wire, and has a resistance of 100,000 ohms.

THREE WIRE SYSTEMS OF DISTRIBUTION.

Herr Hermann Müller describes in the *Elektrotechnische Zeitschrift* a method, invented by himself, of distributing energy on the three-wire system. He proposes to employ a small two-pole machine with three brushes, A, B, C (see figure below), brushes A and B being connected to the two outer wires, and brush C to the neutral wire. When the two circuits are balanced the machine is a motor running light. If the consumption increases on one of the circuits, I_1 becomes greater than I_2, the neutral wire is traversed by a current, $I_1 - I_2$ and a current, i_1, passes through the armature from C to B The machine then revolves as a motor, and there is a production of mechanical energy, which is transformed into electrical energy in circuit 1. An E. M. F. is generated in A C, which is added to that already existing, and compensates for the extra volts lost on the line



MÜLLER'S THREE WIRE SYSTEM.

owing to the increased current. If we denote the current coming direct from the generator by I, the current passing from C to B by i_1, and that passing from C to A by i_2, we have

$$I_1 = I + i_2 ;$$
$$I_2 = I - i_1 .$$

But the current i_2 produced by the rotation of the armature is sensibly equal to i_1, which causes that rotation. Hence i_1 being equal to i_2, we have

$$I_1 + I_2 = 2 \times I ;$$
$$I = \frac{I_1 + I_2}{2}.$$

The tendency of this arrangement is, therefore, to make the total current at any instant the arithmetic mean of the currents in the two circuits. Half the armature always acts as a motor, one of the remaining quarters acting as motor and the other as a dynamo.

Telephone Matters.—The monthly *News Letter* of the National Telephone Exchange Association, which is issued by General C. H. Barney, covering the month of February, reports that a bill has been introduced in the Maryland Senate to tax foreign corporations doing business in Maryland. Among its provisions is one taxing foreign telephone companies two per centum of gross receipts. Secretary Barney takes occasion to notify the members that the proceedings of the association at its meeting in 1885 are out of print, and that a member of the association will give $5 and his thanks for a copy of the same. His file is incomplete without it. The *News Letter* says that the ordinance granting the Northwestern Telephone Company the right to lay a private conduit on the streets has been acted upon favorably by the Council Committee on Streets at St. Paul, Minn.

New Application of Electricity.—An American electrician has devised a method of expanding hoops and wheel tires by heating them with the current. It is claimed for the new process that the heat is more uniformly distributed than with gas furnaces or piles of embers. The current is brought by wires connected to opposite points on the tire, and divides equally through each half of the ring.

Observatory Time.—The Western Union Telegraph Company has run a wire to the naval academy in order that the Washington Observatory time may be sent direct.

FLEXIBLE CORDS FOR INCANDESCENT LAMPS.

With the introduction of the incandescent lamp, a flexible conductor, particularly for movable lamps, was found desirable. High insulation was necessarily an essential quality of such cords, on account of the frequent handling, sometimes with moist hands.

Phillips, of London, was the first to apply gum, which he did in the form of a very thin rubber tape wound spirally around the stranded wires. Slight vulcanization was found necessary for the rubber, which even then was short-lived, and the vulcanizing material also corroded the wires badly.

Under the above conditions the Bishop Gutta-Percha Co., of New York, was stimulated to find a better and more reliable insulator for the purpose. Its success is attested by the universal acknowledgment that its Balata Insulation is the best and most durable of any yet discovered. It is the only Gum Insulation used on Flexible Cords which is Water and Acid Proof, and which does not corrode the wire. It has stood over five years' usage without a crack or a flaw

The Balata Cords are complete in themselves without any covering. The insulation does not have to be held on. They are just the thing for medical or other battery connections, made of any desired conductivity, any number of conductors, and covered with Silk, Cotton or Worsted braid, either plain or mixed colors.

Balata is obtained from the bullet-tree of Guinea, South America in the form of a creamy sap. It is more like Gutta-Percha than any other gum, but stands exposure to the air much better, retaining its flexibility.

No solvents or chemicals are used in Balata or Gutta-Percha Compounds, therefore they preserve instead of destroying the copper.

These goods, like all others manufactured by the Bishop Gutta-Percha Company, give the best of satisfaction to all who use them.

TENACITY OF COPPER AND IRON WIRE. — Every one who has handled copper wire after it has been in use for electrical purposes has noticed its brittleness. When new, copper wire is very tenacious and will stand considerable torsional strain before it will break, but after an electric current has passed through for some time, that quality disappears. Frequently a slight twist is sufficient to cause a fracture. Iron wire, on the contrary, increases in tenacity by passing an electric current through it.

INTERNAL RESISTANCE OF BATTERIES.—Some very valuable and interesting investigations have recently been made by MM. P. Bary and G. Margaine, with reference to the variability of the internal resistance of primary batteries. It has often been held that the resistance of primary batteries and accumulators is not a constant quantity, and the fact has been proved by the above named gentlemen. Apart from the variations in resistance caused by temperature, change in density of solutions and polarization, the resistance of the cell is a changeable quantity. The results of these investigations show that in the case of the Leclanche cell the internal resistance diminishes as the current flowing increases. What cau-es this, however, has not yet been determined, and electricians at large will be interested to learn further particulars of these interesting investigations.

THE CENTRAL ELECTRIC CO. of Chicago, since it has moved into its excellently appointed quarters on Franklin street, finds that business has materially increased. It is experiencing what is known as a "Chicago boom" This house has recently been appointed the Western agency of the Brady Mast-Arm interests, and also agents for the Weston Electrical Instrument Co. of Newark, N. J. It is a well known fact that the ammeters and voltmeters manufactured by this concern are highly recommended by all the electric light companies in the United States. Such valuable connections as these are bound to push this enterprising house in the front ranks of large supply houses. The catalogue of the Central Electric is complete in every detail and worth possessing.

LARGE TELEPHONE SWITCH BOARD.—The Western Electric Company of New York has received a contract for a new multiple switch board, to be installed in the new building of the Bell Telephone Company in Boston. The board will be of the standard type with all the latest improvements. Its capacity will be 6,000 connections.

The *Railway Service Gazette* of Toledo, O., says the storage battery electric car, being tested by General Manager Lang on the consolidated street railways of Toledo, seems to work admirably.

RESIGNATION AND DISMISSAL.—At a meeting of the Board of Electrical Control on March 7th, Inspector George W. Reilly's resignation was accepted and Inspector George W. Roth was dismissed. Both were charged with neglect of duty. Expert Wheeler was authorized to fill the vacancies temporarily.

ELECTRICITY AND LONDON FIRE ALARMS.—For a charge of $25 per annum a person in London may be put into electric communication with the nearest fire engine station.

EDISON LAMPS,

½ TO 36 CANDLE POWER.
2½ TO 40 VOLTS.

FOR BATTERY OR DYNAMO.

These Lamps can be used in Series on Dynamo Circuits for all kinds of Decorations and Displays.

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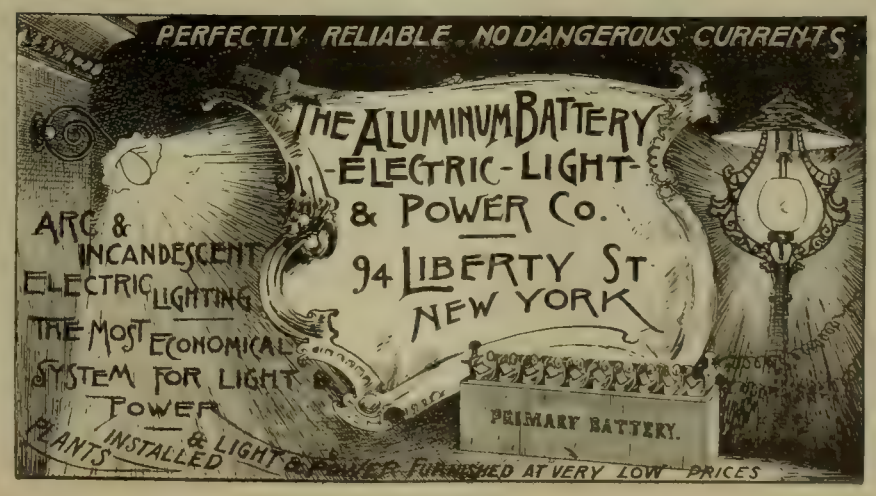
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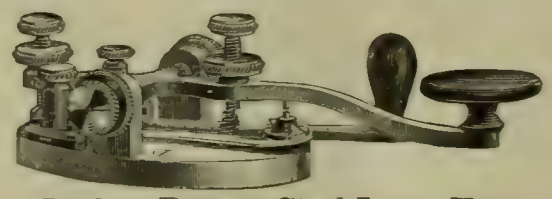


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THE SUBWAY INJUNCTION DENIED.

Judge Andrews, of the Supreme Court, on March 20th gave his long-awaited decision in the important suit by the Manhattan Electric Light Company against Mayor Grant and the Board of Electrical Control. The immediate question at issue was whether the Board of Electrical Control should be enjoined from awarding the contract for building electric light subways to the Standard Company, and to restrain the Consolidated Telegraph and Electrical Subway Company from transferring the present subways to the new company.

Judge Andrews denies this injunction and dissolves the temporary one granted.

"The defendents," says Judge Andrews, "have clearly the right to construct the subways, and to enjoin them would be to inconvenience the public and delay the repavement of the streets."

"There has been no allegation of bad faith against the defendants. The purpose of the original contract was to provide subways, and it seems too clear for argument that the contract has been and is wholly ineffectual for the accomplishment of its purpose and the purpose of the act."

The decision refers to the cutting of the wires in December last, and the consequent darkness of the streets.

"The contract," says Judge Andrews, "it seems to me, has been ineffectual to the present time. There are as yet not sufficient subways, and it is a matter of public interest that they should be constructed as soon as possible. In order to provide accommodations the Board desires to have between fifty or sixty miles of subways constructed as soon as possible, and it is of great importance to the public that they should be completed during thi year. The city is in partial darkness, and th sooner subways are constructed the sooner will the public be provided with electric light and power. The present company cannot do the work within two years, and the Standard Company agreed to complete the work in the present year."

The settlement of the question was, however, again deferred by the action of the Manhattan Electric Lighting Company in taking an appeal from the decision of Judge Andrews. At the meeting of the Board of Electrical Control on Saturday, March 22d, Assistant District Attorney Dean said that Justice Andrews had, at the application of the Manhattan Company added to the order of dissolution a provision that it should not go into effect until the question at issue had been decided by the General Term, notice of appeal to which the Manhattan Company had already given. DeLancey Nicoll and Elihu Root appeared before Justice Andrews for the Manhattan people, and Mr. Dean opposed them for the Board of Electrical Control.

Mayor Grant said that under the circumstances the Board could not do anything, and a motion to adjourn was just going into effect when Mr. Clark of the law firm of Root & Clark, appearing for the Harlem Electric Company, interposed, saying that he desired to call the attention of the Board to the fact that there was seemingly an effort on foot to injure the Harlem Company. They had filed an application with the Consolidated Subway Company for ducts in the subway over sixty days ago, and no attention has been paid to it. Ex-Senator Grady, for the East River Company, had a similar complaint to make. Mayor Grant ordered the complaints referred to the engineer of the Board, and the meeting adjourned until the 27th.

Electrical Executions Constitutional.—The Court of Appeals, at Albany, on March 20th, affirmed the judgments of the courts below in the Kemmeler murder case, declaring the Electrical Execution Act constitutional, and holding that no error was committed on the trial of the accused. The court is unanimous. Judge O'Brien rendered the opinion. He says: "The court finds that the mode of execution proposed is not cruel within the meaning of the Constitution, though unusual. On the contrary, all agreed with the court below that it removes every reasonable doubt that the application of electricity to the vital parts of the human body under such conditions and in the manner contemplated by the statute must result in instantaneous and, consequently, painless death. The order appealed from should be affirmed." This decision settles the question, and the condemned men who are awaiting execution of the death sentence will pay the penalty for their crimes by electricity at the times and places appointed. Under the law the details of such executions are not to be given to the public press. but it will hardly be possible to successfully prevent it. The wide-awake newspapers these days seem to find a way somehow to break down all barriers in the way of getting news, and it will indeed be strange if their enterprise should be baffled in this instance. The result of the first execution will be eagerly watched for by all classes of people There are several condemned murderers awaiting the execution of the death sentence, and on the 21st one more was added to the list—James J. Slocum, an ex-base ball player, for the murder of his wife, in this city.

A Generous Offer.—Sir David Salomons, the well-known author of works on electric lighting and accumulators, has made a generous offer of £1,000 to found a scholarship of £35 per annum, to be held for three years, and to be entirely under the control and at the disposal of the Institution of Electrical Engineers. The council has accepted the offer and the details in connection with the scholarship will soon be settled. This generous act on Sir David's part should stimulate others to do likewise.

Electric Road in Australia.—An electric street railway is being built in Melbourne, Australia.

A Horse in a Subway Manhole.—A curious accident occurred in this city on March 20th. While some work was being done to some wires in the subway manhole at the corner of Broadway and Warren street, a horse hauling a truck was crowded against the guard-rail put up around the manhole. The rail was dislodged, and the horse, losing his feet, fell into the manhole, hind legs foremost. His fore legs caught on the edge, thus preventing his entire body from going in. He struggled frantically to extricate himself, and finally died. The body had to be hauled out of the hole by a safe derrick which was erected over the spot. Some workmen were in the manhole at the time, and they had a pretty lively time in keeping clear ef the horse's feet which were kicking around the interior of the cavern in a vigorous manner. They, however, escaped with nothing worse than a big scare.

How Shall We Make Our Wires Safe.—Mr. W. D. Sargent, General Manager of the New York and New Jersey Telephone Co., Brooklyn, N. Y., says: "I do not feel that I am a competent person to express opinions on electric light questions as I have no practical experience in that direction, but from a general knowledge of the electrical business I can see no reason why electric wires may not be made safe by insulating them *and keeping them insulated.* As to how they should be insulated, that is a question for experimental demonstration."

Quick Work.—The editor of a London paper recently sent for an electrician and said to him: "This room gets so hot in the evening, with the gas, that we can't stand it any longer. We want to have the gas taken out and the electric light put in by to morrow evening." "All right," said the electrician; "you shall have it." The next evening, at four o'clock, the editorial rooms were lighted by electricity. No other form of energy is capable of being thus rapidly applied.

An Appropriate Introduction.—A novel and amusing way of introducing the electric light took place at a ball at Evanston, Ill., recently. The grand march opened with the orchestra playing the "Dead March in Saul," to which tune the gas was slowly turned off and darkness reigned. Suddenly when the strains of "See, the Conquering Hero Comes" the room was flooded with a soft and beautiful light of 300 incandescent lamps.

Electric Mail Service.—The La Plata *Gozette* announces that on April 1st an electric mail service will be put in operation between Buenos Ayres and Montevideo, which are 180 miles apart. Two wires connect the cities, along which a small mailbox, containing messages on thin paper will be sent at lightning speed. Here is a South American republic that is ahead, on this one point at least, of the United States in the application of electricity.

Storage Battery Suit Decision.—The Brush Electric Company's suit of infringment against the Julien Electric Traction Company was decided a few days ago by Judge Coxe in favor of the Brush Company. The decision broadly sustains the claims of the Brush Company and practically gives it control of all practical forms of storage batteries. The decision was a voluminous one.

Florence to be Lighted.—The Municipal Council of Florence have just approved, by a majority, of a contract, previously arranged with the Italian Edison General Electric Lighting Company, for the electric lighting of the principal streets in the centre of that city. It is believed that the installation will be completed in three months hence.

About Rubber.—The "shortage" in the rubber crop of Brazil is said to be about 1,000 tons, and it is owing to this that the price has increased. Considerable speculation has been going on in this commodity. The present season ends with this month, and the next begins in July.

SOME POINTS IN DYNAMO AND MOTOR DESIGN.

PAPER READ BY W. B. ESSON BEFORE THE ENGLISH INSTITUTION OF ELECTRICAL ENGINEERS.

Though the recent progress in dynamo construction has been of a highly satisfactory character, there still remain several points affecting design which have received but inadequate attention, and to which reference is seldom made outside the drawing office. In the present paper a few of these unsettled points will be brought before the Institution, in the hope that a full discussion will enable us to make some progress towards a solution of the various questions raised.

1.—MAGNETIZING FORCE FOR A SIMPLE MAGNETIC CIRCUIT.

Foremost among the factors which have contributed to the progress of recent years has been

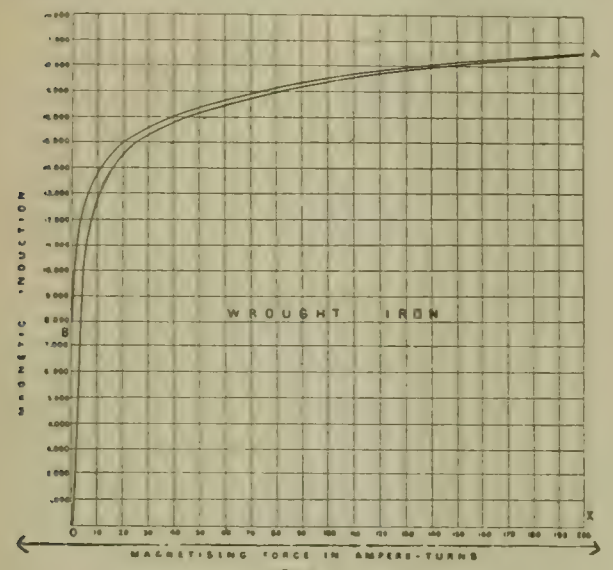


Fig. 1

a more perfect comprehension of the laws of magnetic induction, and now, knowing the magnetic properties of the iron with which we deal, it is a perfectly easy matter to determine the magnetizing force required to produce, in any simple magnetic circuit of given configuration, a specified induction. The formula of Drs. J. and E. Hopkinson, which was published in the *Philosophical Transactions* in 1886, is now adopted by most designers who desire to economize their time. Reduced to ampère turns, this formula for the magnetizing force is—

$$A_1 = L f\left(\frac{N}{a}\right) + L_1 8 \frac{v_1 N}{a_1} + L_2 f\left(\frac{v_2 N}{a_2}\right) + L_3 f\left(\frac{v_2 N}{a_3}\right) + \ldots.$$

Here A_1 is the magnetizing force; L, L_1, L_2, and L_3 are the mean

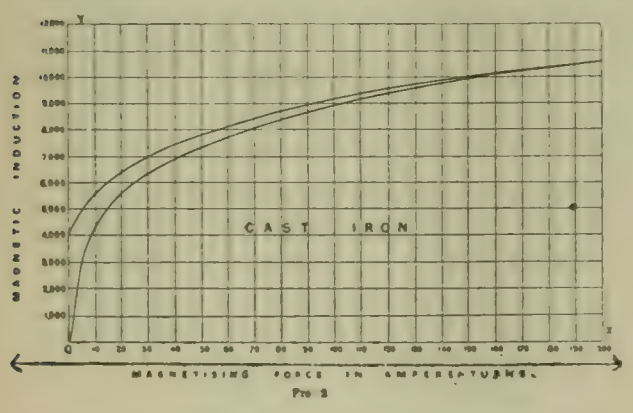


Fig. 2

lengths, in centimetres, of the separate parts which constitute the magnetic circuit—comprising in this case armature core, air gaps, magnet limbs and yoke—while a, a_1, a_2, and a_3 are the cross sections, in square centimetres, of these several constituents. Owing to the spreading of the induction, it is necessary to assume the air gaps as having an extension beyond the polar area equal to ·8 of the distance between the armature core and the polar surface. Of the induction produced in the magnet cores, only the portion N, which passes through the armature and is enclosed by the coils at the brushes, is serviceable, the lines of force which choose a path outside the armature constituting a stray field which cannot be utilized. In the above expression v_2 is the ratio of the induction in the magnets to that in the armature, the total lines induced being therefore v_2 N. Since, in cylinder armatures some of the lines stray through the internal opening, in these the induction in the air gaps will be greater than N. If we call v_1 the ratio of the lines in the gap to the lines in the armature, the lines in the former will be v_1 N.

the functions $f\left(\frac{N}{a}\right)$, $f\left(\frac{v_2 N}{a^2}\right)$, &c., are read directly off the curves, Figs. 1 and 2, where ordi-



Fig. 3.

nates give the induction per square centimetre, and abscissæ the corresponding ampère turns required per centimetre length. These curves are reduced from the results of Dr. John Hopkinson.

2.—MAGNITUDE OF THE STRAY FIELD.

The expression in 1 gives a general formula for any configuration of magnetic circuit, but in order to employ it, we require to know the

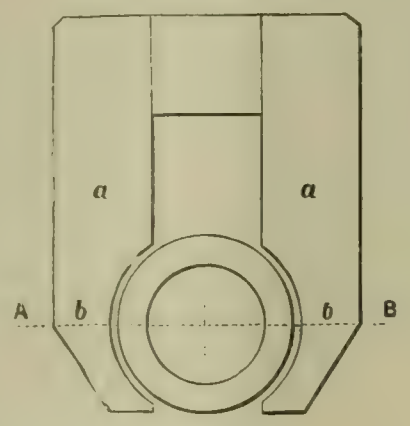


Fig. 4.

values of v_1 and v_2 or, in other words, we must know the magnitude of the stray field. To be quite accurate, we should know the exact distribution of the field, for in any particular machine v_2 has evidently a different value at every part of the cross section. In the absence of actual measurement, however, its mean value can only be guessed at from a knowledge of machines of similar type.

The value of v_2 in different types of machines

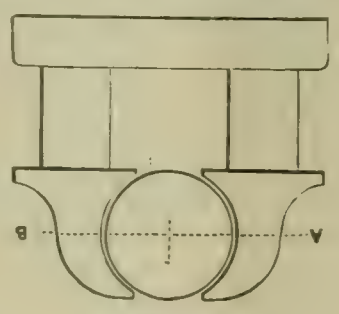


Fig. 5.

depends not only on the shape of the magnetic system, but on the position of adjacent masses of iron in bed plates, bearing brackets, flywheel, etc. Calculations undertaken with a view to ascertaining its value from a knowledge of the shape of the machine, without reference to previous machines, are necessarily of a laborious character, and the labor in the end leads to no great accuracy. But I find that a very close approximation to the truth may be arrived at by taking the known value for some particular type of machine and considering step by step the effect produced in the stray field by the changes in the dimensions and shape. It must be remembered that no two machines of the same type have exactly the same value of v_2 unless their dimensions correspond in every particular. Every alteration to the patterns, and every modification in the details, introduce a new value for this ratio. Our calculations, therefore, must be to a great extent guesswork. We cannot help it. If the guess is a good one, we congratulate ourselves on the soundness of our judgment, or on the accuracy with which we make our calculations. If it is a bad one, we write to the forge about the annealing of the iron.

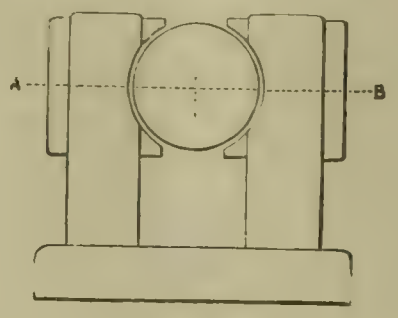


Fig. 6.

The values of v_2 have been ascertained for the following machines, and it will be found, probably, that for all modern types they lie between these limits. With these values to guide us we cannot go far astray in new designs.

TABLE I.—STRAY FIELD IN DIFFERENT DYNAMOS.

Name of machine	Field	Armature	Remarks	Value of v_2.
Edison-Hopkinson.	Single magnet, 2-pole	Drum	Poles next bed plate	1.32
Siemens.....	Single magnet, 2-pole	Drum	Yoke next bed plate	1.30
Phœnix	Single magnet, 2-pole (fig. 8)	Cylinder	Yoke next bed plate	1.32
Phœnix.....	Double magnet, 2-pole (fig. 3)	Cylinder	Horizontal	1.40
Manchester. .	Double-magnet, 2-pole	Cylinder	Bed and 1 pole cast together	1.49
Victoria.....	Double-magnet, 4-pole	Ring	Ordinary pat.	1.40
Ferranti	Double magnet, multipolar	Coreless disc	Ordinary pat (Alternating)	2.00

The measurements of the Edison-Hopkinson and Manchester machines were made by Drs. J. and E. Hopkinson, of the Victoria by Mr. Mordey, of the Ferranti by Dr. W. E. Sumpner, and of the Phœnix by myself.

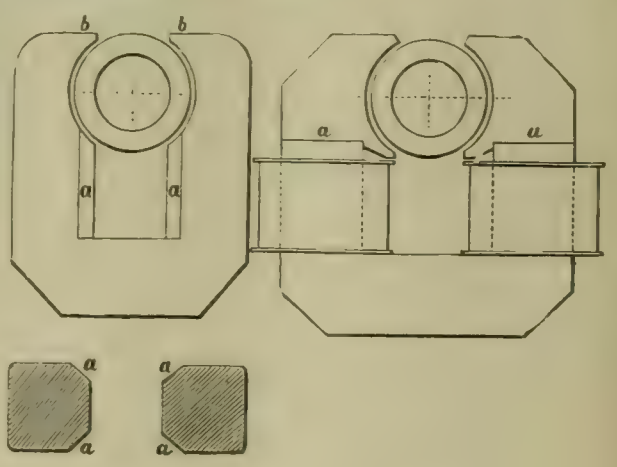


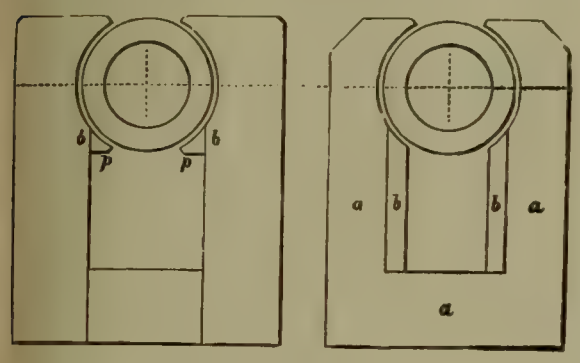
Fig. 7. Fig. 8.

When the linear dimensions of a machine are increased in the same proportion, v_2 remains approximately unaltered. Suppose, for example, that all the dimensions of a magnetic system are increased n times. If the induction per square centimetre is the same, the total flux of lines is n^2. The cross section of all the paths for stray lines are increased to n^2, and the distances between ad-

acent surfaces are increased n times. The lengths and cross sections of the stray paths are, therefore, increased in the same proportion as the usual paths, and the ratio between useful and useless lines is unchanged.

If, the length of the magnetic circuit remaining the same, both dimensions of the cross section are increased n times, making the area n^2, the total flux through the machine is n^2; and since the cross sections of the stray paths are n^2 times greater, the value of v_2 remains as before.

If the length of every part of the magnetic circuit is increased in the same proportion, while the cross section remains the same, v_2 is increased somewhat, owing to the increase in the cross section of the stray path. If the dimension of either



FIGS. 9 AND 10.

factor of the cross section is increased, while the other is unchanged, and the length of the magnetic circuit remains the same, v_2 is reduced, its reduction depending upon the ratio of the two factors of the cross section.

As the exact value of v_2 is a matter of some doubt until the machine is built, it may be instructive just to notice upon what the difference in the calculated flux through the armature, and the actual flux as modified by an error in the estimation of the stray field, depends. Assuming that we can measure accurately the path of the induction in the armature—often a matter of uncertainty—the magnetizing force for the armature and the air gap can be determined independently of the magnitude of the stray field. The magnetizing force to be

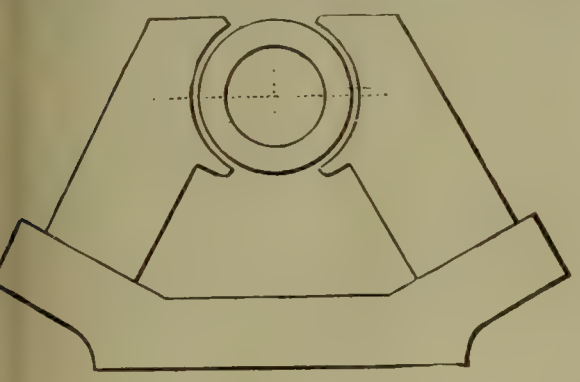


FIG. 11.

allowed for the magnets depends, however, on the amount of stray field we assume. Imagine that in designing the machine we estimated a certain value for v_2, which turns out, when the machine is built, to be too low. Now the reduction in the flux through the armature due to this error will depend upon the magnetizing force required for the magnets as compared with that required for the rest of the machine, and on the difference in the magnetizing forces necessary for the induction in the magnets under the real and assumed values of v_2. If these two quantities are large, the error will be considerable, increasing as the magnets are more saturated, and as their resistance in proportion to the other components of the magnetic circuit increases. If the difference in the magnetizing forces for the real and assumed values of v_2 is small, the converse holds good, the error being small in proportion. In the Edison-Hopkinson machine, for instance, the magnetizing force required for the magnets is rather over one-eighth of the whole machine, and the value of v_2 is given in the table as 1.32. If in this machine an erroneous value of 1.25 had been estimated in designing, the diminution of the flux through the armature, with the calculated ampère-turns so allowed for, would be only about 2 per cent.; *i. e.*, the machine, to give the same output, would have to run at 765 revolutions instead of 750. If the magnets were saturated to a greater degree, or constituted a larger proportion of the magnetic resistance, the error would be correspondingly greater.

It must be noticed that the values in Table I. are given at the working saturation of the machine. As the bending in the magnetization curve of the iron becomes more pronounced, v_2 increases. In actual machines we work above the bend, and with a reduced saturation v_2 would be less than given in the table. In practice, differences in the quality of the iron lead to much greater errors than are likely to arise from an error in the estimation of the stray field.

3. SYMMETRY OF THE FIELD.

It is of some importance to obtain a symmetrical field through the armature, as it is only when the field is symmetrical that the armature is electrically and magnetically balanced. Looking at Fig. 3, it will be observed that a line, A B, drawn diametrically across the armature divides it into two halves, which are perfectly similar as regards distribution of field; and, generally, this is true of all machines in which there is a double magnetic circuit. There is here no tendency of the armature to move laterally in the field, provided its centre is concentric with the bore of the polar cavity. But with single magnet machines it is different.

In Fig. 4, for example—which is about the

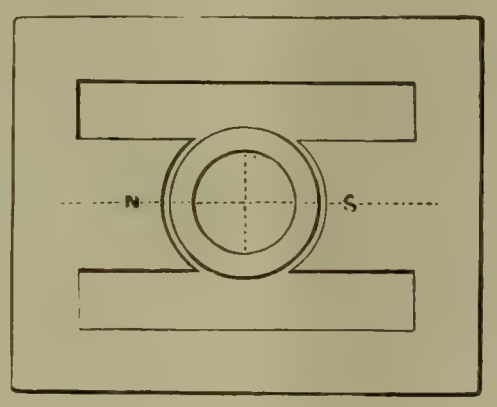


FIG. 12.

worst form of magnet, on account of the section being reduced at *b* to half what it is at *a*—there is a strong upward magnetic pull, producing an abnormal pressure on the bearings, which may under some circumstances lead to serious trouble from heating. Most makers of single magnet machines have experienced some trouble from this cause, and have adopted, with more or less success, some means of curing the evil. A remarkable instance of the heating due to magnetic pressure on the bearings was recently brought to my notice by M. Heilmann, of the Société Alsacienne de Construction Mécaniques, of Belfort. In the inverted machines first constructed by this company, the magnet cores, Fig. 5, were of wrought iron, on the top of which were fitted cast iron pole pieces of comparatively small mass. From the look of the thing one would expect a very considerable downward pull, and in the case of some machines of 60,000-watt capacity the pressure on each bearing due to magnetic pull reached the high figure of 1,500 pounds. This, of course, led to serious heating, and in later machines the cylindrical wrought iron cores have been continued to the top of the machine, as shown in Fig. 6, being fitted with cast iron shells, which, together with wrought iron limbs, form, when bored out, the polar cavity. It will be noticed that the reduction in the section of the wrought iron due to the boring out is very small, and I am informed that in this design the evil of heating has been completely abolished, a practically symmetrical field being produced. The machines are of the drum type.

In well-designed machines of the single magnet type there need be no trouble, however, from magnetic pull on the armature. The first essential is that the section at the thinnest part of the magnet be reduced as little as possible. The form in Fig. 6, for example, where this is carefully attended to, may be cited as an example of good design; while that in Fig. 4 illustrates a magnetically bad design. Since the induction always takes the path of least resistance, the importance of keeping up the full section of the limbs at the poles, in order that the resistance due to saturation may not cause unequal distribution of the field, will be obvious.

The magnetic pull may be balanced by the very simple device of placing the armature eccentrically in the field, as I suggested two years ago, its centre being somewhat farther from the yoke than the centre of the polar cavity. In some cases the magnets, after boring out, have been brought closer, so that the

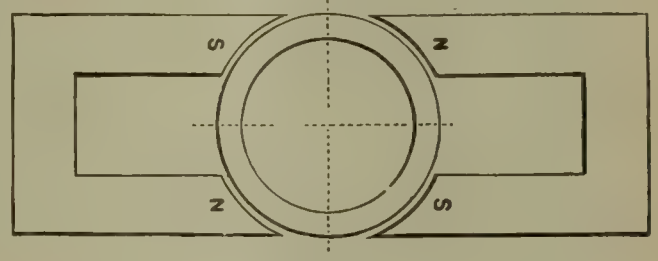


FIG. 13.

air gap increases gradually to the polar tips; but though the pull is reduced to some extent by these means, the device is not so efficacious as the one previously mentioned. I understand that in order to reduce heating this latter course had to be adopted in the machines built for the Bradford Corporation, the magnets in these being somewhat similar in shape to that shown in Fig. 4.

Electrically there is in drum armatures no want of balance due to an unsymmetrical field, as every convolution of the conductor encloses the whole of the lines of force passing through the armature core. The only result of a want of symmetry is that the position of the brushes on the commutator for a sparkless collection may become more marked, and the variation of current possible without readjustment of the brushes therefore less. But in cylinder-wound armatures not only is there a want of magnetic balance when the field is unsymmetrical, but from the fact that each convolution encloses only half the lines passing through the core, there is a want of *electrical* balance, and it becomes, in consequence, doubly important to get a symmetrical induction, or the same number of lines through each half of the armature. Though the lines were unequally divided there might not be any appreciable difference in the E.M.F.'s. generated in each half with the brushes diametrically opposite; but from the fact that a want of electrical balance requires rather more lead to be given to the brush farther from the yoke, it is possible that the E.M.F.'s in the two halves of the windings may be unequal, the result being a local current round the armature, and consequently waste of power.

There are several methods of obtaining an approximately symmetrical field besides that already mentioned of placing the armature eccentrically in the cavity. What we have to do, if possible, is to make the path for the induction through the half of the cylinder core which is farther from the yoke, of similar resistance to the path through the nearer half, so that a similar number of lines may flow through each. In the Phœnix dynamo we employ sometimes, with this object in view, the device shown in Fig. 7. Here the cast iron magnet, instead of being rectangular in section, has the inside corners cut away, as shown in the section at *a*, the top corners at *b* being left on. In this way the magnetic resistance across the bottom path is increased, and the induction in the two halves

Continued on page 6.

THE SHAVER MOLECULAR TELEPHONE.

Many inventors have in late years given a good deal of their time and thought to the production of a telephone for short distances, which would overcome all the difficulties and annoyances met with in electrical telephones. Mr. George F. Shaver is the pioneer investigator in this field, and after many years' experimentation produced, a few years ago, what is known as the "Acoustic Telephone." This was a good fair weather instrument, but in stormy weather the sound vibrations transmitted over the wire did not proceed very far before they were completely neutralized. Manifestly this could not be called a reliable telephone. What was needed was a system that could be depended on to work in all kinds of weather. Mr. Shaver's experience in this field was such that he could foresee that a perfect mechanical or non-electrical telephone was a possibility, but like every other undeveloped possibility, how was it to be made a practical thing? The inventor followed out a line of thought which he was sure would lead him to success, and in due time a telephone, based on an entirely new principle, and perfectly reliable at all times, was the result. The action of this new telephone, as its name implies, is based on molecular vibrations.

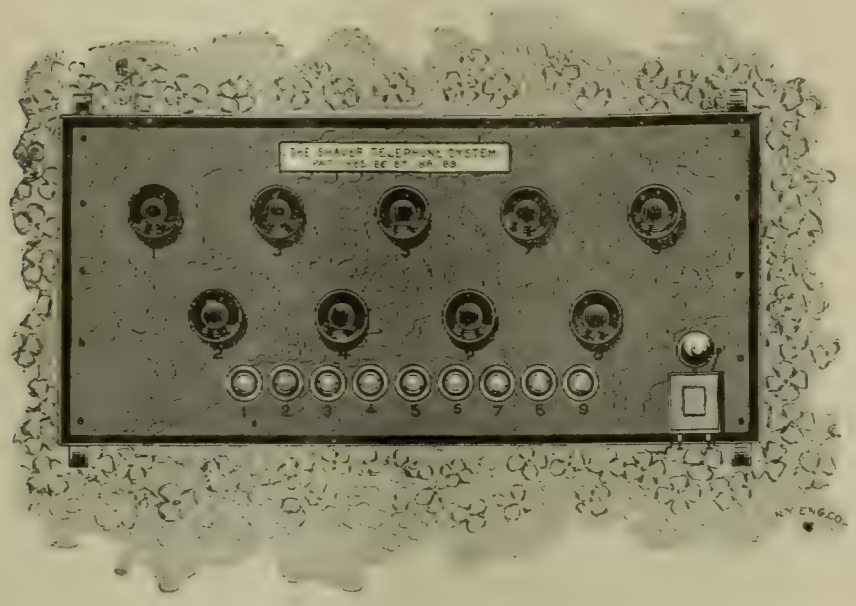


FIG. 1.—BANK 'PHONE SYSTEM FOR HORIZONTAL WIRES.

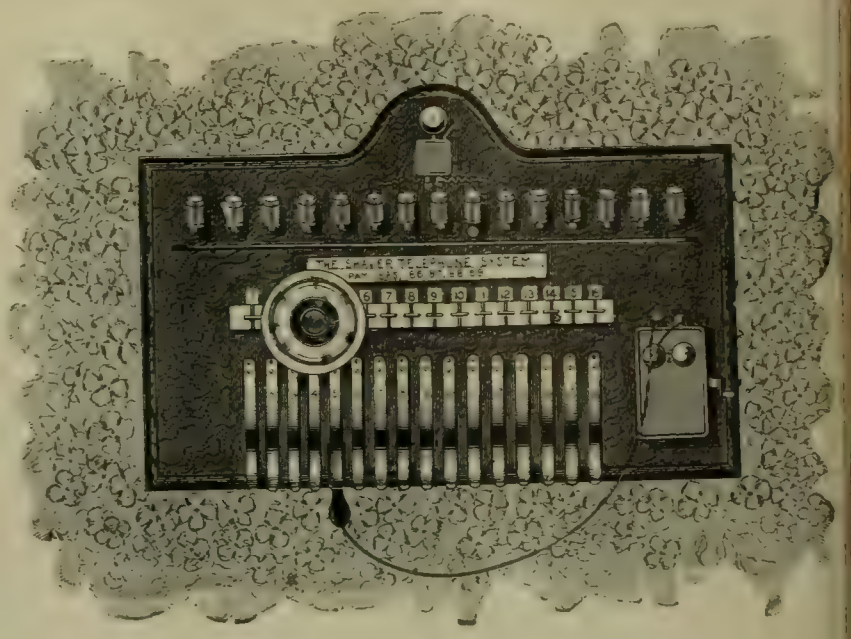


FIG. 3.—SHIFTING HAND 'PHONE SYSTEM.

The fact that, under certain conditions, molecules vibrate has been known to scientists for many years, but it remained an obscure phenomenon until Mr. Shaver, during his researches, invented a method of making these minute sounds audible. Every one has noticed that if a piece of timber is scratched with a pin at one end the sound can be heard at the other by placing the ear against the wood; and by placing the ear close to a railroad track the rumble of a train miles away may be distinctly heard. These sounds, although infinitesimal, are the result of molecular vibrations. Hence, it is, obvious that if something could be so attached to the medium of transmission of these inaudible sounds as to amplify them and make them audible, we would have the active principle of a telephone. This is what Mr. Shaver has done, and he magnifies these minute sounds, as a microscope magnifies objects invisible to the eye and renders them visible. It does not require any scientific discussion to make it understood that the molecules will vibrate in any kind of weather, hence the value and importance of this invention.

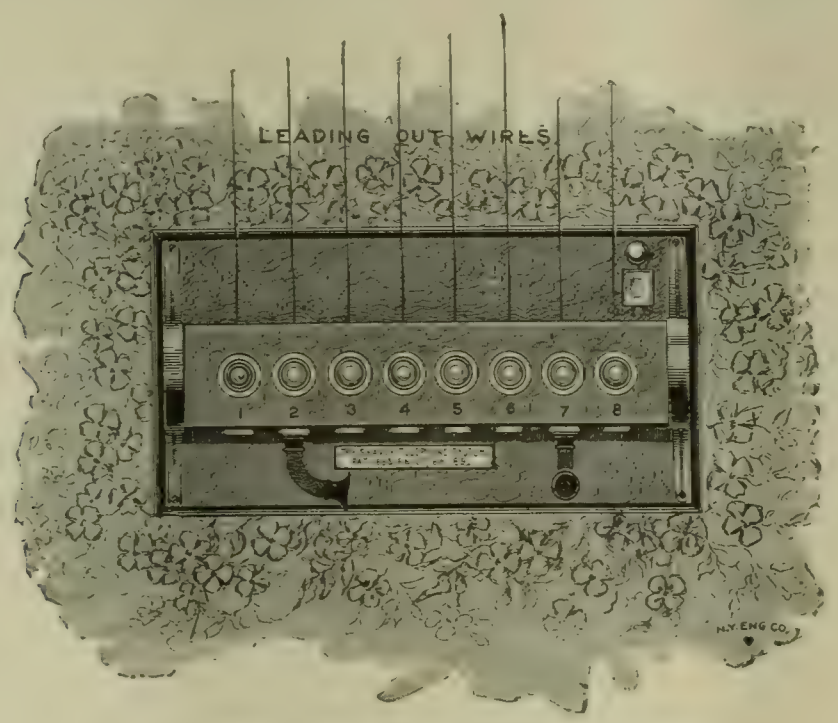


FIG. 2.—BANK 'PHONE SYSTEM FOR VERTICAL WIRES.

Mr. Shaver's invention consists of a Molecular Resonator and an improved conducting wire. The resonator resembles a cymbal in shape, but of much smaller dimensions, being about two and one-half inches in diameter. To the convex side of the resonator is firmly secured the end of a cable wire of small diameter. The joint is metallic and firm. To the other end of the cable wire is attached a similar resonator, and then we have the essential parts of the telephone. In practice these resonators are combined with sounding boards, which greatly amplify the sounds. The wire between the two terminal telephones are drawn taut to produce the best results. Proper means are adopted to turn corners and angles, so that there is no loss of vibrations, or what is the same as leakage on a telegraph circuit. The distinctness of articulation in the telephones and their range of action are very remarkable features. It is not necessary to put the ear close to the 'phone to hear what the speaker at the other end has to say. His words can be heard several feet away from the instrument, and the sound will fill a good sized room. A yell can be heard in every corner of a large hall, and what is most remarkable, a whisper can be heard as distinctly as ordinary talk, by placing the ear to the 'phone. Hence, confidential communications are possible on this telephone. As the quality of every sound is perfectly reproduced, the speaker at the other end can readily be distinguished by the sound of his voice.

This telephone is indeed a very efficient instrument, and is far superior to anything of the kind ever produced. The inventor does not claim that it will give the best of satisfaction on lines longer than half a mile, but he does make a strong claim that up to that limit it will work better than any telephone ever invented. We have tried it on a half mile line and the results were surprising, and amply justify the claims made for it. It is of great value to manufacturing establishments where the offices are some distance from the factory, and already many plants of this character have been put in. It is possible to connect two independent wires on the central exchange plan and thus put two different subscribers or departments, in the case of a large factory, in communication with each other. The method of establishing the connection at the "central" office is very simple. Figure 1 is an illustration of a bank of 'phones for horizontal lines. Each line has its annunciator, push button and mouth piece, which latter answers the purpose of transmitter and receiver.

The operation of the push button at either end of the wire causes the annunciator at the opposite end to drop. Fig. 2 shows a Bank 'Phone system for vertical wires. The 'phones are detachable and can be connected with any one of the wires. Fig. 3 illustrates the Shifting Hand 'Phone system, the 'phone sliding along a saddle as shown in the cut. Fig. 4 represents a vertical exchange for inside work, that is, for wires running to different departments or locations in large factories, and Fig. 5 shows the Horizontal Exchange system for small cities. Fig. 6 shows the Wall 'Phone and Magneto Call.

The conducting wire used in connection with the Shaver Molecular Telephone is composed of several strands of steel wire, twisted together spirally, with a hemp core. The core has the effect of deadening metallic sounds and cutting off the tendency to produce musical notes which is so common in acoustic telephones.

The diameter of the wire is about No. 10 or 12, or, that of ordinary telephone wire.

In this new system it is possible to have intermediate stations, or 'phones on one wire, without any detriment whatever to service, and this is a valuable feature in itself.

conveyance costs you a certain sum of money. As you proceed on your journey, the dial, by the aid of cyclometer, registers every unit of distance traveled, and as the cab hire is reckoned by these units, the hirer and cabman can tell at a glance the miles or fractions thereof that they have gone, and the fare is only a matter of mental arithmetic, allowing no difference of opinion as to the amount.

ELECTRIC BOATS ON THE THAMES.—By next June it is expected that there will be twenty-three or twenty-four electrically-propelled launches upon the Thames at London. Many house-boats are being fitted with the electric light.

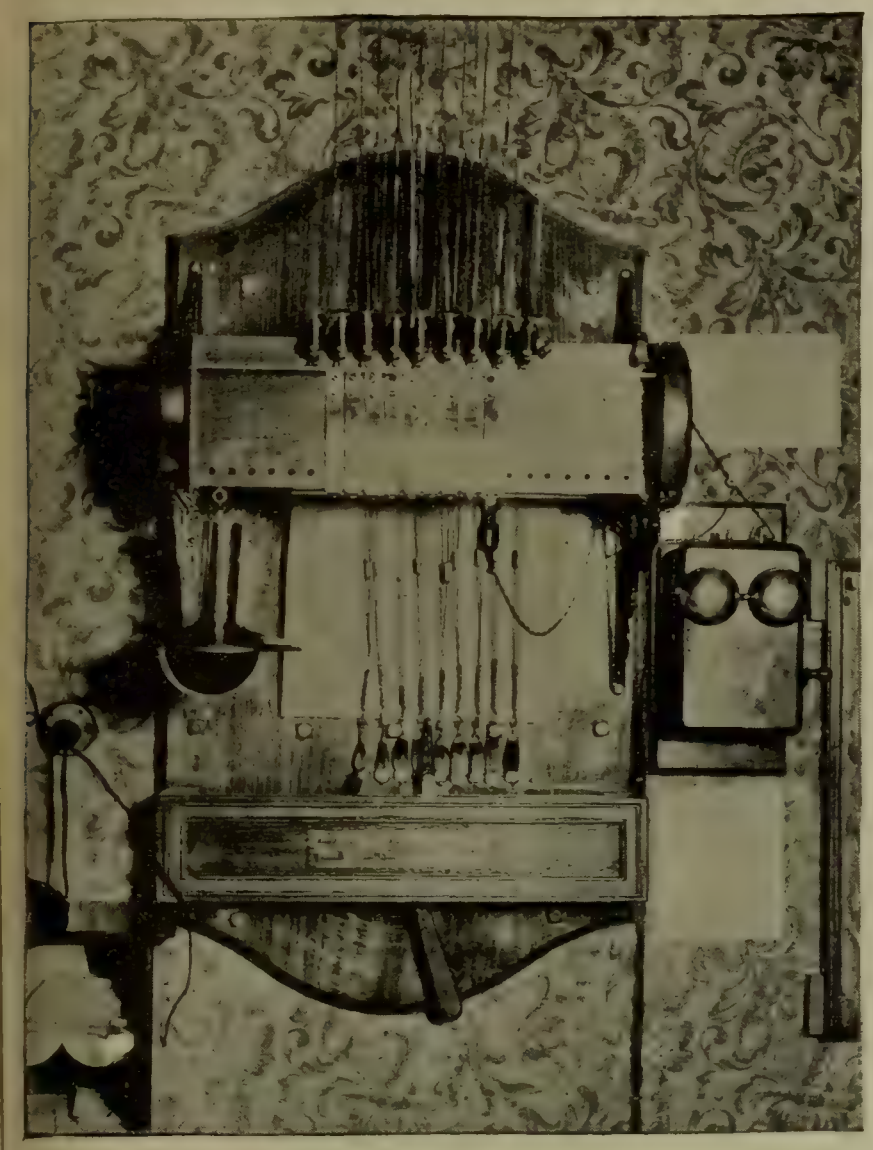


FIG. 4—VERTICAL EXCHANGE SYSTEM.

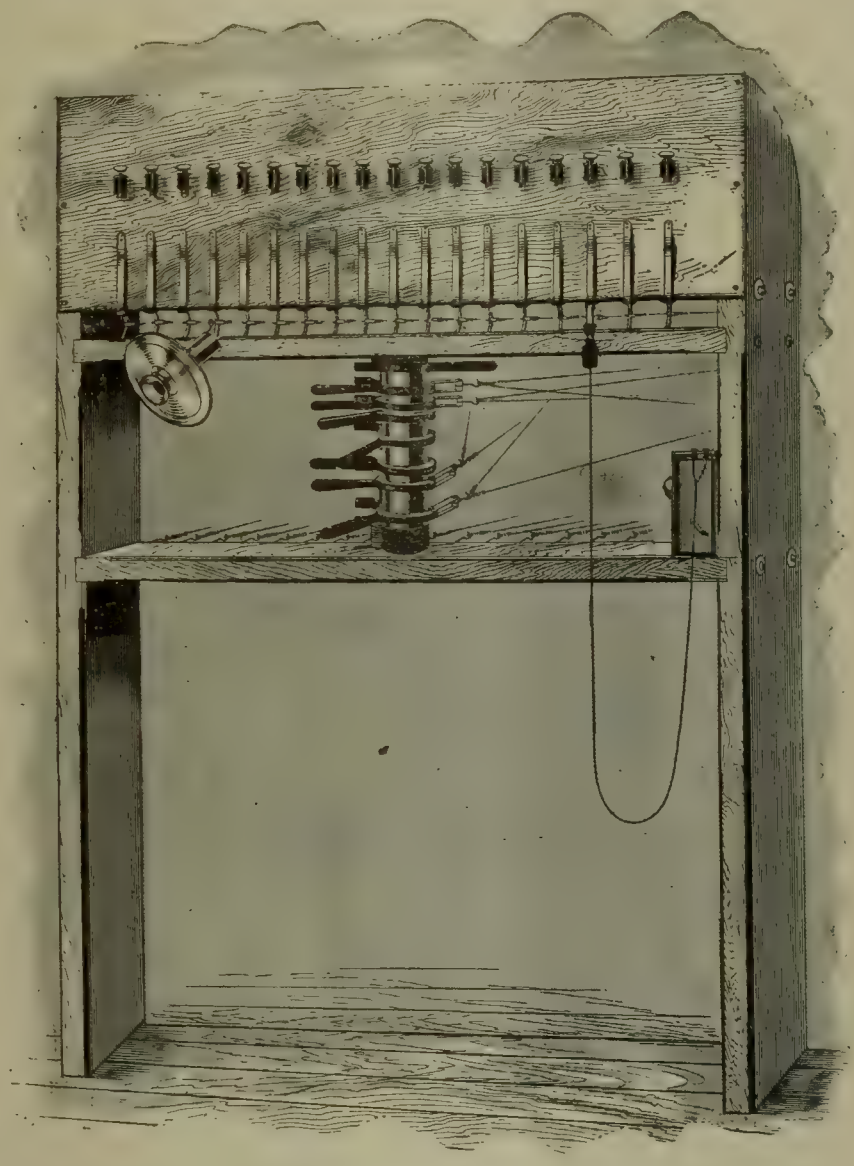


FIG. 5—HORIZONTAL EXCHANGE SYSTEM.

During the season of 1889, this telephone was dopted by many leading railroads, including he Lehigh Valley, Delaware, Lackawanna & Vestern, New York Central, Western New York Philadelphia, Chicago, Milwaukee & St. Paul. s also in operation at the Wagner Palace Car Vorks, at Buffalo, and the U. S. Rolling Stock Vorks, at Anniston and Decatur, Ala., where fty of them have been in constant use for early a year, without once getting out of order. Over one hundred have been ordered and rected in the City of Buffalo, N. Y. since eptember 1st, 1889, and an exchange of ten tations was built and successfully operated ver seven-eighths mile circuits for the Buffalo nternational Fair Association.

This system, in no way, infringes the patents f the Bell Telephone Company. It is absolutey new and embodies principles never before tilized in the arts, and is superior to all other ethods of transmitting speech.

The Shaver Corporation, which has recently pened elegant offices at 207 Broadway, report hat orders for these telephones are coming in ster than they can be readily filled and the deand is constantly increasing.

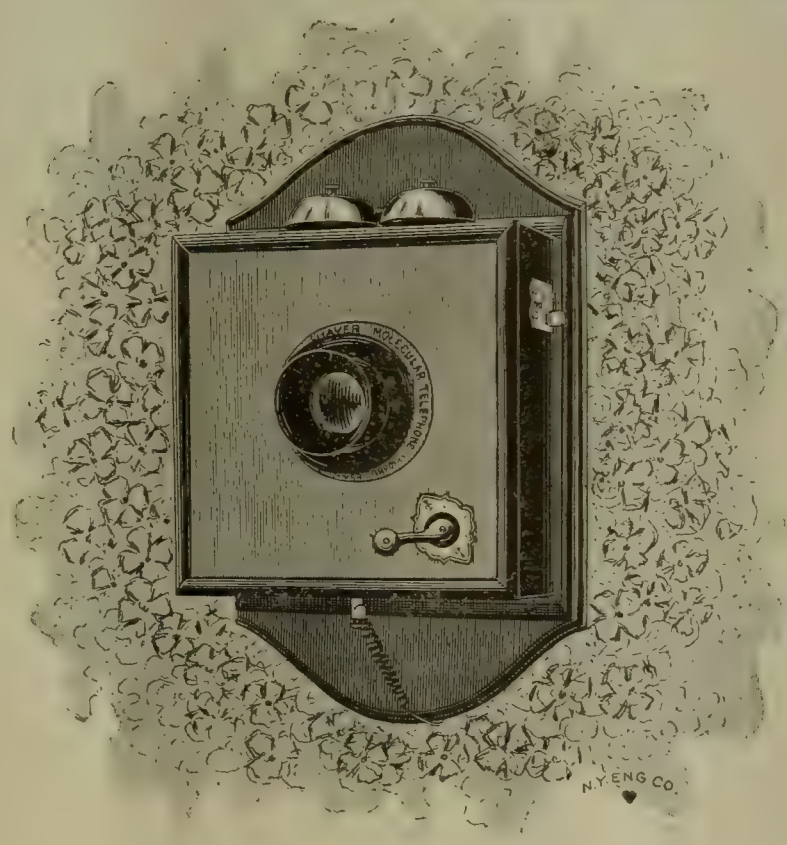


FIG. 6—WALL 'PHONE.

NOVEL ELECTRICAL APPLIANCES.—There is no nd to the variety of uses to which electricity ay be applied. In Paris it is adapted to cabs, show the passenger the actual distance he as traveled and also the amount of fare for hich the distance he has gone makes him able. The act of entering the vehicle closes electric circuit which acts on a registering al, telling you that the very act of entering the

NEW ELECTRIC ROAD—St. Paul, Minn., operated the first electric road in its limits a few days ago.

GAS COMPANY AND ELECTRICITY—Troy, N. Y., is to be lighted by electricity, supplied by the local gas company.

UNDERGROUND WIRES.—The electric light wires in this city are being put underground as fast as subways are provided.

SOME POINTS ON DYNAMO AND MOTOR DESIGN.

(*Continued from page 3.*)

of the armature made equal. Another plan is to shape the magnets as in Fig. 8, there being a faced joint at *a*. A plan adopted in several direct-driven ship sets we have just completed is shown in Fig. 9. The magnets are in this case of wrought iron, the limbs and top polar expansions being in one single forging, while the bottom polar expansions, *p*, are of cast iron. The magnetic resistance of the cast iron, combined with that of the joint at *b*, compensates for the diminished length of the induction path through the lower half of the armature. Another design by which the same end may be attained is shown in Fig. 10, where the magnet is partly of wrought iron, *a*, and of cast iron, *b*.

With a view to obtaining a more symmetrical field some single-magnet machines have been shaped as in Fig. 11. Here, to attain the object, the magnetic circuit requires to be lengthened, the magnetizing force required being correspondingly greater. In Figure 12 is sketched a single magnet machine in which the field is quite symmetrical, although here the magnetic circuit has been made still longer.

It will be understood that it is possible to have an armature out of balance magnetically while electrically it is perfectly balanced, as, for example, a drum armature in the misshapen field, Fig. 4. On the other hand, it is possible to have magnetic balance while electrically there is want of balance, as may be the case when a cylinder armature is placed in the four-pole field, Fig. 13.

When the armature core is carried round by spider arms, which fit into slots in the iron washers, it is important that the reduction of the core area due to these slots be as small as possible. Variation in the section causes magnetic kicks, or periodic fluctuations in the field during rotation.

(*To be continued.*)

MR. A. R. FOOTE ON SOCIALISM.—In a communication to a Baltimore daily paper, Mr. Allen R. Foote very severely criticizes the statements made by Professor Ely, of Johns Hopkins University, Baltimore, in a recent lecture in Buffalo. The lecture was on "Socialism and Political Economy," and Mr. Foote very ably proves the fallacy of Prof. Ely's theories.

Prof. Ely, in his lecture, made the statement that Dunkirk, N. Y. was the best electrically lighted city in the country, as far as he had seen, and the lights cost only ten cents per lamp, while Buffalo was paying forty cents. This low price was due, according to the Professor's theory, to the fact that Dunkirk owned its own plant. The object of this argument was to show the advantages of having everything, including electric lighting, dominated by public spirit. This was the essence of socialism. Mr. Foote, however, upsets this argument by throwing some light on the subject from the opposite standpoint. He told the story of a thrifty housewife, who entertained a company of ladies. A cake she had served, was much praised for its excellence, and, finally, one of the guests asked the hostess how much the cake cost. "Ten cents," replied the hostess. All present expressed surprise at the small cost. Finally, the lady explained that she bought a bottle of flavoring extract for ten cents, and the other things she had in the house. "It is so with Dunkirk," continued Mr. Foote. "The city has some things in the house, or buys them, and covers the expense in other accounts; then it buys carbons or lamp globes, and charges them to lighting account. The small expense of the lighting thus shown is the flavoring of the accounts exhibited, to make the plant popular and cause the people to demand plenty of lamps because they are cheap."

Mr. Foote concluded by referring to the Professor as one of the dreamers of the world who cannot do enough good to counterbalance the harm they do by their misleading theories. The good done in this world, said he, is accomplished by practical men, who know the value of ideas, and at the same time recognize the laws of common sense and veracity.

PRACTICAL FORMULAE FOR BATTERIES USED IN INCANDESCENT LIGHTING.

Let i' be the intensity of current required in each lamp to keep it white hot; let e' be the difference of potential and r' the resistance between the binding screws of each lamp, while in use. The resistance, when hot, may be roughly considered as one-half that found when cold. If we have n' lamps connected in multiple arc, the current necessary to supply them will be:

$$I = n' i' \qquad (1)$$

Let n be the number of elements of battery or accumulator required, each having an electro-motive force e, and an internal resistance r; the greatest possible intensity of current to be obtained from each will be, from Ohm's law,

$$i = \frac{e}{r} \qquad (2)$$

that is, when short circuited, but no useful work is done. The maximum of useful work is obtained when the external resistance is equal to the internal, or when

$$i = \frac{e}{2r} \qquad (3)$$

In practice, however, it is found more economical to make the external resistance four or five times that of the battery, to decrease the effects of polarization, and increase the *efficiency*, or proportion between the useful work and the energy expended. The practical value of i must therefore be determined by the nature of the element, its size, the length of time it is required to work, etc.

As each element or series of elements should only be traversed by a current $i\,q$, the number of series should be such, that

$$qi = I \qquad (4)$$

$$\text{from which } q = \frac{I}{i} \qquad (5)$$

If t be the number of elements in each series, the value of I, according to Ohm's law, is

$$I = \frac{te}{\frac{tr}{q} + \frac{r}{n}} \qquad (6)$$

$$\text{from which } t = \frac{q\,e'}{q\,e - r\,I} \qquad (7)$$

If the resistance R of the connecting wires is large enough to be taken into account and all the lamps are in one group, formula (6) becomes

$$I = n\,i = \frac{te}{\frac{tr}{q} + \frac{r}{n} + R} \qquad (8)$$

The value of q is the same, but t becomes larger. When the lamps are in groups, the formula is a little more complicated.

For example, let there be 50 lamps, whose constants are $i' = 1.5$ ampères, $e' = 48$ volts r' taken hot, 32 ohms. How many Faure accumulators will be required to supply them? The constants of each element are, for a current i of 16 ampères, $r = .01$ ohm, $e = 2$ volts. The resistance of the connecting wires is supposed to be zero.

From (1), $I = n'\,i' = 50 \times 1.5 = 75$ ampères.

From (5), $q = \frac{I}{i} = \frac{75}{16} = 4.68$; as q must be a whole number, $q = 5$.

From (7), $t = \frac{qe}{qe - rI} = \frac{5 \times 48}{(5 \times 2) - (.01 \times 75)} = 25.8$; $t = 26$.

Therefore, 5 series of 26 elements each, or a battery of 130 elements, will be required.

We have given i a value of 15 ampères only, in order that the polarization may not bring the electro-motive force below 2 volts. Let us suppose that the cells can be worked to their full capacity, that is, make

$$i = \frac{e}{2r} = \frac{2}{2 \times .01} = 100 \text{ ampères.}$$

As the lamps require only 75, $q = 1$, and becomes

$$\frac{q\,e}{q\,e - r\,I} = \frac{1 \times 48}{2 - (.01 \times 75)} = 38.4$$

39 elements arranged in 1 series will suffice.

A voltaic cell or accumulator may be regarded as a reservoir containing a certain quantity of electricity, but the amount available for useful work is much less than this. If we represent by Q (expressed in coulombs), the quantity thus available, the number of seconds S, during which normal working will continue, will be

$$S = \frac{Q}{i} \qquad (9)$$

since a current of i ampères equals i coulomb per second. It has been found that a Faure accumulator weighing 10 lbs. will furnish 500,000 coulombs. Applying formula (9) to the first solution of the example, where $i = 15$

$$S = \frac{Q}{i} = \frac{500.000}{15} = 33.330 \text{ seconds} = 9 \text{ hours } 15 \text{ minutes.}$$

In the second solution, provided each accumulator could furnish 500,000 coulombs before e falls below 2 volts.

$$S = \frac{500\,000}{75} = 6{,}660 \text{ seconds} = 1 \text{ hour } 5 \text{ minutes.}$$

A comparison of the length of normal work in each case with the number of accumulators shows a decided advantage in favor of the smaller value of i, although the total energy given out by each cell is the same in both cases. The resistance of the 50 lamps is .64 ohm; of the 130 cells, .05 ohm; of the 39 cells, .39 ohm. In the first case work has to be done against .69 ohm resistance; in the second, against 1.0 ohms. Therefore, to give the current a strength of 75 ampères, an electro-motive force of 52 volts will suffice for the smaller resistance, while 78 volts are necessary for the larger.

IMPROVED STORAGE BATTERY.—It is said an improved storage battery has been invented by Professor Main that seems to have been remarkably successful. It consists of zinc plates, horizontal and riveted to copper support plates, and of lead plates perforated so as to present a large surface area, prepared by the Plante process. The power of this battery per pound of lead used, expressed in ampère power is 7.42 against 3.62, 4.10 and 1.77 for three styles of batteries of the Faure type. The battery will bear rough usage. It has not yet been placed upon the market.

BUSINESS NOTICE.—Messrs. Flack & Son, electrical engineers, of Buffalo, N. Y., after a seven weeks' test of the James H. Mason Primary Battery, have taken the sole agency for these goods in that city. These gentlemen are well-known electricians and know a good thing when they see it.

THE SPRAGUE OVERHEAD SYSTEM.—After an unsuccessful experience with the Bentley Knight underground system in Allegheny City, Pa., the conduit has been abandoned, and the Sprague Electric Railway & Motor Co's overhead system has been adopted in its place.

THE ELECTRIC LIGHT IN SACCARRAPPA.—Saccarrappa is not a very euphonious name for a town, but that town, in Maine, is going to have its streets lighted by electricity just the same.

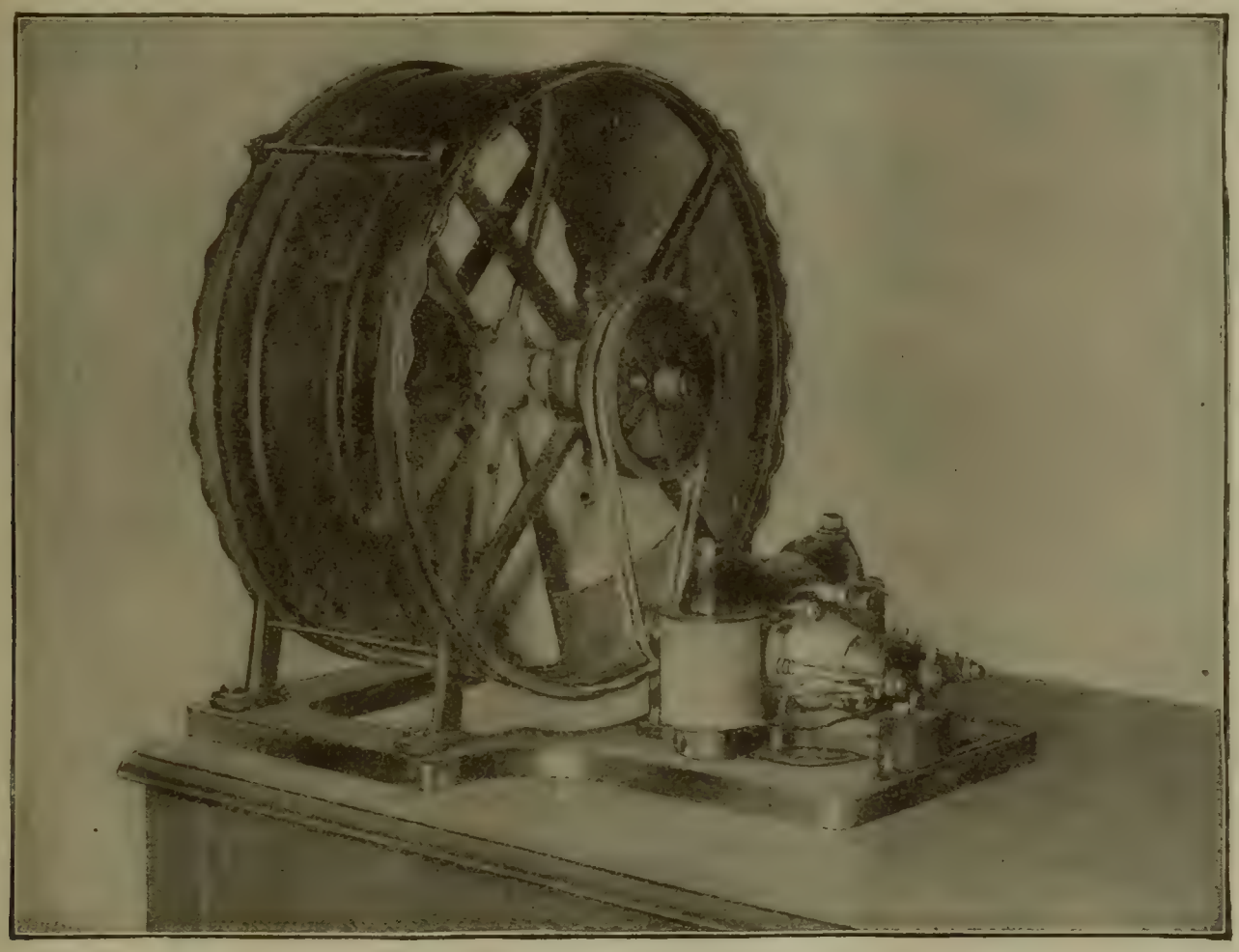
ELECTRIC LIGHTS IN HORSE CARS.—The Berlin horse car companies have decided to illuminate their cars by electricity.

COMBINATION SPRAGUE STATIONARY MOTOR AND FAN.

With the approach of summer the question of the best method of ventilating naturally suggests itself, and for that purpose the use of electricity as an agent for transmitting power from a central station to the point of use, holds an unrivalled position.

On this page we show a new combination of electric motor and fan which has recently been brought out by the Sprague Electric Railway and Motor Company, and which promises to meet a widespread demand for a simple and reliable fan, which can be operated directly from a constant potential circuit. As shown in the view, the motor and fan are both on the same stand, the motor being belted directly to the fan. The motor, on account of its winding, can be set in operation by the simple movement of a switch, and stopped as easily; there is no necessity of using a rheostat in connection with the motor.

When all the advantages of electric power are taken into consideration, the absence of fire, smoke, ashes, engineer or expert attention, it is not surprising that so many electric motors have been adopted for the general distribution of power, and each new application, like the one illustrated, tends to popularize the use of electric power.



COMBINATION SPRAGUE STATIONARY MOTOR AND FAN.

Electricity on Belgian Railways.—Tenders were recently invited by the Belgian Minister of railways, posts, and telegraphs, for the erection of an electric light installation at the Namur railway stations. The regulations contained in the specification were very stringent, and, as yet, the contract has not been decided.

Telephonic Communication with Ships at Anchor.—The Havre Chamber of Commerce is about to carry out some experiments with a view of testing the feasibility of a system of telephonic communication between ships at anchor in the Roads and the local Exchange.

Wants Electricity for Everything.—Kenton, Ohio, is going to have its streets lighted by electricity, and wants an electric street car line.

ANSWERS TO INQUIRIES.

"A Beginner," Wenham, Mass.—The article you refer to is quite correct, and its object is to correct the misapprehensions that you and very many others labor under. If you will read carefully you will see that the author says: *A current is rated by ampères, not by volts.* A wire carries current at the rate of so many ampères; a current cannot be measured or designated by volts." A volt is the unit of measurement of difference of potential, and does not express any attribute of the current. The article does not say the ampère is the measure of intensity. The volt is the measure of intensity. The ampère is the measure of the current. The power to overcome resistance is measured by volts.

The second question cannot be answered unless the size of the battery is known.—Ed. Electric Age.

In answer to an inquiry from a correspondent at St. Williams, Ont., as to whether anything has been invented to take the place of a transmitting key, we would say that several methods have been devised for transmitting automatically. An automatic system of transmitting usually includes a slip of paper on which is punched or embossed the matter to be transmitted, and the slips thus prepared are passed through the transmitting instrument. This method renders it possible to increase or decrease the speed at will to any limit. An instrument of this class is used in the Wheatstone system. Siemens Bros., of London, manufacture an iustrument, which in appearance resembles a typewriter. By manipulating the keys certain mechanism is operated which performs the functions of an ordinary transmitting key. This instrument, while it transmits automatically, obviates the use of prepared slips by transmitting directly. It is fully described in Prescott's book on the Electric Telegraph. Instruments of this class are necessarily expensive on account of their intricate mechanism. There is nothing that we know of besides these two types of instruments that are of any practical value.—Ed. Electric Age.

Editor Electric Age.—What is the resistance of the primary and secondary coils of the induction coil used in connection with the transmitter of the telephone, and the resistance of the wire used on the earphone?

Milwaukee. S. W. G.

Answer.—The resistance of the primary coil is about two-tenths or three-tenths of an ohm; of the secondary coil the average is about 150 ohms, and of the earphone about 75 ohms.—Ed. Electric Age.

Editor of the Electric Age.—What is basis of the unit of illuminating power of electric lights. This power is measured by so many candles. What kind of candles does that mean?

Houston, Texas. J. W. H.

Answer.—The term candle-power is very indefinite. One candle may have greater or less illuminating power than another. The material used in the candle affects the light given out. Thus, tallow, sperm, paraffine, etc., have unequal illuminating power as compared with each other. In practice, only an approximate idea can be had of the value of a candle-power light. There is, however, a standard unit of candle-power, which is the light given by a sperm candle consuming approximately one hundred and twenty grains of spermaceti per hour. This is the American and English standard. The French standard is the "carcel" lamp, which consumes six hundred and forty grains per hour, while in Germany, another standard is adopted. None of the standard units are absolute, and, as will be seen, are not based on anything very definite. Many suggestions have been made in the direction of a uniform and practical standard, but nothing tangible has yet been evolved.

Engines for Electric Lighting.—Engine and boiler makers say there is a sharp demand for all descriptions of steam-plants just now, especially the types favored by the electrical lighting and motor people. Indeed the outlook for this manufacture is most encouraging, the only thing to be dreaded, the appearance of that class of new manufacturers that may be attracted to enter the field because of its favoring conditions. Engine and boiler building, however, is quite different from most other trades. Steam users rarely purchase plants because they are cheap. They must be of a reliable and favorably known manufacture. The really far-sighted steam-user will pay more for a good type of engine and boiler, because its maker's name is at stake and hence it is to his interest to see that it is properly constructed.

Fog and Atmospheric Electricity.—In a letter to *Industries*, Mr. W. H. Daniels asks the question which, he says, has been mooted in maritime circles, whether fog does or does not affect the mariner's compass. His own opinion is that it does for the following, to him, conclusive reasons: "Magnetism is a form of electricity and so is lightning; lightning is in the clouds, and a fog is a cloud. Moreover, in the normal course of things, a cloud should rise in the air, whereas a fog descends." The late Captain Saxby used to mention that on one occasion a convoy of thirty sail found themselves steering a wrong course through fog.

Electric Power.—A general inclination is being evinced by electric lighting companies to provide power as well as light to their customers. This requires a modification as well as an extension of plant but, if properly managed, is pretty sure to prove profitable. The customers of such a plant are, for the most part, small power users, some used to getting their power by auxiliary belting from an adjoining mill or workshop, while others have operated a small steam plant of their own.

Its Name is Its Business.—The Electrical Reminder Company is the name of a concern recently incorporated in Chicago to sell electrical goods and supplies.

CHICAGO NOTES.

35 Commercial Bank Building,
CHICAGO, March 20th, 1890.

INDIANOLA, IOWA, is soon to have an electric light plant.

P. C. ACKERMAN, of New York, is in the World's Fair City this week.

DR. PAUL SCHOOP, of Zurich, Switzerland, is still with us, and his application for membership in the Electric Club is on file.

THE STREET RAILWAY ORDINANCE, which has been so bitterly fought in the Elgin, Ill., council, and which brought about the alleged boodle expose, was passed on the 17th. Work on the ten miles of electric road will be begun at once.

THE CENTRAL ELECTRIC COMPANY, Chicago, seem to be determined to keep themselves prominently before the electrical trade and are cer tainly anxious to afford their customers every facility in ordering supplies. The latest evidence of this is the fact that they have just had a private wire run into their office connecting them with the Postal Telegraph Cable Company's system, and the merry click of the instrument has a familiar sound to many an old time telegrapher who has graduated from the ranks into some of the later and more remunerative fields of the electrical business.

THE WESTINGHOUSE ELECTRO-PNEUMATIC INTERLOCKING SYSTEM installed at the Union Depot, Kansas City, Mo., was recently given its first trial with very satisfactory results. The system, which covers fifty switches, is operated by compressed air and controlled from a tower by electricity. The air pumps located in the basement of the depot annex deliver the air into a series of tanks from which it passes through two main pipes to the yards south and west. Here the air passes through numerous branch pipes to the various switches and signals. The construction has been under the direction of Mr. Vibe Spicer, engineer of the United States Switch Company.

CORPORATIONS.—The following companies have been incorporated: Cross-town Electric Railway Company, of St. Louis, Mo., capital stock $100,000 half paid up; incorporators, S. Campbell, E. D. Meier, D. K. Ferguson, D. W. Brown, P. K. Marion, C. C. Carroll. Wichita Electric Railway Company, of Wichita, Kan., capital stock, $100,000; directors, J. O. Davidson, Thomas G. Fitch, George L. Rouse, B. H. Campbell, C. A. Walker, all of Wichita. The Periferie Steam Engine Company, of Chicago, Ill., to manufacture and sell steam engines under the Beck patents and to carry on a general manufacturing business; incorporators, Bruno Beck, Edward C. Fish, Frank C. Ruttan.

CHICAGO ELECTRIC CLUB.—At the regular meeting of the Electric Club, March 17th, the library of the old American Electrical Society, consisting of about 400 volumes was formally transferred to the club.

Dr. Louis Bell presented an able and very interesting paper on "Electric Motors in General Railway Work." The running of single cars has already been abandoned on a large number of street railways, and experiments show that motors as powerful as locomotives can be made and handled; which facts suggest the possibility of an electric motor car at the head of a regular train. The two questions which arise: Can we build a motor to handle railroad trains at railroad speed? and can we rely upon a motor with anywhere near the same feeling of certainty as upon a locomotive? Dr. Bell answers affirmatively. Recent rapid improvements in insulation and details of construction and the placing of the motor upon a special car where it can have close attention should cause it to give little trouble.

But the vital question is, Can the requisite amount of power be transmitted with a tolerable degree of economy to the distances required? The immediate solution of the difficulties presented in long distance transmission is to operate the line in sections of reasonable length. Taking as a special case the transforming of the "Big Four" line from Chicago to Cincinnati into an electric line, Dr. Bell carefully works out the problem, dividing the distance (300 miles) into ten sections and placing a power station in the centre of each. The efficiency, he shows, would be about fifty per cent. from the indicated horse power at the engine to the power supplied at the axles of the car.

By comparison with the locomotive Dr. Bell shows that the saving of fuel effected in the electric system would probably be about one-half, and, having considered all factors, concludes that the "margin of economy between a long distance electric system and locomotives appears to be just about enough to balance the losses in the transformation in the electric system." The latter, however, has two advantages, a somewhat cheaper grade of coal can be used, and the weight efficiency is greater. He is of opinion that the increased adhesion due to the use of the rail as return conductor will maintain the tractional power sufficient with a considerably decreased weight of motor car.

The case where an electric system would work to the very best advantage is on elevated railroads. Taking the Manhattan Railroad of New York, Dr. Bell showed that the use of electricity would mean a saving of about $400,000 a year over the locomotives, in the single item of coal.

In an elevated road the absence of the noisy locomotive spluttering by one's front window and dropping cinders and ashes upon passers by, is especially to be desired, and would probably lessen the cost of right of way.

Among recent visitors at the club were S. H. Klinger, St. Louis, Mo.; R. I. Sloan, New York; Theo. C. Ives, New York. F. M. I.

A WATT-METER.—Some French electricians have contrived a wattmeter, says an exchange, which, it is thought, will be of great service in the case of alternating currents. The instrument is an electrometer, in which the two opposite halves of the aluminum needle are insulated from one another. There are two pairs of semi-circular "quadrants," one above and one below the needle, and, when used as a wattmeter, the upper and lower plates on the same side are connected together, and are then placed in connection with the ends of the conductor in which the expenditure of power is to be measured; the two halves of the needle are connected to the ends of a non-inductive resistance, which must be placed in series with the other conductor. Although a reliable wattmeter is not important in connection with continuous currents, it may prove of great use in many alternate current investigations.

SUIT.—Col. Jacob E. Bloom, a lawyer, is suing James M. Seymour and Francis J. Patten to establish an interest in Patten's electrical inventions and to recover $200,000. He alleges that in 1888 Patten gave him the exclusive right of sale of his inventions for fourteen months, and that later in the same year he gave Seymour the same right. Judge O'Gorman, in the Superior Court, on March 21st, granted an order for the defendants to show cause why they should not be examined before trial in order to enable Col. Bloom to frame his complaint.

KILLING SWALLOWS.—The question of the wholesale destruction of swallows by electricity has at last been taken up in France, and a report on the subject was presented at a recent meeting of the Zoological Society. In the south of France long wires are systematically erected along the seashore, and when the tired swallows alight on them they are stunned or killed by an electric shock. The birds are then sent to Paris, where they are used for decorative purposes.

DEVELOPMENT OF INVENTIONS.

When man is bending some newly discovered force of nature to his will, says the Boston *Transcript*, there must of necessity be a struggle, and in that struggle life and limb may perchance be lost. It has always happened so, and probably the progress of science will always be fraught with more or less danger. Science has found real martyrs, however, who willingly gave up life for progress and the benefit of mankind in general. Other victims of science have been the foolhardy and the ignorant. Every invention, almost, has claimed its lives. Powder, matches, lamps (oil and spirit), guns (especially when unloaded), gas, carriages, bicycles, railway trains have caused deaths without number and injury to property by explosion and fire. Yet it is scarcely necessary to say that, now we have experienced the benefit of them, we will not forego the advantage of them. People used to blow out the gas and then seek the cause of the odor with a lighted candle or match, with a result that it is not necessary to name. In the use of electricity, properly applied, the most stupidly ignorant person could not cause accident.

The one objection to be urged against the farther development of electrical invention is that it is apt to add more rapidly than anything else to the vice of laziness. The very latest labor-saving device that has come under our notice is an arrangement connecting the clock and the stove. The clock indicator is set over night, and when the hands reach the specified time in the morning, an electric spark is produced in the stove, which lights the fire, all without disturbing the *pater* or *mater familias*. When the fire has got to going, and the temperature has been warmed to a certain degree, a thermometat sounds an alarm and the sleeper is awakened, dressing in a summer-like warmth that is most pleasing. The act of getting up has no rigors to him when thus supplied, except in case it does not work. Then—but we would rather not picture the scene, as it might take us too far into the domain of realism.

By the time the sensational stories of accidents due to the careless handling of electricity, which are printed in papers that do not know a volt from a sweet potato, reach England they are horribly exaggerated, to judge from the comment of the English papers. Here is the impression they have created there: "A mild flirtation carried on over the telephone was tragically interrupted by a flash of fire, which left the lovers lifeless corpses. Tram-cars were made to bound about the street like Victor Hugo's cannon, or like the semi-human locomotive in the Mexican mystery, 'going for' innocent victims against whom they shot burning flames; while overhead wires, descending with evil intent, forced you to clutch them with convulsive and unwilling grasp, while they poured a stream of electric agony through twitching nerves, till death gave release.

SEARCH LIGHTS.—The English turret ship Magdala has been making some very successful experiments in ship-lighting in the harbor of Bombay. This vessel has on board two search lights of 25,000 candle-power, and by them shipping can be discovered between two and three miles off on the darkest night. By throwing the light against the sky messages can be telegraphed to ships fifty miles off.

ELECTRIC WELDING.—With a view of testing the rapidity of electric welding twenty pieces of one-inch common round iron bars with rough ends were recently welded together by two men in thirteen minutes.

THE ELECTRIC LIGHT ASSOCIATION.—An English contemporary comments favorably on the work of the recent Electric Light Convention and suggests that a like institution in England would be advisable.

NEW CABLE STEAMER LAUNCHED.—The new cable steamer "Relay" was recently launched in England. She has double screws, and is equipped with all modern improvements.

THE INVENTOR OF THE TELEGRAPH.

Many people think there is a scheme to rob Professor Morse of the glory of the invention of the Telegraph—Who is the real inventor of the Telegraph?—An interesting letter on this subject from James D. Reid, the bosom friend of Professor Morse.

There seems to be a widespread opinion that here is a movement on foot to efface the name of Professor Morse from history as the inventor of the telegraph, and substitute therefor that of Alfred Vail. That Alfred Vail did a great deal toward putting the great invention on its feet through his mechanical skill no one doubts, but to credit him as being the inventor of the telegraph evokes considerable indignation in some quarters. Prof. Morse's name has been indelibly inscribed in the pages of history as the inventor and to attempt to rob it of that honor at this late day seems like trying to do an impossibility; not that Alfred Vail or anyone else ought to have the honor, but because Morse's name is there for all time. There is no case on record where the name of one man intimately connected with some great event has been substituted by the name of another simply because somebody thought the honor did not belong to him but to somebody else. Every man that has become famous, necessarily has adherents and defamers, and the latter will try at every opportunity to rob him of the honor he has won. Alfred Vail, no doubt, was entitled to great credit for his part of the work in putting the invention into practical shape, but Morse is the recognized inventor and was the moving spirit in the enterprise. No one can tell who was the real inventor—that is, who first conceived a plan of communicating intelligence to a distance. But it is recorded in history that to Morse is due the honor of putting the idea into practice. So it will avail nothing to attempt to undo what has taken nearly half a century to do.

The proposition to sell to the government the first Morse register for $10,000, has evoked considerable criticism among those who witnessed the birth of the telegraph and who understand the circumstances attending its early development. This generation of telegraph workers do not know or understand why there should be any objection to selling this historical relic to the government, whose generosity at a critical period in the lifetime of the telegraph saved the latter from oblivion. But those few surviving witnesses and participants in the early struggles of the great invention, know full well why this particular instrument should not be made an object of barter. The opposition is not based on sentimental grounds, either. It has for its foundation right and justice. The telegraph has no better defender when right and honor are assailed than that stalwart, whose character is a synonym for integrity and purity, the Hon. James D. Reid, United States Consul at Dunfermline, Scotland. Mr. Reid is on his native soil, and no doubt enjoys the association of his kith and kin, but he has at the same time an eye on what is transpiring in the telegraph field in the land of his adoption.

Mr. Reid does not regard the proposition with any favor. He earnestly protests against such a bargain, and for very good reasons. In a recent communication he very forcibly expresses his views on the subject. He says: "There can be no objection to George Vail or any one else buying or selling relics as a business, but the proposition to sell to the government the first Morse register should not be considered for a moment, and the whole nation should rise up against the consummation of the ungenerous act.

As the value of the instrument proposed to be purchased is in its special association with the first message, it might be well to ascertain which instrument received the message in question. If sent from Washington to Baltimore, then the true relics are the Washington key and the Baltimore register, unless, which is not unlikely, both instruments were allowed to make the record in the act of transmission to gratify local curiosity. Even then, the true relic is the Baltimore register and the Washington key.

One thing is certain, and that is that government paid Prof. Morse for both instruments, and that were he alive he would never consent to offer them for sale at any price, least of all to government, whose money constructed them. Prof. Morse would have presented them to the nation. When government sold the line between Baltimore and Washington to the Magnetic Telegraph Company, a company the chartering of which George Vail, for reasons well known to himself and which I know, violently opposed, these original instruments were given to Prof. Morse, and by him given, through courtesy, to Mr. Alfred Vail at his (Vail's) request. It would surely be a marvelous thing if a gift so bestowed should be made the occasion of smiting the generous giver under the utterly unfounded claim that Alfred Vail was its inventor. The truth is that Mr. Vail was Prof. Morse's mechanical assistant, an office procured for him by Prof. Morse, and for which Government paid him (Vail) a salary of $1,000 a year, and, as such, he constructed these instruments for the experiment government had ordered, and of which Prof. Morse was superintendent and Ezra Cornell the outdoor constructor. Alfred Vail never claimed the honor now asked for him. He was Prof. Morse's trusted friend. He was mine also.

It would be a very curious thing, should this purchase be made, if the Smithsonian Institute should accept the care of a relic, a book giving the description of which, written by Alfred Vail, was peremptorily refused by Prof. Henry to be allowed to be placed in the cornerstone memorials of the Smithsonian Institute? Let this violator of Alfred Vail's honor take care. There are some memorials of the dead and living he may be unwilling to see.

Here are two memorials of men long since dead, with both ofwhom I was glad to be intimate, which speak of a mutual esteem quite indicative of their relation to each other.

ALFRED VAIL TO PROF. MORSE.

'I feel, Prof. Morse, that if I am ever worth anything, it will be wholly attributable to your kindness. I now should have no earthly prospect of happiness and domestic bliss had it not been for what you have done, which I shall ever remember with the liveliest emotions of gratitude.'

PROF. MORSE TO ALFRED VAIL.

POUGHKEEPSIE, Aug. 7, 1847.

Dear Friend Vail: I hope and trust you are agreeably situated. You say "you hope I shall not forget that we have spent many hours together." You might have added "happy hours" I have tried you, dear Vail, as a friend, and think I know you as a zealous and honest one.

I may have more to say on this subject when I obtain access to my papers."

PETITIONS SIGNED.—The petitions sent out by Mr. A. J. DeCamp, of Philadelphia, Pa., on Feb. the 6th, asking the electrical profession to take advantage of the bill before the Senate and House Committee to secure the necessary authority for making a complete investigation of the Electrical Industry for the present census, have been liberally signed and forwarded to Washington.

CATHEDRAL LIGHTING.—The lighting of the interior of Strasburg Cathedral by incandescent lamps has proved highly effective, and the arc lights used outside the building show off the details of the façade exceedingly well.

Mr. T. F. Clohesey, of Kansas City, Mo., agent for the Detroit Motor Co., reports business good in the motor line. Mr. Clohesey is one of the best electrical engineers in the Southwest.

ELECTRIC OSCILLATIONS IN RAREFIED AIR WITHOUT ELECTRODES.

A DEMONSTRATION OF THE NON-CONDUCTIVITY OF A VACUUM.

BY JAMES MOSER.

M. Hertz has recently obtained an experimental realization of the theories of Mr. Heaviside and Mr. Poynting respecting electric oscillations. According to these theories the electric oscillations in a wire originate upon the surface of the wire, and the slower they are the further do they penetrate into its interior. The more rapid, the more superficial they remain. M. Hertz imagines a wire conductor in the form of a cylindrical cage. Twenty-four wires stretched between two metallic discs represented the surface of a cylindical conductor, whilst in the middle a metallic rod joining the two centres of the discs. and interrupted by a spark micrometer, represented the axis. He showed that an electric oscillation induced in this did not produce any sparks in the micrometer placed upon the axis.

This led me to make the following experiment in which I use rarefied air spaces without an electrode of any kind as conductors for the oscillations.

It has often been observed that tubes of rarefied air become luminous in the neighborhood of an induction coil in action. But, according to all accounts, the tubes were furnished with electrodes passing through the glass as in the Geissler tubes, or simply applied to the external surface, as in those of Gassiot. But in no description have I found the experiment which seems to suggest itself, and which consists in exciting a tube without any electrode by the discharges of a bobbin placed near it. Yet, the elimination of the electrodes would simplify the solution of some problems in physics.

In my experiment, I enclose a sealed tube of rarefied air, forty centimetres long and three millimetres in diameter in another tube, which is somewhat longer, and is ten millimetres in diameter. This outer tube is sealed up at one end, and fitted at the other to the Geissler pump. The vacuum of the inner tube remains invariable and becomes luminous, and of a light blue color, without stratification, when near an induction coil. If, now, we also produce a vacuum in the outer tube, the vacuum of the inner tube remaining constant, we note the following facts:

1. If, in the outer tube, the pressure is equal to that of the atmosphere, the inner tube, under the influence of a bobbin, becomes luminous, and turns light blue, as usual.

2. If, in the outer tube, the pressure is reduced to one millimetre of mercury, the air in it becomes conductive and luminous, and turns dark red. At this moment the *protective effect* of the enclosing tube shows itself. The phenomenon is reversed.

We know that the Geissler tubes, furnished with electrodes, and brought to a state of extreme rarefaction, will not conduct an electrical discharge. This phenomenon has given rise to a great deal of discussion. Some physicists have explained it by the insulating power of the vacuum; others, looking upon the vacuum as a good conductor, conclude that great resistance to the passage of the discharge is offered at the surface of the electrodes. But, in my experiments, there are no electrodes; thus there can be no question as to this resistance to the passage. The experiment shows, in fact, that by lowering the pressure to less than one millimetre and rendering the rarefaction extreme, the enclosing tube again becomes obscure and the inner tube luminous. In appearance it is the same as if the pressure in the outer tube were equal to that of the atmosphere.

The most perfect vacuum, therefore, has no longer any protective effect; it is devoid of conductivity for the electric current.—*London Electrical Review.*

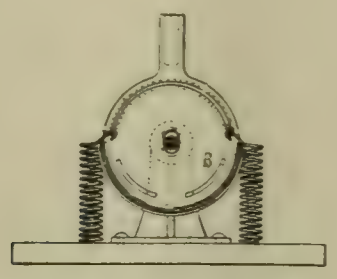
THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED MARCH 18TH.

423,361. Coin-Operated Electric Apparatus. John S. Wallace, Belfast, Ireland. Filed Aug. 29, 1889.

423,391. Trolley for Overhead Electric Railways. Frank B. Rae, Detroit, Mich. Filed Nov. 14, 1889

This is an improvement in trolley arm bearings, and permits of forward and backward motion.



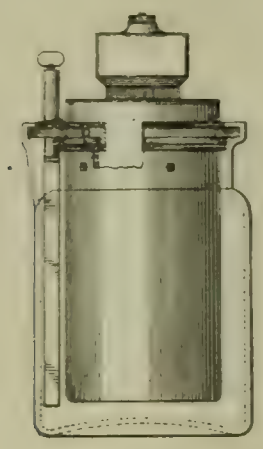
NO. 423,391. TROLLEY.

423,400. Electric-Motor Car. Detlef C. Voss, Medford, assignor of one-half to Edward A. Clark, Boston, Mass.

This invention provides for an electric motor car, having motors at opposite ends, with the circuits so arranged that either or both may be placed in or out of circuit, and an electrically operated device between the motors and contacts to open and close the circuit.

423,421. Apparatus for Producing Steam, Heat and Light by Electricity. Theophilus D. Farrall, Michigan City, Ind. Filed Oct. 5, 1889 This apparatus consists of a source of electricity and an electric transformer, storage battery or accumulator in combination with an electric heating cartridge, steam generator and electric lighting apparatus. This system is adapted to heating and lighting railway trains.

423,449. Electric-Wire Molding. John A. Seely, Brooklyn, N. Y. Filed Oct. 30 1889. This invention consists of a flexible and non-elastic molding in which are embedded one or more electric wires.



NO. 423,594. GALVANIC BATTERY.

423,487. Fire or Police Telegraph. George C. McCullough, Richmond, Ind., assignor of one-third to John B. Dougan, same place. Filed Feb. 5, 1889. This is a combination of independent outlying main circuits with a central station at which there is a repeater, so that a signal from one circuit may be repeated to each of the other circuits.

423,488. Electric Switch. Thomas S. McEvoy, Waterbury, Conn. Filed Nov. 25, 1889. This switch is opened and closed by means of a scroll cam.

423,495. Crossing for Electric Conductors. Henry A. Seymour, Washington, D. C., assignor to the Short Electric Railway Company, Cleveland, Ohio. Filed Jan. 31, 1890. This invention, by the use of insulated plates to which electric railway conductors are attached, makes it possible for two or more conductors to cross one another in such a manner that there will be no interference of conductors, and without in any manner disturbing the usual operation of the cars.

423,527 Electrical Conductor. George E. Miller, Lynn, Mass. Filed, Jan. 27, 1890. This invention consists of a method of shunting an electric railway conductor around a railway gate, so that the lowering and raising of the gate will not interfere with the electric operation of the system.

423,549. Electro-Therapeutic Appliance. Charles E. Brunning, Stockton, Kans. Filed Nov. 16, 1889.

423,575. Individual Telephone-Call. Joseph Sack, Dusseldorf, Germany. Filed May 1, 1889.

423,594. Galvanic Battery. Martin M. Clark, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 9, 1889. This is an improvement in the method of supporting and hanging the elements.

423,600. Ampère Meter. Gustav A. Frei, Boston, Mass., assignor to the Bernstein Electric Company, Portland, Me Filed Dec. 3, 1889. This meter consists of two stationary coils connected in series and placed side by side, and offset, combined with a movable coil within them and in shunt with the stationary coils.

423,616. Galvanic Apparatus for Dental Surgery. Charles Wm. Manker, Nebraska City, Nebr., and George F. Manker, Bedford, Iowa, assignors of one-third to Henry E Manker, Elliott, Iowa. Filed Aug. 23, 1889.

423,632. Electric Wire Supporter. William F. Rothenberg, Denver, Colo., assignor of one-half to Joseph Turre, same place. Filed Nov. 20, 1889. This is a method of supporting electric wires above the streets by means of arched supports between the sidewalks.

423,637. Carbon-Rod for Arc Lamps. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 3, 1888. This carbon rod is tubular and a wire inserted within is bent in wave line form to secure good conductivity.

423,638. Cut-Out for Electric Arc Lamps. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 26, 1889. Differentially-wound lifting magnets of an arc regulator are combined with the carbons, and a shunt circuit around the carbons containing a switch so arranged that its closure directs the whole current back through the second of the windings of the magnet to neutralize the same.

423,697. Bell. Louis M. Pinolet, New York, N. Y. Filed July 15, 1889.

423,707. Electric Bell. Arthur F. Stanley, New York, N. Y. Filed Jan. 20, 1890.

423,708. Static Electrical Machine. Hugo Tirmann, Cleveland, Ohio, assignor to the United States Mine Supplies Company. Filed June 18, 1888. This is a combination of two compound electrics, each consisting of an interior body of hard rubber or of glass and an excitant envelope formed of a special preparation,

423,732. Method of Welding Metals by Electricity. Charles L. Coffin, Detroit, Mich. Filed Nov. 12, 1889.

423,733. Method of and Apparatus for Electric Welding. Charles L. Coffin, Detroit, Mich. Filed Nov. 19, 1889.

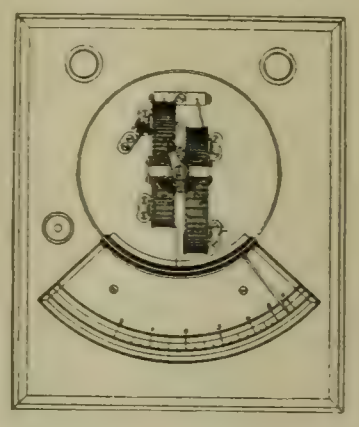
423,734. Method of Welding Metals by Electricity. Charles L. Coffin, Detroit, Mich. Filed Nov. 19, 1889.

423,735. Method of Welding Metals by Electricity. Charles L. Coffin, Detroit, Mich. Filed Dec. 6, 1889.

423,736. Method of Welding Metals Elec trically. Charles L. Coffin, Detroit, Mich. File Dec. 12, 1889.

423,753. Electric Burglar and Fire Alarm William Gee, New York, N. Y. Filed Nov. 19 1889.

423,788. Lightning-Arrester. George S Maxwell, Louisville, Ky. Filed Dec. 4, 1889 This is a combination of an instrument to b protected with a magnet connected with th same, a circuit breaker located between th



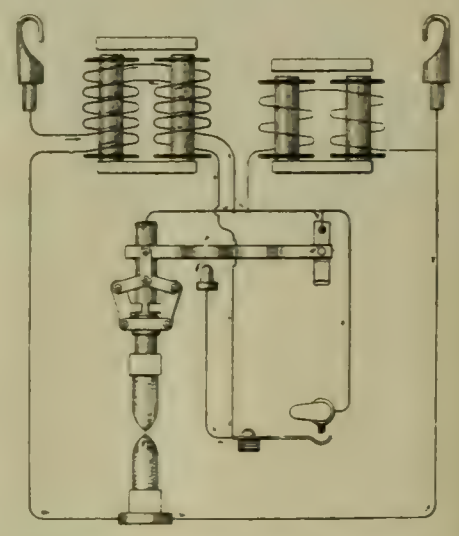
NO. 423,600. AMPERE METER.

magnet and the outside circuit and a groun connection therefor.

423,807. Arc Lamp. Henri Pieper, Fil Liege, Belgium. Filed Sept. 21, 1889. Patente in Belgium Mar. 15, 1889, and in France Ma 23, 1889. In the lamp a carbon rod is used i conjunction with two or more electrodes i contact with arc end of said rod, one or mor of the electrodes being movable.

423,842. Thermostat. Joseph Wach, Höchs on the-Main, Prussia, Germany. Filed Sept 30, 1889. Patented in Germany, Oct. 27, 1888

423,873. Elevating and Lowering Electri Lights, Robert Kinney and John P. Hebendahl Weatherly, Pa. Filed Nov. 6, 1889.



NO. 423,638. CUT-OUT FOR ELECTRIC LAMPS.

423,874. Means for Supplying Electricity t tram-cars. Alexander L. Lineff, Chiswick County of Middlesex, England. Filed Aug. 27 1889, Patented in England July 11, 1888 This provides means for conveying electricit to tram-cars, consisting of an electric main, continuous flexible magnetic main, a surface contact piece or pieces, and a magnet and cu rent-collector situated on the car.

423,886. Electric Railway Gate. Morto Toulmin, Baltimore, Md. Filed July 29, 188

423,891. Switch for Electric Apparatus. Sam uel L. Barriett, New Orleans, La., assignor t the Southern Electrical Manufacturing an Supply Company (Limited), same place. File Mar. 2, 1889.

MORE ELECTRICAL APPARATUS FOR THE TRANSVAAL.

We gave a description some time ago of a large installation for the electric transmission of power which was being manufactured by the Sprague Electric Railway and Motor Company for the Forbes Reef Gold Mining Company of the Transvaal, South Africa.

This plant will transmit power from a waterfall, where are situated a number of Pelton wheels, to the mine premises, more than three miles away. The wires connecting the power-house at the water wheels with the electric motors at the mine will be carried upon poles right across country in a direct line. The amount of power transmitted will be one hundred and forty horse-power.

The Forbes Reef Company are now so thoroughly satisfied that electricity is the most convenient and economical agent for transmitting power long distances, and applying it at its point of use, that the managers of that company have ordered additional apparatus, including dynamos and motors with wires for the transmission of 75 more horse-power. This will make a total of 215 horse-power to be transmitted from the water power, which will be used on the mine premises. The efficiency of the whole electric system will be about seventy per cent.; that is, out of every ten units of power delivered from the turbine to the dynamo, seven units will be delivered from the motor pulleys for work, and only three lost in the transmission in both machines. When the long distance which the power is transmitted is taken into account, this is, indeed, a remarkable record. Part of the apparatus has already been shipped to the Transvaal, and the rest will follow soon. The construction and installation of this plant will be under the direction and supervision of Mr. Wm. Rydler of the Sprague Electric Railway and Motor Company. When this is finished it will be one of the largest if not the largest and most extensive electric mining transmission plant in the world. While it is to be regretted that the managers of mines in this country have as yet not availed themselves to any great extent of the advantages in the transmission of power by electricity, it will probably not be long before many of the water powers which now run to waste in many mining localities will be utilized with advantage.

CURIOUS EFFECT OF ATMOSPHERIC ELECTRICITY ON AN UNDERGROUND TELEGRAPH WIRE.—In a recent number of *La Lumière Electrique*, M. P. Marcillac, in commenting on some earth phenomena recently observed by Signor Palmieri, relates the following interesting incident connected with subterranean telegraph wires: In 1883, while fault finding, M. Marcillac found himself in a wood between Marseilles and Toulon. The weather was fine and he was in telephonic communication with Marseilles by means of some excellent Siemens apparatus. The telephone was interposed in a circuit formed by two underground wires, and there was, strictly speaking, no earth and no overhead section. The weather suddenly clouded over, and a violent crackling was heard in the telephone. Rain soon fell, and obliged the party to seek refuge in their tents. At about three kilometres distance M. Marcillac noticed a gray-colored cloud, shaped like an inverted cone, oscillating in a most extraordinary manner. Each oscillation of the cloud corresponded to a violent crackling in the telephone The noise of the thunder prevented conversation, and a field Morse apparatus was rapidly installed to maintain communication with Marseilles. The effect of the oscillating cloud continued and caused the tongue of the Morse apparatus to be attracted with such force that in order not to sacrifice his apparatus M. Marcillac had to put the line to earth. The rain fell in torrents for a few minutes, after which the phenomena ceased. M. Marcillac points out that this was not a question of earth currents, but of induction experienced in a carefully insulated subterranean line.

RAILWAY COMPANIES AND THE TELEPHONE.—In several towns in Germany and Austria the railway companies have placed their goods yards in connection with the local exchange. By this means consignees are informed of the arrival of their goods, and merchants and shopkeepers are able to obtain any information they may require from the railway company without delay. This extension of the telephone system has proved very popular.

ELECTRIC ROAD.—It is proposed to connect Urbana and Champaign, Illinois, by electric railway.

DISCHARGE OF A CONDENSER.—When a condenser is discharged a sound is often heard. This was noticed by Sir W. Thomson in the case of air condensers; and Varley even constructed a telephone in which the rapid charge and discharge of a condenser gave rise to distinct tones.

A MICRO FARAD.—The unit of capacity is a Farad. The practical unit, however, is a micro-farad (one millionth of a farad) which is equal to the capacity of about three miles of an Atlantic cable. A condenser of one micro-farad capacity contains about 3,600 square inches of tinfoil.

ELECTRIC LIGHTING IN GREECE.—The light has recently been making great strides, notably at Athens. By a recent law overhead lines are prohibited.

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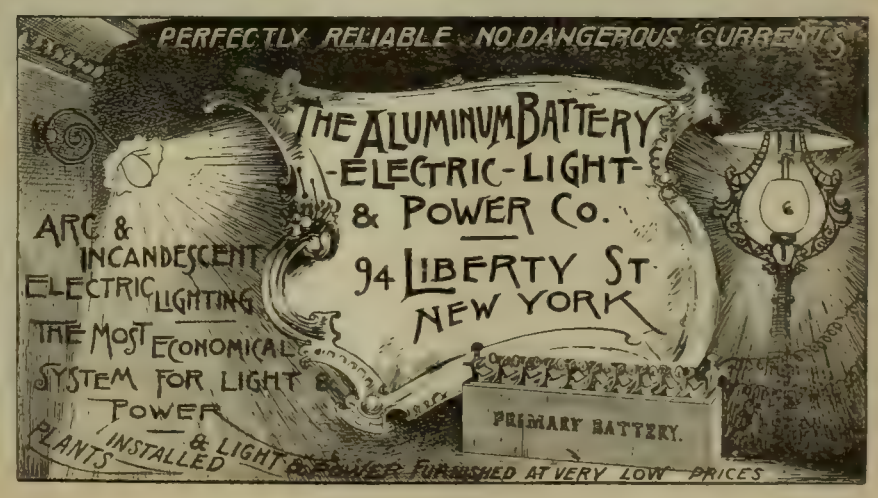
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TALK OF A BIG ELECTRIC COMBINATION.

A dispatch from Boston says: Negotiations are in progress for the forming of an electric light and railway trust. The three great electric companies of the country are the Edison, Westinghouse, and Thomson-Houston. These companies control all the important patents for electric lights, both arc and incandescent, and for electric motors for street railways.

The Thomson-Houston management proposed to the Edison people some time ago that the motor business of both companies be transferred to a new company, the profits of the new concern to be divided proportionately between the two. Later it was proposed that not only the motor interest, but the whole business of the two concerns be transferred to a trust. For this purpose, so it was stated, all the large holders of Thomson-Houston stock have been asked to deposit their shares with five trustees, ex-Gov. Ames and Messrs. Peaveat, Duncan, Newhall, and Sanford. Further, it is asserted that within two weeks overtures were made to Geo. Westinghouse to have his company come in. His reply is not known, but "the street" says it that his acceptance is not unlikely. An electric light and railway trust could easily pay 20 per cent. on a capital of $50,000,000.

TAKING THE SUN IN FOGGY WEATHER.—Coming over from Europe last fall it is said that Mr. Edison noticed that there was a great deal of guess-work and inaccuracy about "taking the sun" in cloudy weather. Before he left the ship he invented a means to take the sun though it should be obscured by the densest fog imaginable.

THE ELECTRIC LIGHT INVESTIGATION.

REPORT AND RECOMMENDATIONS OF THE SENATE INVESTIGATING COMMITTEE.

The Committee on General Laws submitted to the New York State Senate, on March 27th, the report of the electrical investigation. The report says that expert testimony is at variance regarding the comparative fatality of continuous and alternating currents, but that 250 volts or under, either direct or alternating, are safe. It is recommended, to prevent danger to human life, that all electric wires in New York city, and other cities having a population of 125,000, be speedily put under ground, and the enforcement in all cities and towns where electric lighting is carried on, of such rules and regulations as shall compel the companies to properly construct and maintain their plants and adopt such precautions as are required to insure safety to the public. The experience of New York city with subways has removed all doubt regarding the successful operation of underground conductors. In cities and towns of under 125,000 inhabitants, where the streets are less crowded, and where overhead telephone and telegraph wires are less numerous, electric light wires may be operated with safety, provided proper precautions are taken. But even in cities of less than 125,000 inhabitants, the committee believe the interest of the public would be best served by placing electric light wires in the principal streets under ground.

Testimony, including that of representatives of the New York Board of Underwriters, shows that the fire risk in connection with electric lighting is no greater than in the use of gas, if as great. The testimony shows that both the high and low tension systems can be made equally safe to life and property by the use of proper safety devices. The testimony of experts is to the effect that the converter system, involving the use of the high-tension alternating current in street mains, affords a system which is, if properly guarded, free from danger to either life or property. It is therefore the opinion of the committee that it would be unwise and unjust to the public to restrict by legislation the danger from high-tension currents used in lighting, but the wires carrying them should be kept out of reach of the public, as should street wires under the converter system.

The committee do not think it possible for the Legislature to form satifactory rules and regulations for application to an industry which is not only highly technical, but constantly developing and presenting new conditions, rendering the rules proper this year possibly obsolete next year. There should, however, be some form of supervision by properly qualified State or local authorities over the commercial use of electricity, analogous to the supervision now exercised over steam boilers.

There are two questions upon which the Legislature might properly act by providing: First, that no electric light or power current of over 250 volts pressure be allowed to enter any building; second, that after, say January 1, 1892, no overhead conductors carrying currents for lighting or power purposes be allowed in any street, highway, or public place in any city of the State having a population of 125,000 persons or over, and that the local authorities in the various cities coming under this description, in the absence of any State authority, be empowered and directed to make proper provision for the burial of such wires.

THE LATE W. H. SNELL.—Mr. Wm. H. Snell, editor of the London *Electrician*, who died at his home on March 5th last, was a born scientist. At an early age he showed a taste for science, and during his career brought out many valuable inventions, some in connection with telephony. He was a teacher of science before he was twenty years of age, and subsequently served in several capacities in connection with electrical enterprises. Mr. Snell was born in 1858, and his ability as a scientific journalist was marked.

THE SUBWAY TROUBLES.

At the meeting of the Board of Electrical Control, on March 26th, the Subway question again figured as a disturbing element. The electric light and subway companies were all represented. A letter from the East River Electric Light Company, complaining that duct rentals were too high, was read, and Commissioner Moss inquired if the first bills had not just been sent into the Subway Company. Ex-Judge Kelly acknowledged that his company had not even received its first bill, but he understood the rent was fixed at $1,000 a mile for each duct, and as it had been stated by the electrician of the Consolidated Subway Company that it cost but $3,000 a mile to construct the ducts, he thought the rentals exorbitant. The matter was referred to the experts for investigation.

Mr. Clarke called attention to the offer of the Manhattan Company to build its own subways, but the Mayor told him that when he inquired if the company would do so he could get no assurance that it would, and the matter was otherwise disposed of before the offer was made. The Consolidated Telegraph and Electrical Subway Company was instructed to build a distribution duct for electric light wires on the west side of Broadway from the Battery to Fourteenth street and along Fourteenth street to University place within sixty days and to build a distributing duct in the Bowery and Third avenue on the opposite side from the main trench within seventy days Commissioner Gilroy was on hand and persistently urged that the subways be built at once so as not to interfere with street paving. He thought the subways should be built under the sidewalks and gave notice that he would refuse permits to open newly paved streets.

"It's a question now whether the people or the subway companies own the streets," Commissioner Gilroy said.

PHILADELPHIA FIRE STATISTICS.—The *American Exchange and Review*, of Philadelphia, for April, contains elaborate statistics on the fires in that city during 1889. There were, during that period, 944 fires, of which only four were due to electric lights. The causes are divided as follows:

Due to ELECTRIC LIGHTS	4
" Gas Jets	88
" Gas Lighting	8
" Matches	75
" CARELESS SMOKERS	14
" Coal Oil Lamps	78
" " " Stoves	16
" Defective Flues	109
" Stoves	106

This statement shows indisputably that the introduction of electric lights into buildings is far less dangerous to property than the use of many other conveniences, and when it is considered that careless smokers caused 350 per cent. more fires than electric lights did, the cry against electric light seems rather ridiculous. Common sense needs to be practiced in other directions.

ANOTHER SUBWAY CONFERENCE.—Commissioner of Public Works Gilroy held a conference with Engineer Kearney, of the Subway Board, and representatives of the various electric light companies with reference to the new subways to be built this year. The list of streets selected by Mr. Gilroy for repavement was gone over, and in nearly every instance one or more of the electric companies stated that they wanted subway accommodations through those streets. Mr. Gilroy declared that the Subway Company had been unnecessarily slow in doing its work, and gave notice that he would positively decline to allow the streets to be torn up after the new pavements are laid.

REPAIRING DEEP-SEA TELEGRAPH CABLES.

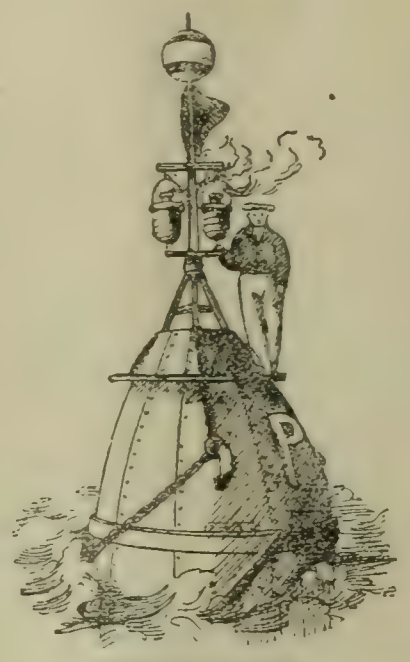
Fancy a telegraph cable lying on the surface of the earth, stretching from New York to San Francisco, then picture to mind its course through the valleys and over the Alleghanies and Rocky Mountains, leaping across bottomless chasms and hanging on mountain crags; then imagine this scene covered with water reaching above the highest mountain peaks, and we have a picture of the home of the Atlantic Cables. One would naturally suppose that at such stupendous depths there would be nothing to disturb the cables, but such is not the case. Eruptions and earthquakes have often broken them. They are also subject to the attacks of the submarine *teredo*, many species of which have never been seen by mortal eyes. There is another danger to submarine cables which cannot be avoided. These slender lines, in many places along their course, hang over deep precipices or jagged rocks. In time the cable breaks at these points, and communication of course is interrupted. When this happens, the first thing done is to locate the fault. This is done by measuring the resistance of the conductors of the cable from the testing-station to the break. The accuracy of this test is usually checked and verified by a similar test applied to the portion of the cable on the other side of the break. Having located the break in longitude and latitude the repair-ship is despatched to the locality with the proper apparatus to grapple with the broken cable. The captain of a repairing steamer usually begins his grappling operations within a mile of the break. The grapnel-iron is about two feet long. At the lower end are



THE GRAPNEL IRON.

the blunt hooks which catch the cables as the device is drawn along the bottom of the sea. The rope attached to the hook is about an inch and a quarter in diameter, and is made of the strongest hemp, having two conducting wires through its centre, which are connected to an electric bell on board ship. The moment the cable is hooked the pressure brings the two conducting wires together, thus closing the circuit and causing the bell to ring. This valuable apparatus is the joint invention of Capt. S. Trott, of the Anglo-American Cable Co., and Mr. H. Kingsford, electrician of the Central and South American Cable Co.

A dynamometer on board indicates the actual strain on the grapnel hook. Should the grapnel become fastened to a rock, the strain rises suddenly and is indicated by the dynamometer; whereas, when the cable is caught the strain rises gradually, as the cable is brought to the surface. As soon as the cable is on board it is cut and tested. One end buoyed, and the other picked up to the point of the damage. The ship then grapples for the other side and when this is recovered she pays out new cable to the point at which she first cut in. The splice is then made which occupies about two hours. When completed it is thrown overboard and the cable is in perfect order again. A cable may break through being originally laid too taut. Another reason that is given for these mysterious breaks is, that the iron wire sheathing gradually decays and finally gives way—when this takes place—the sheathing being made up in a twist—the core of the cable is twisted in the opposite direction and is immediately severed. Hence cables made entirely without wire sheathing are strongly advocated by many, able Captain Trott and electrician F. A. Hamilton, for instance, have written a very valuable paper on this subject.



OCEAN CABLE BUOY.

Outside of this, cables are frequently damaged by the anchors of vessels in comparatively shallow water, fishing vessels chiefly, which anchor for the purpose of carrying on their fishing. Accidents of this kind occur, of course, near the shore or on the banks of Newfoundland. The anchor becomes entangled with the cable, and, rather than spend the time necessary to get it free, the cable is



A FAULT IN A CABLE.

dragged up and cut and the vessel proceeds on its way. Simply to avoid a little trouble the captain of a fishing vessel will put a cable company in for thousands of dollars of expense. The situation is recognized by the cable companies, and they have a standing offer to indemnify any vessel for the loss of an anchor, and they pay out money every year on this score. The principal governments of the world, including the United States, have lately made it a punishable offence to wilfully cut a cable.

Another source of trouble to the cables are the icebergs. These icebergs floating down from the arctic seas frequenily extend beneath the surface of the ocean for hundreds of fathoms, and the base of the passing iceberg catching the cable bears it onward and finally snaps it in two. The bottom of the ocean varies in depth in a very marvelous way, right in the paths these icebergs usually take. Off the banks of Newfoundland the bottom is reached sometimes at so inconsiderable a depth as seventy-five to one hundred fathoms. What this distance is may be estimated when it is stated that, roughly speaking, there are one thousand fathoms to the mile. But from the point where the depth is one hundred fathoms the ocean bottom goes down the side of a mountain to twenty-five hundred fathoms, or two miles and a half, within a very short distance. Perhaps the bottom rises up again and t cable hangs between the two submerged mou tain tops, and the iceberg coming along quie picks up the loop thus formed and carries onward until the strain results in an absol rupture.

It may be mentioned that in grappling for cable with the grappling iron, a sketch of whi is here given, the steamer proceeds in a cour exactly at right angles to the cable, so that t cable is usually caught within a comparative short time.

Of course the cost of repairing a cable is ve considerable. When it is considered that full equipped ocean steamer, with an exp navigator and expert electricians on board, devoted exclusively to the business of repairi the cable for a length of time extending an where from two weeks to a month, some id of the cost may be arrived at.

As three weeks is perhaps an average tim required for the proper repair of an ordina cable break, it will be seen that the mere re of the steamer amounts to about $25,000. T this is to be added, of course, the actual cost the repairs and the twenty-five or fifty miles new cable. And cable, if it were sold by t yard, would be sold almost at the price of fi lace. The two cables which the Western Unic recently laid from Nova Scotia down into Ne York bay, a distance of 840 miles, cost, wi



CAPTAIN SAMUEL TROTT.

the laying, about $1,000,000. Some cab breaks have probably cost $100,000, but it wi be seen that the cost is entirely dependent o conditions which cannot be foreseen and cann be controlled. A foggy day with the Farad in commission means an absolute expenditu of $1,200, and a week of foggy days will brin this up nearly to $10,000, both from the fa that observations can not be taken in ba weather, and from the fact also that successf grappling can not be conducted when the su face of the ocean is disturbed unduly by storms clear, bright weather is almost absolutely esse tial to the prosecution of repairs.

The splicing of a cable has been reduced to science and requires extraordinary skill, e perience and care. Experienced cable splicere are employed on cable repairing ships. To b a successful submarine splicer a man must po sess very soft hands, similar to those of a w man. Men, therefore, having such hands a only selected.

Cables are often picked up from a depth two or three miles, but it requires great skill an nerve to do this expeditiously. Probably th most experienced cable repairer is Capt. San uel Trott, of whom the above is an excelle likeness.

Captain Trott, whose biographical sketch has already appeared in these columns, began his career in the cable service by taking charge of the steamer Faraday from the hands of the builders, in 1874, and continued as her commander until 1880. During this time he laid the French and Direct cables and made some remarkable repairs, which showed him to be a man of rare ability. He astonished the world, when in mid-winter of 1876, he sailed from London to Nova Scotia, repaired the Direct Cable in a gale of wind and a blinding snow-storm, and was back in the Thames again inside of thirty-five days. As he steamed up the river on his return the marine population who had seen him go to sea were amazed and cheered him lustily. He repeated this great feat the same year in 31 days. Several unsuccessful attempts having been made to repair Atlantic cables in winter, at large expense to cable companies, it was considered absolutely impossible to pick up cables between the months of October and May. Captain Trott, however, proved such an idea was altogether erroneous. His achievements naturally attracted the attention of that able Managing Director, Henry Weaver, of the Anglo-American Company, and the command of the "Minia" being vacant, in 1880, Trott's services were secured by him.

Our space will not admit of giving the details of his work since 1880, which has never been equalled. During the past summer he sailed from England to repair the Anglo-American Company's French cable in mid-Atlantic on the same day as the steamer "Scotia," Captain Lucas, sailed to repair the Direct cable, also in mid-ocean. Much interest was felt at the time as to which ship would finish first, but Captain Lucas proved no match for Captain Trott, as the latter completed his work *three weeks* before him, and according to the published reports, the cost of these direct Co.'s repairs made by the "Scotia" footed up to $290,000, while those (similar) effected for the Anglo Company, by the "Minia" did not exceed $110,000.

If this is to be taken as the criterion of the rapidity of which the king of cable repairers does his work, his services must indeed be valuable to his employers.

It has been said of him that he knows the bottom of the Atlantic and the position of every cable as well as a cabman knows the streets of a city, and that on one occasion being aware that a steamer, in laying one of the Atlantic cables, had been compelled during a storm to abandon a length of cable worth many thousand dollars, and happening to be in the locality one day several years afterwards, it occurred to Captain Trott that it would be but little trouble to recover it. He, therefore, stopped his ship, picked up the cable, and resumed his journey within an hour.

On arriving in port he presented the cable to the company to which it belonged, declining to accept any remuneration for his work.

Captain Trott is a joint inventor with Mr. F. A. Hamilton, the chief electrician of the "Minia," of a new type of deep sea cable, which many eminent men of the profession believe is the cable of the future. Some forty miles of it has already been manufactured by the Bishop Gutta Percha Company, of this city, to connect several islands of Honolulu.

Captain Trott is a man of positive views and a strict disciplinarian, but he is just, kind-hearted, thoroughly honorable, and is much esteemed by all who have the privilege of his acquaintance.

Lighting Contretemps.—A few days ago that part of the grand boulevard which is between the Place de l'Opera and the Place de la Madeleine, Paris, was plunged into partial obscurity by the extinction of the Popp regulators.

A Suggestion.—It would be a good idea for the electricians, now that they have the storage battery down so fine, to invent a re-storage battery for the benefit of linemen.—*Exchange.*

EIGHTY-NINE MILES IN EIGHTY-FIVE MINUTES.

A NOTABLE RUN ON THE READING RAILROAD.

The most remarkable feat in the history of American railroading was accomplished a few days ago on the New York Division of the Philadelphia and Reading Railroad, when a special passenger train covered the distance of ninety miles between Philadelphia and New York in the almost incredibly short time of eighty five minutes. The engine which made the record-smashing run is designated as "No. 366." It is of the peculiar type originated by the Reading Railroad, and was built for the regular fast passenger service of that road. The engineer was Frank Wagner, who, when he climbed into the cab, little fancied that he would leave it the hero of the fastest run ever made between two big cities. No special preparation was made for a fast run, both engine and crew being selected hastily and almost at random to meet a sudden call for a "special." The first revolution of the drivers was made at 11.38 A. M., and the real running began at Wayne Junction, on the outskirts of Philadelphia, which station was passed at 11.44½. From this point the road is peculiarly adapted to the attainment of high speed, being straight, free from heavy grades, and in excellent condition of maintenance. The fifty-four and nine-tenths miles between Wayne Junction and Bound Brook was covered in 49½ minutes, an average speed of 66½ miles per hour. The highest rate of speed reached was eighty-seven miles per hour, and stretches seven miles long were run at the rate of eighty-one, eighty-two, and eighty-four miles respectively. A little calculation will show the terrific velocity implied by these figures, and to stand the strain involved requires the very perfection of machinery and roadbed. The best previous record made by any train between New York and Philadelphia was that of a special, also on the Reading, which conveyed the late President Gowen on his return from Europe several years ago. The time then made was ninety minutes for the eighty-nine and four-tenths miles, and it has never been equalled until now, when Engineer Wagner and "No. 366" have beaten it by five minutes.

Bell Telephone Annual Meeting. — The annual meeting of stockholders of the American Bell Telephone Company was held in Boston March 25. The report shows the following: Earnings, $4,044,704, against $3,865,118 in 1888; expenses, $1,385,966, against $1,450,913 in 1888; net earnings, $2,658,738, an increase of $244,533; dividends, $1,230,500, an increase of $16,644; surplus, $2,151,011, an increase of $22,976; instruments under rental, 444,861, an increase of 33,350; total exchanges, 757, an increase of 15; wire mileage, 193,213, an increase of 22,742; subscribers, 185,003, an increase of 13,549; employees, 6,758, an increase of 448; underground wire mileage, 27,676, an increase of 10,311.

Pumping Water by Electricity.—An English electrician has been directing his attention to the purification of sea water and other fluids by electricity. He has made careful application of this principle also to wines and brandies. He finds that it has the effect of softening the asperities of some wines by removing the predominant bitartrate of potash.

Electric Lights in a Palace.—St. James's Palace, London, is to be fitted up with electric lights. At the last levee in another royal palace a few days ago the fog made it so dark that it was almost impossible to see, and the only illumination possible was a few candles stuck here and there and two or three lamps.

The Telephone in Germany.—The traffic on the telephone line between Berlin and Breslau is so great that the postal authorities are considering the advisability of erecting an additional wire between these two cities.

AN OLD SYSTEM REPLACED AT ALLEGHENY, PA.

The managers of the Federal Street and Pleasant Valley Street Railway, of Pittsburg, Pa., which has been operating twenty-five motor cars on the Sprague electric system for some time, are so well pleased with the operation of the same that they have ordered an additional lot of fourteen motor cars. Each of these cars will be equipped with the Sprague improved railway motors.

This road now extends into the city of Allegheny, over the line of the early electric railway on University Hill, which used the Bentley-Knight system with underground conduits, and which was one of the first installed upon that system.

The regular method of overhead contact is now used on this section of the road as well as upon the rest of the line, and the conduit has been abandoned. The grades surmounted by the electric cars upon this road are quite severe, being in one place about 12½ per cent., the length of the grade being over a mile. With the old electrical equipment, this grade was considered too steep to be ascended in the ordinary manner, and at the steepest part a rack was used between the tracks in which a pinion connected with the motors engaged in order to secure the necessary traction. With the new equipment this arrangement is found to be unnecessary, and the Sprague cars have no difficulty in ascending the grade with the aid of no other traction than that which the wheels secure from the rails themselves.

There are now over thirty cars in regular operation upon this line.

The Edison Continentale Company.—The Paris correspondent of the London *Electrician* says: The Compagnie Continentale Edison is about to increase the capacity of its station in the Faubourg Montmartre by the addition of a large battery of accumulators, each to weigh about 800 kilogrammes, and able to discharge at the rate of 1,000 ampères. These accumulators, although of a special type, will be constructed on the lines of those made by the Société pour le Travail Electrique des Métaux, which possesses a large factory at St. Ouen. The Compagnie Continentale Edison has also purchased a site in the Avenue Vendaine, in the Quartier Rouchouart, where they intend erecting a 3,000 horse-power station, which will be connected to the one mentioned above.

The Telephone in Russia.—Experiments have been recently made for the purpose of establishing telephonic communication between St. Petersburg and Moscow. The Goosdeff system was employed on the ordinary iron wire telegraph circuit, and it is reported that the experiments were in every way extremely satisfactory. The distance in a straight line between Moscow and St. Petersburg considerably exceeds 300 miles, and the suceessful employment of iron wire on such a long circuit is somewhat of a new departure.

Business Notice.—Mr. James H. Mason has opened an office and exhibition room at 63 Broadway, this city, where the value and utility of his primary battery may be seen to the best advantage. Electric lights, fans and motors for light mechanical work are in operation, and he invites every one interested to visit his place and see for themselves what merit there is in his primary battery.

Portable Lighting Stations.—Some Continental railway companies have adopted a system of movable electric lighting plants on their lines. The object is to have a light at hand for application at any given point for important purposes, such as the lighting of the scene of an accident, the disembarking of troops, etc. Two kinds of plants have been suggested, one being a locomotive surmounted by a dynamo.

SOME POINTS IN DYNAMO AND MOTOR DESIGN.*

(Continued from page 6, issue of March 29th.)

4.—RATIO OF ARMATURE SECTION TO FIELD-MAGNET SECTION.

In the early days of dynamo-designing the cross-section of the armature core in cylinder machines was very small in proportion to that of the field magnets, the copper in the armature was excessive and the air gap correspondingly great. The result was an induction no greater than in modern machines, but an enormous stray field. In the machines made by my firm six years ago, the section of the armature core was about one-third of the section of the magnets, the latter being of wrought iron. I may say these machines anticipated Mr. Swinburne's latest notions, inasmuch as the 14in. armatures of those days were loaded to 25,000 ampere-turns. The first great improvement consisted in doubling the iron and halving the copper, a machine so modified giving about the same output, but with less heating and less sparking, and requiring less magnetizing force. We got the same output for two reasons: first, the decreased magnetic resistance resulted in an increased total induction: secondly, of this induction a far higher proportion was utilized. The ratio of the armature section to the magnet section, when modified as above, stood at .66; but we went much beyond this in increasing the iron in the armature, finding that we obtained for every increase, keeping the air gap the same, an increase

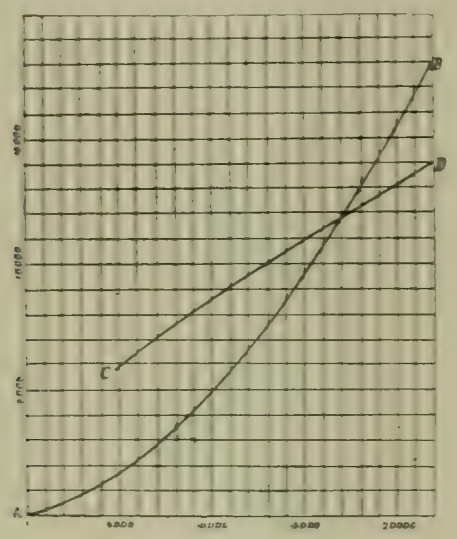


FIG. 14.

in the induction. The latter was not, of course, in proportion, but it was still very considerable, as will be realized from the fact that in an armature having a ratio of .75 the induction was 10 per cent. greater than in one having .6. When Mr. Kapp read his paper here on "Characteristics," I mentioned that then the ratio in our dynamos stood at .75. Since then we have, in machines for incandescent lighting, returned to .6, for a reason which will be by-and-by apparent. It may be mentioned here that when the magnets are of cast iron the ratio is .33, while the cast iron yokes for wrought iron magnets are from two to two and a-half times the area of the wrought iron.

I bring this forward because it is of some importance when the aim is to construct dynamos having a large output for their weight. The weight of the armature is only a fraction of the total weight of the machine. The field magnets are many times heavier, but, beside these, the bed-plate, bearings, etc., make up a large portion of the weight: and since the weight of neither magnets nor bed-plate is increased by an increased armature section, manifestly, if a large output for the weight is the object, and if nothing occurred to interfere with the process, the cross-section ought to be increased to such dimensions that for any further increase to the total weight of the machine we get no corresponding advantage.

Some interesting experiments to determine this point, which completely corroborate my own, were made by Mr. Dugald Jackson, of Cornell University, and communicated by him in 1887 to the American Institute of Electrical Engineers. These experiments can be consulted by those interested; for the present my remarks are based on the results obtained. Assume that the iron core of a cylinder armature having a ratio of .6 is one-tenth of the total weight of the machine: then, by increasing the ratio to .75—that is, roughly, increasing the weight by 25 per cent.—we make an increase in the total weight of 2.5 per cent. But the increase in the induction will be about 10 per cent., so that clearly an advantage has been gained by increasing the section. If we increase the mass of the armature core by 50 per cent., it makes 5 per cent. increase in the total weight, but we get 15 per cent. increase in the induction. If we go farther we shall still get an increase, but it gets

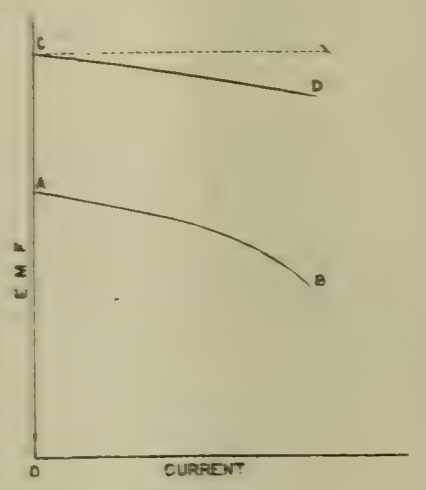


FIG. 15.

correspondingly less with each addition to the weight. The actual increase may not be in all cases in the proportion I have given. Necessarily it depends upon the design of the machine, but in the particular dynamo to which my remarks refer the results were as stated: and what I wish to point out is that in light weight dynamos the armature must have a comparatively large section, and be worked at a lower saturation. Though the output for the armature weight is less, the output for the total weight is greater.

There is a limit to increasing the cross section of the armature, which is reached when self-induction troubles us by creating a tendency to sparking, and cross induction troubles us from the diminished

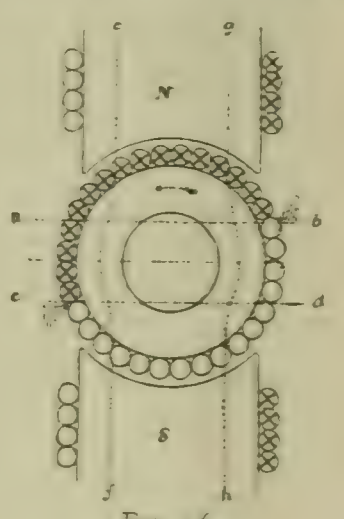


FIG. 16.

saturation of the core. Accordingly the practical limit in this direction is fixed for us at about .75, and the induction at 14,500 or 15,000 C.-G.-S. per square centimetre. It must not be forgotten that increasing the section of the core increases the length of the wire on it by a small percentage.

Pressing the induction up to high values is not advisable, as the magnetism then costs too much. It will be seen from the curve (Fig. 1) that the magnetizing force to produce an induction of 18,000 per square centimetre is about twice, while the magnetizing force for 20,000 is more than six times, that required for 17,000. As the core saturation is increased the stray field is increased, while the heating due to hysteresis is also greater. Everything considered, 17,000 per square centimetre is probably the best degree of saturation to employ for cylinder armatures, and makers who once employed a greater induction are, I believe, coming down to this. If we work lower we get on the bend of the curve, or on that part where the angle changes rapidly; so that it is not possible to obtain in compound machines with a lower induction such perfect regulation. It may be mentioned in passing that, since the loss of potential in the armature and series winding is generally in slow-speed machines a higher proportion of the E.M.F., in these the difference in the induction on open circuit and at full load is proportionally greater, and the compounding, in consequence, less perfect.

There is no particular advantage in reducing the induction, save that of obtaining a higher weight efficiency. The reduction of the loss due to hysteresis is very small and less than might at first sight be imagined. In Fig. 14 is given a curve, A B, showing the energy in ergs required to carry a cubic centimetre of iron through a complete cycle of magnetization at different degrees of saturation. Induction per square centimetre is measured by abscissæ, and the energy by ordinates. It will be observed that for 17,000 the energy is greater by about 24 per cent. than for 15,000: but for an armature of given output the cross-section of the core has to be increased in proportion as the induction is diminished, and the total work ex-

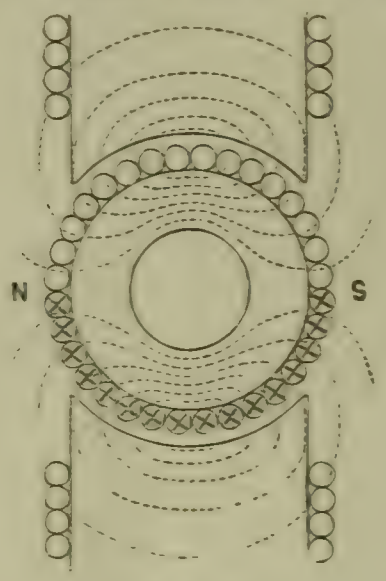


FIG. 17.

pended in carrying the armature through a cycle of magnetization is, roughly, proportional to the ordinates of the curve, C, D. To draw this curve an induction of 17,000 is taken as the normal, and all the ordinates of A, B, multiplied by the ratio of 17,000 to the induction. It will be observed that for any specified output there is only about 8 per cent. more power wasted in hysteresis at an induction of 17,000 than at 15,000.

In four-pole machines it is usual to saturate the armature to a lower degree—about 14,000—and in alternators the induction is still less—about 6,000. As the curve, A, B, gives energy in ergs, the watts expended in the armature are found by multiplying this by the number of cycles per second and by the number of cubic centimetres in the armature, and dividing the product by 10^7. In drum machines the induction per square centimetre is rather over half of the value given for cylinders, and the ratio of armature to field section varies from .8 to 1.0. The diameter of the armature being fixed with reference to the number and size of conductors, there is nothing to be gained by cutting away the interior of the washers. On the contrary, by cutting an opening only large enough for the shaft, the induction is kept low, and the magnetizing force for the armature correspondingly small, while the heat generated due to hysteresis is also diminished.

*Paper read by W. B. Esson before the English Institution of Electrical Engineers.

5.—INTERFERENCE OF THE ARMATURE FIELD.

Though iron may vary in quality, and so upset occasionally our calculations, no great difficulty need be experienced in approximating pretty closely the magnetizing force required for a given induction in the armature core. But when we allow a current to flow in the coils, and so magnetize the core, we superpose on the original a second field and the interference between them renders the case no longer simple. If we excite the field magnets of a dynamo with a constant current, and allow currents of various magnitudes to flow through the armature, we find on maintaining the speed uniform that the E.M.F. falls as the current is increased. In 1884 some investigations of mine were published which dealt with this question, and established the result that when the ampère turns on the armature were few, and the field strong, the fall of E.M.F. with a fixed lead was about proportional to the current. As the field was weakened the line representing the E.M.F. began to bend, until, when it was very weak, a kind of inverse characteristic was obtained, as shown in fig. 15. In fact, the results are similar to those which would be obtained by reducing the winding on the magnets; the effect due to this being small when the magnets are fairly saturated, and large when they are far from saturation.

Consider the magnetic system shown in fig. 16. N and S are the north and south poles of a field magnet, the magnetizing currents flowing into and out of the paper as shown by the open and crossed circles respectively. There is no current flowing in the armature coils, and the lines of force flow from pole to pole through the core as indicated by the dotted lines. Imagine that the current flowing round the magnet is stopped, and that a couple of brushes placed on the collector at S, N, fig. 17, cause a current to flow through the armature winding alone. We have the lines along paths indicated by the dotted lines, and obviously through this circuit, at right angles to the other, the cross

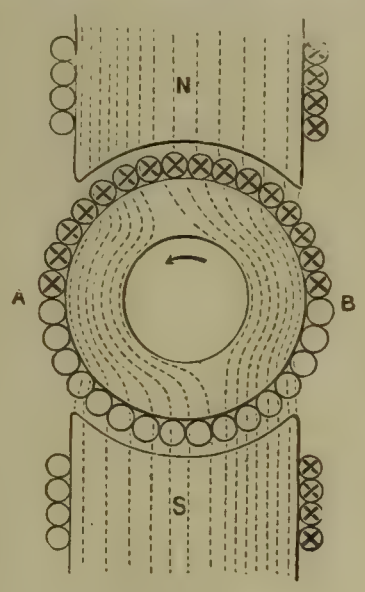


FIG. 18.

induction depends, for a given number of ampère turns, mainly upon the length and cross section of the air gap. If we place the brushes at right angles to this position, we have no cross induction, but, instead an induction taking the same path as the forward induction, though in an opposite direction. If the current is allowed to flow through field and armature coils at the same time, as it does in actual machines, we have the distribution of field as sketched in fig. 18, the lines of force due to the magnets being pushed towards the left-hand top corner and right-hand bottom corner of the poles. Where the armature or cross induction opposes the magnet, or forward induction, the field in the air gap is weakened; where the cross induction helps the forward induction the field is strengthened. In consequence of this distortion, with reference to the brushes, the sections under them have become active, and, to avoid sparking, a lead must be given, which will remove the commutated sections beyond the sphere of activity. This lead diminishes the forward induction, at the same time diminishing the distortion with reference to the new position of the brushes.

6.—THE EFFECT OF DISTORTION ON THE E. M. F.

The distortion of the field produces in a dynamo run without lead a diminution in the E. M. F., for two reasons—first, because the induction acts differentially on the conductors lying between the brushes; secondly, because the currents flowing in sections active when short-circuited under the brushes weaken the field. These local currents induce lines in the opposite direction to the forward induction.

Let the machine run as a motor in the opposite direction, the currents flowing through the field magnets and armature being, of course, in the same direction The E. M. F. is induced in the armature in the opposite direction, and since in an active coil short-circuited under the brushes the current will flow in the direction of the induced E. M. F., its effect will be to directly strengthen the field as it increases the forward induction. We may say, then, that the effect of distortion is to diminish the E. M. F. in a dynamo run without lead, and increase it in a motor, owing to the local currents generated in the short-circuited coils.

The difference in the E. M. F. of a machine run without lead as dynamo and motor may be considerable, as shown by Prof. Ayrton's exp riments at the beginning of last year. These experiments were made on a drum machine which had a comparatively weak field. I am not quite certain as to whether the cause here given is sufficient to account for the difference, but I believe that were the brushes adjusted in each case until the local currents were annihilated, the same E.M.F. would be, with properly laminated armatures, generated by both dynamo and motor. That there is a certain amount of power wasted in these currents is quite obvious, though from their tendency to lessen the distortion in the motor, their magnitude, and the consequent waste, is in the motor less.

7.—POSITION OF THE BRUSHES IN DYNAMOS AND MOTORS.

If dynamos are to run sparklessly there must be a lead given to the brushes, or, in other words, the point of collection must be advanced in the direction of motion until the field passing through the commutated sections is just of sufficient strength to stop the current, reverse it, and bring it to its normal strength in the opposite direction before the section leaves the brush. When a section is short-circuited under the brush, any lines of force which were induced, due to the current flowing in it, are annihilated, the current tending by self induction to continue in the same direction round the short circuit. As the section leaves the brush a current has to be started in it in the opposite direction, and the self-induced E.M.F. opposes this also, thus tending to prevent both the stopping and the starting of the current.

The E.M.F. of self-induction depends, obviously, upon the variation in the number of lines through the section which the cessation of the current is capable of producing, on the speed of the armature, and on the number of turns per section. When an armature core is saturated to 17,000 per square centimetre it will be realized that the variation in the lines through the section which the short-circuiting is capable of producing is very small; in fact, we may say that it is practically negligible. But with the smallest amount of self-induction present it takes a certain time to effect these changes in the section, and the brush must be of such thickness that the changes are effected before the short circuit is removed. The brush must be placed in advance of the neutral point: in an armature, for instance, having fifty sections, presuming that five volts are wasted in the armature, a section when it leaves the brush must move in a field having such strength as will neutralize the effect of self-induction, and give one-fifth of a volt over. If the armature has 100 sections, the field must give a resultant of one-tenth of a volt; but the E.M.F. due to self-induction will be, in the latter case, only one-fourth of what it was in the former. By saturating the core, and making the sections sufficiently numerous, we can make the self-induction as small as we please; and in machines in which the current varies from 0 to a maximum, we purposely make it as small as possible. The reason is, that as the current increases, the variation in the E.M.F. of self-induction does not correspond with the variation in the shape of the field for different positions of the brushes, perfect adjustment for all currents being therefore difficult. By making the self-induction very small we get a close approximation to perfect adjustment; we can place the brushes very little in advance of the zero position, reducing in this way the adjustment for variation in the current to a minimum.

We see, then, that in a dynamo the brushes must be set in advance of the neutral point, and that self-induction increases the lead. Is the trail in a motor similarly increased? The answer is that it is. The brushes must be set in a motor behind the neutral position, so that the induced E.M.F. is in the same direction as the current to be started in the section, and so that the E.M.F. of self-induction which opposes the starting is neutralized. It appears that the best position for the brushes in a motor is the position in which they have about the same trail as they have lead when the machine works as a dynamo, and that in a motor the trail is *increased* by self-induction.

(*To be continued.*)

THE WESTON ELECTRIC LIGHT SALE.—The transfer of the plant of the Weston Electric Light Company, for the nominal consideration of $1 and the making of a mortgage to Marcellus Hartley for $750,000, has occasioned considerable talk in Newark business circles. Edward Weston started the Company bearing his name in 1874. In 1881 it was bought by the United States Electric Light Company, of New York, but Mr. Weston retained the management of the Newark business, which turned over an annual profit of $400,000. It is said that in 1885 profits were about doubled, but the earnings were all dissipated by bad management in the New York office. The Company, it is said, was only kept afloat by the contributions of Marcellus Hartley, Anson Phelps Stokes and H. B. Hyde. Matters became so bad that Mr. Weston withdrew from the directorate nearly four years ago. Mr. Hartley had the mortgage made to secure himself.

TESTING CAR MOTORS.—One of the most interesting sights at an electric factory where railway motors are made is the testing of a new car truck after the motors are attached and the frame is ready to receive the box. The truck is placed on suitable rails and chained down, in order to prevent running away, which it surely would do under the powerful electric current. Experimental wires are attached to the two motors on the axles of the trucks, and the wheels well smeared with grease in order to prevent friction. When the current is turned on the wheels begin to move, and as the current increases they revolve with lightning-like rapidity, consuming the lubricating matter on the wheel faces almost as fast as it can be poured on. After this thorough test of the motors the truck is run off to receive the car box.

NEW BRAZILIAN CABLE.—It is rumored that the Brazilian Government has decided to grant the concession for a direct submarine cable between Brazil and the United States to the amalgamated companies the Société Générale des Téléphones and the Société Française des Télégraphes Sousmarins.

INTERNATIONAL TELEGRAPHIC CONFERENCE.—The International Telegraphic Congress will be held in Paris this year. This Congress, which embraces all the means for the transmission of speech and thought by electricity, meets every five years. It met in Germany five years ago.

THE ZIPERNOWSKY-DERI-BLATHY SYNCHRONOUS MOTOR.

A synchronous motor is set in motion by an alternating current sent through the armature, and when working under normal conditions the number of revolutions is equal to the number of alternations. An alternator, the magnets of which are excited by a direct current, can be used without difficulty as a synchronous motor; but the alternator must be brought to synchronism before it will work. The magnets of a synchronous alternating motor can be excited by an alternating current; for this purpose a revolving commutator is necessary to give the requisite direction to the current impulses in the magnets. In its simplest form such a commutator consists of as many segments as the

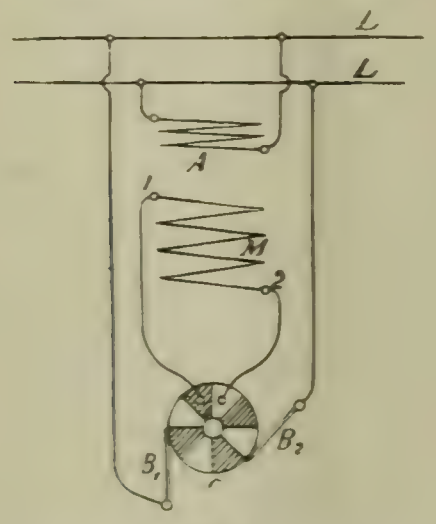


FIG. 1.

L L—Leads. A—Fixed Armature. M—Magnet Coils. B1 B2—Brushes.

motor armature contains coils, the even segments being connected to one another and to one end of the magnet coils, whilst the odd segments are also connected to each other and to the opposite end of the magnet coils. If the brushes are given the proper position it is evident that (supposing the motion to be synchronous) each time the current changes its direction the connections to the magnets will be reversed, so that the magnets are excited by a uni-directional intermittent current. A diagram of the essential parts of such a motor is shown in Fig. 1.

In a motor with fixed magnets and rotating armature two additional pairs of sliding contacts are required to supply the armature with current and to take the current off the commutator to the magnets. Motors arranged as above can also be started by an alternating cur-

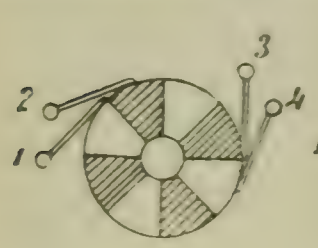


FIG 2.

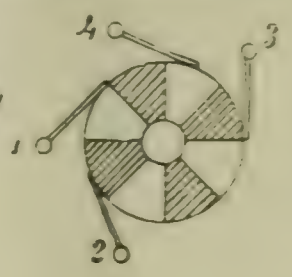


FIG. 3.

rent, but the iron of the field-magnets must be protected against Foucault currents. When in such a motor a favorable position is given to the armature and the magnets (or a slight motion imparted), an alternating current will start it, and the speed will increase until it is running synchronously; but practically such a machine is useless on account of sparking, both during the first motion and at full speed.

It is this difficulty which Zipernowsky, Deri, and Blathy claim to have overcome. The sparks are caused by the extra currents induced at each alternation. The current is only strong enough during part of the period to keep the magnets sufficiently magnetized, and when the strength falls off an extra current is induced in the magnet coils. At this moment a path of low resistance is provided and then immediately broken again. Sparks are the result. The intensity of the fields also undergoing great fluctuations, the speed of the motor is very uncertain, and it easily falls out of synchronism. All this is overcome by short-circuiting the magnet coils a short time before the reversal of the current, the brushes being so arranged that at the moment of segment-change the extra current acts in opposition to the main current, getting rid of the sparks. The momentary short-circuiting is effected by employing four brushes, which are connected as shown in Fig. 2; 1 and 2 being connected with one lead, and 3 and 4 with the other, the magnet coils being short-circuited during the time that the brush 2 is on the shaded segment. The distance between the contact points of the brushes 1 and 2 is ¼ to ½ of the width of a commutator sector. It is, of course, not necessary that the brushes at one end of the conductor should be on the same segment, as they may be on different segments of the same class, as shown in Fig. 3, the effect being the same; or, instead of two separate brushes, one with a broader bearing surface may be used. Numerous tests show that with this arrangement of short-circuiting the brushes sparking at the commutator is obviated, and the motor runs sychronously.

The above arrangement is perfectly satisfactory when the motor has attained the synchronous speed; but starting is difficult, and the torsional moment being small, the normal speed is not quickly reached. At starting, a slight displacement of the brushes is necessary. An arrangement has, therefore, been adopted by

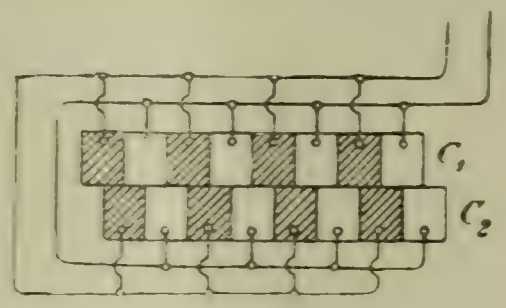


FIG. 4.

which one brush of each pair, 1 and 3 or 2 and 4, may be cut-out at starting, or both of each pair 1 and 2 and 3 and 4 are brought to the same respective segments, so that no short circuit occurs. As soon as synchronism has been reached, the arrangement permits the other two brushes to be brought to the positions shown.

The short-circuiting of the magnet coils may also be effected by the use of two commutators side by side, the segments of which overlap each other (as shown in Fig. 4), to the extent required to bring about the requisite short circuiting. The necessary removal of the short-circuiting at the start can be brought about either by taking away the short-circuit brushes or by the automatic arrangement shown in Fig. 5.

To prevent too great an increase in circuit during the short-circuiting, a resistance is provided in the circuit. The same object is gained by using an induction coil, the windings of which are connected to the armature and the magnet coils respectively. The induction prevents a too great increase in current (Fig. 6).

This motor has been put up in various places, among which may be mentioned—Wiener Neustadt, three motors of 10 horse-power, and Innsbruck, one motor of 50 horse-power, one motor of 10 horse-power, and one motor of 5 horse-power.

The London *Electrician* gives the following abstract of the report of the Committee recently appointed by the Town Council of Frankfort-on-Main to inquire into the alternating and direct systems of distribution which will be of interest in this connection.

On the question of the output and efficiency of the Ganz alternate-current motor, the Committee report that experiments were made with the 25 horse-power and 5 horse-power types. The former gave efficiencies of 82 per cent. to 88 per cent. for outputs of 15 to 35 horse power; the 5 horse-power showed efficiencies of 62 per cent. to 80 per cent. for outputs of 3 to 8 horse-power, the figure for normal load being on an average 78 per cent. The efficiency, therefore,

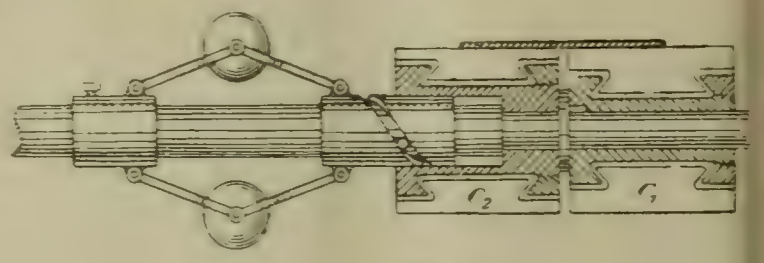


FIG. 5.

does not differ to any important extent from that of direct-current motors.

With respect to starting it was found that the 25 horse-power motor could not start itself, and the smaller sizes, 5 horse-power and 1-5 horse-power, were unable to do so in certain positions. A test as to starting the motor with full load on was not made, as Messrs. Ganz & Co. objected to it. The time necessary for the attainment of normal speed was from 30 to 45 seconds. The start was always accompanied by heavy sparking at the brushes, diminishing as the normal speed was reached. In the 25 horse-power machine these sparks were 5cm. long, and 3cm. on the 5 horse-power machine. At normal speed the sparking was not worse than with direct-current motors.

With regard to noise, the Committee pointed out that from the nature of the action, as well as from the sparking, when not running synchronously more noise was to be expected from the alternating-current machine. In factories and on tram-cars this noise was unimportant; but it would exclude the larger sizes of the motor from dwelling houses, unless exceptionally good foundations were secured. With the small motors the noise would not ex-

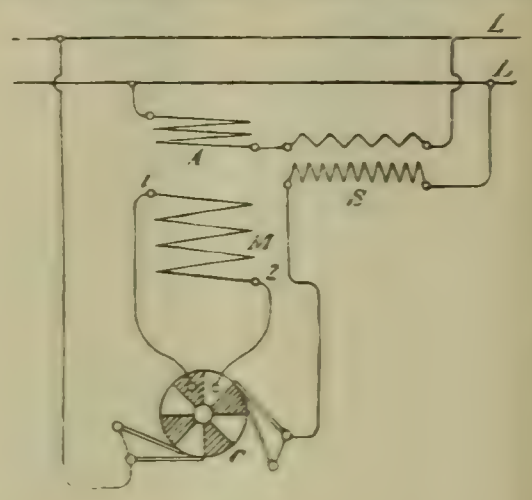


FIG. 6.

ceed that of the machines used to drive sewing machines with. The motors being synchronous, regulation of speed could only be arrived at by means of multiple-speeded pulleys.

A series of tests was made to ascertain the effect of sudden application of load and of overloading, and it was found that the 25 horse-power motor did not fall out of synchronism till it was loaded with 40 horse-power, and the 5 horse-power motor could be loaded up to 8 horse power, in each case a maximum load 60 per cent. in excess of the normal. A sudden load of 26 horse-power can be put on to the large machine when running light, though a heavier load than this suddenly applied will

use it to stop. When running at 26 horse-power a further sudden load of 8 horse-power, and after the application of this a further 6 horse-power, can be put on, the total load being then 40 horse-power. The whole of this load can be suddenly removed without affecting the behavior of the machines. The 5 horse power machine could take a sudden load of 6 horse-power, which in the same way could be suddenly increased to 8.

These tests show that the normal output must be kept well under the possible maximum, or, in other words, that a considerable margin must be allowed in settling on the size of machine to be employed. It should be mentioned that the machines tested were the second of their respective classes that had ever been made.

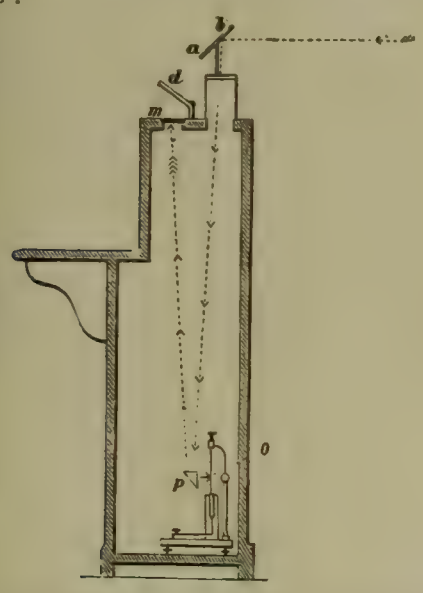
ELECTRICAL MEASUREMENTS.

At the ordinary monthly meeting of the Société Internationale des Electriciens, held February 5th, M. L. Violet described a new method for taking electrical measurements with the mirror. He said :

The transparent scale in glass, celluloid, oiled paper, has contributed largely to the spread which has taken place in recent years of the use of galvanometers and of electrometers with the mirror ; it is easy to manipulate, and may be used in daylight operations ; this was an impossibility when we had only the old method of scales and petroleum lamps combined.

Still cases do occur in which one hesitates to use the mirror, and has recourse to galvanometers with movable needle and dial. Now it is to be noted that a needle is rarely 0 m., 50 long, and that scales are, as a rule, situated at 1 m. from the mirror, so that the exactness of the reading is always 20 times less at the least.

The mirror is frequently discarded in connection with industrial matters for the following reasons :



A NEW METHOD OF ELECTRICAL MEASUREMENTS

In the first place the two parts, the galvanometer and its scale, are separate from each other ; it is possible they may put each other out ; and, moreover, the adjustment necessary at the commencement of every measurement is a delicate matter. The writer has often been told that this method of arrangement, excellent though it be for laboratories, is too complex for industrial purposes

Another reason, which might at first sight cause surprise, is this : it frequently happens that there is no sufficient space for the arrangement ; the two parts of the apparatus do not of themselves occupy much room, but the luminous ray which connects them is 1 m. in length, and in some workshops the space is so taken up that it is impossible to afford even this amount.

It occurred to the writer that, with a view to rendering the use of the mirror general, it would be interesting to construct an arrangement in which the scale should be invariably connected to the galvanometer, and in which the luminous ray might occupy less space.

The following is the plan suggested.

In the lower end of a wooden box of about 1 m. in height, 0 m. 50 in width, and 0 m. 30 in depth, place a Deprez d'Arsonval galvanometer for instance, and in front of the mirror, *o*, a prism whose total reflection is *p ;* within the opening at the upper end of the box insert the transparent divided scale *m ;* the luminous ray will pass through a hole which has been previously bored, and, if the distances have been properly set, the image on the fine wire placed in the hole will be set at *m* on the divided scale.

Observe that by means of this arrangement the difficulty with the luminous ray has been got rid of ; the ray being no longer in plane but vertical.

To complete the arrangement the author has fitted the box with a tablet for the instruments used for measuring, viz , the resistance boxes, condensers, keys, etc. This arrangement allows of the experimenter being seated ; in addition there is a mirror *d*, above the scale, which reflects the results of the measurements.

The light is thrown on the galvanometer by means of a double movement mirror, *a*, *b*, similar to that used with ordinary divided transparent scales.

There is likewise a small size incandescent lamp which may be substituted for the mirror *a*, *b ;* this gives a splendid spot.

The available space at either side of the galvanometer is occupied by the cells of a battery, both poles are connected to terminals at each side of the apparatus.

CONTINUOUS OUTPUTS OF TWO-POLE DYNAMOS AND MOTORS.

BY ALBION T. SNELL.

The following equations are intended for the use of engineers in charge of electrical plant, and demand no special electrical knowledge, the measurement being made by a foot-rule. They give approximately the safe average output of dynamos and motors *for continuous running*, and are based on observations made during the past few years with machines of nearly all the best manufacturers. They, of course, only average the results, and so will not give a sufficiently high output for machines of abnormal proportions, *i. e.*, with unusually heavy fields, or very deep armature cores. With very light machines the formulæ will give results too high.

With normal machines the outputs given by these equations will generally be about 10 per cent. lower than that given in the price lists. This margin is made to meet the contingencies incidental to continuous running.

The outputs are expressed in terms of the armature lengths and diameters and the number of revolutions per minute. The constants rare carefully determined from a large numbe of tests. (They depend on the fact that the average magnetic induction through an armature is determined by the effective area of the iron and the magnetic density per unit area. For a given field excitation the total induction will be sensibly constant through considerable variations of radical depth of armature. This is apparent when we consider that the conductivity of the armature iron bears but a small proportion to the conductivity of the magnetic circuit as a whole, and hence an increase of iron will not largely increase the total induction, but will almost always decrease the induction per unit area). The outputs of dynamos are given in watts (746 = 1 horse-power). Those of motors are given in brake-horse-power. The linear measurements of the armatures are made in inches. l = the length of the armature parallel to the shaft. In the case of cylinders the length may be taken over all, *i. e*, from one end of the winding to the other. In drums, only that part of the armature covered by the pole pieces must be measured for the value of l. The outer diameter d of the armature is measured over the windings. The revolutions per minute can be taken by a speed indicator or counter.

For two-pole dynamos :

l = length of armature in inches.
d = diameter of armature in inches.
r = number of revolutions per minute.

I. Drum armature : $l\ d^2\ r\ .015$ = output in watts.

II. Cylinder armature : $l\ d^2\ r\ .01$ = output in watts.

For two-pole motors : (Symbols have the same signification).

III. Drum armature : $l\ d^2\ r\ .000015$ = B. H.P.

IV. Cylinder armature : $l\ d^2\ r\ .00001$ = B. H. P.

With a four-pole machine, since for the same magnetic density in the armature double the field excitation required for a two-pole machine is necessary, the *constant* must be multiplied by *two*. Some four-pole machines, however, have very light fields, and then the output is given nearly correctly by the formulæ. Generally, with machines of more than two-poles the equations will only be useful for determining the safe load for a *first run*. If the heating be very little the output can then be gradually increased until a suitable load be obtained.

The following examples, chosen at random, show the method of applying the formulæ to various machines :

Edison-Hopkinson Dynamo.—Drum armature, 9¾ in. in length, 10 in. in diameter, 970 revolutions per minute.

Equation I.

$9.75 \times 10^2 \times 970 \times .015 = 14,200$ watts.

The output is given at 15,700 watts.

Paterson and Cooper dynamo.—Cylinder armature, 10 in. in length, 13.5 in. in diameter, 850 revolutions per minute.

Equation II.

$10 \times 13.5^2 \times 850 \times .01 = 15,500$ watts.

The actual output is given at 16,200 watts.

Immisch Motor.—Drum armature, 14 in. in length, 7.25 in. in diameter, 1,000 revolutions per minute.

Equation III.

$14 \times 7.25^2 \times 1000 \times .000015 = 11$ B. H.P.

This machine is actually designed to give 10 B. H. P

Immisch Motor.—Cylinder armature, 16 in. in length, 24.5 in. in diameter, 560 revolutions per minute.

Equation IV.

$16 \times 24.5^2 \times 450 \times .00001 = 43.2$ B. H. P.

The actual horse-power given continuously by this motor is between 44 and 45.

The writer has found these equations of great assistance in selecting the size of armature for a given machine, before making more complete calculations.—London *Electrician.*

An Explanation.—In the article on the Shaver Molecular Telephone, in our last issue, an error was made in regard to the distance which it is possible to work these telephones. This telephone has worked successfully on lines 2¼ miles in length, and by the exchange system connections of one mile or more in length are common. The statement in the article referred to that the practical limit of successfully working lines was half a mile, was misleading. What was meant was that subscribers within a radius of half a mile or more of the Central Exchange could be placed in communication with each other, thus making a circuit of a mile or more in total length.

Bids For Electric Lighting.—Bids for gas and electric lighting in this city for the year beginning May 1st next, will be opened at the office of the Gas Commission on April 7th.

ELECTRICAL CALCULATIONS.*

The readers of this paper often send questions as to the battery required to do different kinds of work. It is believed that a few words on the subject will be appreciated by them.

In fixing the requirements in any case of electrical supply, three factors are concerned, the maximum difference of potential in the circuit, or the electromotive force, the resistance of the circuit, and the current required. Any two of these being given, the third is deducible by Ohm's law, which may be thus expressed: The current, C, given or required is equal to the electromotive force or difference of potential, E, divided by the resistance, R. $\left(C=\frac{E}{R}\right)$ Ampères, volts and ohms are generally used as the units of current, of potential or electromotive force, and of resistance respectively.

In considering the battery to be used, we must have regard, *a*, to the minimum number of cells that will do the work, and to their arrangement, or, *b*, to the proper number of cells to work economically. As regards the latter, it may be said that, theoretically, the more cells we use, the more economical will be their working. We can apply practical considerations only in determining the economical number, because of the fact stated in the preceding sentence. We may first consider case *a*.

A battery cell is rated by its resistance and electromotive force. Dividing the last by the first, we get the current it can give through an external resistance equal to zero, or infinitely small. Multiplying such current by E. M. F. (electromotive force), we obtain the energy which it can develop through such a circuit, such energy being expressed in volt-ampères or watts. Suppose a battery giving 2 volts E. M. F. with a resistance of ¼ ohm. Its current through zero resistance is equal to $\frac{2}{\frac{1}{4}}$ or 8 ampères. The energy it can develop through zero external resistance is equal therefore to 8 ampères multiplied by 2 volts = 16 volt-ampères or watts. To ascertain the energy absorbed by any appliance, a lamp for instance, the same calculation is gone through. A 100 volt lamp of 30 ohms resistance requires a current of $\frac{100}{30}$ = 3⅓ ampères, absorbing 100 volts multiplied by 3⅓ ampères = 333⅓ watts of energy.

The general rule for determining the minimum number of cells required per lamp, etc, to be supplied may be thus stated: Divide the energy absorbed in a single lamp or other apparatus by one-quarter of the energy of a single battery cell as determined above; both energies being expressed in watts. The quotient is the smallest number of cells that will do the work. In the case cited in the preceding paragraph the lamp energy is 333⅓ watts. One-quarter of the battery cell energy is $\frac{16}{4}$ = 4 watts. Dividing 333⅓ by 4, we obtain 83⅓ cells as the number required.

This rule is derived from the following considerations. If a current is passing through a circuit, energy is expended on any portion of the circuit in proportion to its resistance. If, therefore, a battery supplies an external circuit of resistance equal to its own, one-half the energy is expended in the battery and one-half in the external circuit. But the total current or energy expended on the whole circuit is equal to one-half that which the battery could develop with an external circuit of zero resistance. Therefore, the external circuit (lamp or other appliance) receives only one-quarter of the sum of the energies of the cells when calculated as short circuited.

A less abstract way may be taken to reach the same result. A given battery does the maximum work when its internal resistance is equal to the resistance of the external circuit. By its internal resistance it acts as a rheostat. To force a given current through a lamp or other appliance and through its own cells double the voltage is required that would supply the lamp alone, because the resistance of the battery in addition to the external resistance has to be overcome. Hence, double the cells required to give the voltage of the lamp have to be placed in series, and as this doubles the resistance, the number of cells has again to be doubled in order to form a parallel circuit, thereby reproducing the original resistance. This quadruples the battery, and the rule embodies this multiplication of the cells.

This rule is of interest, as it is so general. But where a definite voltage and ampèrage are to be supplied, it does not always apply. Thus, it gives the minimum battery required per lamp where a number are to be supplied, but not necessarily the number required for a single lamp only. The following rule is simple and of general applicability:

Express the ratio of resistance to voltage in the appliance to be supplied and call it 1 : *n*. Do the same for one cell of the battery. If it is 1 : 2 *n* or 1 : 3 *n*; that is to say twice as great, or more than twice as great, as that of the outer circuit, lamps, etc., the cells of the battery must be arranged in a single series in number deduced by the following rule: The number of cells equals the ampèrage of the outer circuit (lamp or other appliances) multiplied by the resistance of the same outer circuit divided by the difference between the voltage of a single cell and the product of the ampèrage of the outer circuit by the resistance of a single cell. Using small letters for the cell constants, and large ones for the outer circuit constants, the formula is thus expressed: Number of cells $= \frac{C\,R}{e-C\,r}$ If the cell ratio is less than 1 : 2 *n*, then, by placing two or more cells in parallel, a group can be made which will satisfy exactly or exceed as little as possible this ratio. Then the formula given is to be applied to such group exactly as if it was a single cell.

Suppose a 100 volt 3⅓ ampère lamp is to be supplied. The resistance of such a lamp is found by dividing 100 by 3⅓, giving 30 ohms. Suppose it is to be supplied by a battery of cells, each of two volts electromotive force and ¼ ohm resistance. The lamp ratio of resistance to voltage is 30 : 100 or 1 : 3⅓. The battery cell ratio is ¼ : 2 or 1 : 8. This latter being more than twice as great as the lamp ratio, the cells must be placed in series by the formula: Number of cells $= \frac{C\,R}{e-C\,r}$, or $\frac{3\frac{1}{3}\times 30}{2-(3\frac{1}{3}\times\frac{1}{4})} = \frac{100}{2-0.833} = \frac{100}{1.166}$ or 85$\frac{5}{7}$ cells. To test the accuracy of the work, we may apply Ohm's law. $C = \frac{E}{R+R}$, 86 cells give E = 172 volts *R* = 21½ ohms. R we know is 30 ohms. Substituting these in the formula, we have $C = \frac{172}{30+21\frac{1}{2}}$ = 3·34 ampères. A slight excess of current is given, as we have taken $\frac{5}{7}$ of a cell too much, which is unavoidable.

Next assume the same lamp to be supplied by a battery of the following cell constants: *e* = 1 *r* = 8 *c* = ⅛. The battery cell ratio of *r* to *e* is 8 : 1 or 1 : ⅛. Fifty-four such cells placed in parallel will reduce the resistance to $\frac{1}{54}$ this amount, or the resistance of the group will be expressed by $\frac{8}{54}$ ohm, giving the ratio $\frac{8}{54}$: 1 or 1 : 6·675. Applying the formula to this group, whose electromotive force is still 1 volt, we have: Number of groups $= \frac{3\frac{1}{3}\times 30}{1-(3\frac{1}{3}\times\frac{8}{54})} = \frac{100}{0.506} = 200$ groups in series, nearly; or 54 cells in parallel and 200 cells in series, a total of 10,800 cells. Testing the correctness of our work by Ohm's, law, we have current $= \frac{200}{28.5+30}$ or 3·4 ampères, again a slight increase over that required.

We have seen how to calculate the minimum number of cells of any given battery to supply a specified current through a specified resistance. This is what we termed case *a*. The next thing to be determined is what number of cells should be used to give a fair economy in the consumption of zinc and chemicals. This we have called case *b*.

Where the resistance of the battery is equal to that of the outer circuit, 50 per cent. of the energy will be wasted in overcoming the resistance of the battery. If the battery has one-fourth the resistance of the outer circuit, only 20 per cent. of energy will be wasted. This may be taken as a fair economy, and the calculations for such a battery are the following:

Divide the resistance of the outer circuit by 4; this gives the proper resistance of the battery. Multiply the resistance of the outer circuit by the current to be maintained; and increase the product by one-fourth of itself; this gives the proper E. M. F. of the battery. The cells are then to be arranged to develop these quantities, as follows:

Enough cells are put in series to give the E. M. F. called for. This number is then multiplied by the known resistance of a single cell, and the product is divided by the proper resistance of the battery. The quotient is the number of cells to be put in parallel.

Assume as before that on the outer circuit a current of 3½ ampères has to be supplied through a resistance of 30 ohms. Assume a battery, one cell of which has an E. M. F. of 2 volts and resistance of 1 ohm. Following the rule just given, divide 30 by 4, giving 7½ ohms as the final battery resistance. Next multiply 30 by 3½, giving 100, and increase this by $\frac{100}{4}$ = 25, giving 125 volts as the final E. M. F. of our battery. To develop this voltage, $\frac{125}{2}$ cells are needed in series, giving 62½ cells, or say 63 cells. Multiplying this number by 1 ohm, the resistance of a single cell, and dividing by the final battery resistance, 7½ ohms, we have 8·4 cells in parallel $\left(\frac{63\times 1}{7\frac{1}{2}} = 8{\cdot}4\right)$. Therefore we put nine cells in parallel, as wherever a relatively small fraction of a cell is called for, it is well to put in an excess. Our total cells, therefore, are 9 × 63 = 567 cells. As combined the E. M. F. is 125 volts, the resistance is 7 ohms. Applying Ohm's law to prove our work, we have $C = \frac{E}{R+R}$ or $\frac{125}{30+7} = 3{\cdot}4$ ampères nearly, or a slight excess of current.

This seems a large number of cells, but economical results cannot be attained with a small quantity of high resistance cells. We may, to illustrate this fact, apply these calculations to two other batteries, assuming the same outer circuit constants in both cases.

Let one high resistance battery have the following cell constants; *e* = 1 volt; *r* = 3 ohms. To develop the 125 volts called for, 125 cells in series are needed. To reduce the resistance to 7½ ohms, we need 50 cells in parallel, $\left(\frac{125\times 3}{7\frac{1}{2}} = 50\right)$ giving a total of 6,250 cells.

Let the other battery have the following constants: *e* = 2 volts; *r* = ¼ ohm. To develop 125 volts, 63 cells in series are needed. To give 7½ ohms resistance we need 2 cells $\left(\frac{63\times\frac{1}{4}}{7\frac{1}{2}} = 2\right)$ in parallel, giving a total of only 126 cells.

This shows the importance of a low resistance ratio compared to voltage. Practically, a high resistance battery cannot be used for heavy work. Low resistance may even compensate for low voltage, as in the oxide of copper—caustic soda battery.

* [illegible]

Taking a battery of the constants, $e = 2$ volts, $r = 1/6$ ohm, it will be found that $1\frac{1}{4}$ cells are needed in parallel for the above conditions. As this is impossible, and as the fraction is relatively too large to neglect, the best plan in such a case is to take the next highest integral number for the cells in parallel and reduce the number of cells in series. Thus, instead of $1\frac{1}{4}$ cells, take 2 cells in parallel, and calculate the constants of such group. They are in this case $e = 2$ volts, $r = 1/12$ ohm. Applying the rule already given in this article, we have: Number of groups $= \frac{C\,R}{e - C\,r}$ or $\frac{3\frac{1}{3} \times 30}{2 - (3\frac{1}{3} \times 1/12)} = 58$ cells in series and 2 in parallel, a total of 116 cells. Applying Ohm's law to test our work, we have $C = \frac{116}{30 + 4{\cdot}8} = 3{\cdot}3$ ampères. The economy in chemicals and zinc is increased by this procedure, the waste energy being only $\frac{4{\cdot}8}{34{\cdot}8}$ or about 14 per cent.

BOOKS RECEIVED.

The ninth edition of J. A. Berly's Universal Electrical Directory is just out. This well-known work is growing larger every year, which indicates two things—1st, that the electrical industries are continually expanding, and 2d, that there is a great demand for this book. It is invaluable to everyone in any way connected with electrical industries, whether as a manufacturer, electrician, contractor, engineer, or student. In short, this work is indispensable to those having dealings with the electrical trade in any capacity or branch. As its name indicates, it is a Universal Electrical Directory. It is divided into three sections, viz: American, British and Continental, and each contains the names and addresses of all the prominent persons connected with the electrical trade in that section of the world, also electrical companies, societies, etc. There are nearly one hundred additional pages of matter in this last edition as compared with last year's and the information given is guaranteed to be reliable. This book will be found very valuable to Americans who are interested to know the addresses, etc. of those engaged in electrical pursuits in England and on the continent.

CATALOGUE RECEIVED.—We are in receipt of a copy of the latest catalogue issued by the Brown & Sharpe Manufacturing Co., Providence, R. I. It is very complete, and gives the prices of all the goods manufactured by this well-known concern. The catalogue can be had on application and will be found valuable to electrical engineers, draughtsmen, and dealers in electrical goods generally.

ELECTRICITY IN PERSIA.—The Shah of Persia is about to introduce railroads and electric plants into his dominions, and has given the contract for their building to a citizen of Bar Harbor, Me. It was American contractors who first built railroads in Russia, and the Czar is said to have advised the Shah to depend upon American skill and enterprise.

INDUCTION TELEMETER.—The induction telemeter is being used in Germany. By it the indications of a distant thermometer are obtained and transmitted by telephone. The arrangement comprises induction coils, and a telephone so connected that when silence in the telephone is obtained, the indications of the transmitting and recording instruments are identical.

THE BERMUDA CABLE.—A London contemporary states that the steamship *Westmeath* has been chartered by Messrs. Henley & Co., of North Woolwich, for the laying of the Halifax-Bermuda cable.

A LONG ELECTRIC ROAD.—An electric railway is to be constructed between Cleveland and Berea, Ohio, a distance of twelve miles.

CHICAGO NOTES.

35 COMMERCIAL BANK BLDG.,
CHICAGO, March 29, 1890.

NED FOX, of the Phœnix Glass Co., Pittsburgh, was in Chicago last week.

MR. E. BAGGOT, dealer in gas and electric fixtures, Chicago, has just returned from an eastern trip of several weeks.

THE WEST END STREET RAILWAY CO. has been organized at Rockford, Ill.; Capital, $30,000; Incorporators, J. S. Tichnor, B. A. Knight, Otto W. Haegg.

MR. H. P. LUCAS, general salesman for Holmes, Booth & Haydens, of New York, spent some days in the city lately.

THE CALIFORNIA RAILWAY CO. has been formed at Chicago, to construct and operate street railroads; Capital stock, $500,000; Incorporators, Edward Russell, Wm. Ewan, F. H. Russell.

ST. PAUL, MINN.—The burning out of a box belonging to the Northwestern Telegraph Company, on the 21st, resulted in the destruction of 300 wires, entailing a loss of about $500, and causing much inconvenience. The fire is supposed to have originated by the crossing of the telegraph wires with the trolley wire of the electric street railway.

THE SPERRY ELECTRIC CO., Chicago, report the sale of arc plants to Wytheville, Va., and Weston, W. Va., this week, also the shipment to A. L. Ide & Son, Springfield, Ill., of a specially designed steam dynamo. This machine has a capacity of 200 incandescent lights and will be installed by A. L. Ide & Son, at Kansas City, Mo.

THE EMERY ELECTRIC MINING MACHINE CO. has been organized at Chicago, for the manufacture of mining machinery and electric appliances; Capital, $50,000: Incorporators, J. L. Ludwig, Cyrus Emery, B. F. Stewart.

NOYES BROTHERS, 83-87 Fifth Ave., Chicago, report several large orders for their electric brackets. They are engaged in preparing a catalogue, illustrating the specialties they manufacture.

JEAN A. WETMORE, salesman of the Norwich Insulated Wire Co., of New York, has been at the Electric Club several times lately and finds the rooms and society so pleasant there that he was easily induced to allow his name to be introduced for membership.

J. M. GODFREY, General Manager of the New York Insulated Wire Co., manufacturers of the well-known Grimshaw wires, spent a few days in the city this week, and shook hands with many friends here at the Electric Club. Mr. Godfrey has been making a somewhat extended trip throughout the West, coming here from New Orleans.

THE CARPENTER-NEVENS ELECTRIC HEATING CO. has been formed at Minneapolis, Minn.; Capital stock, $300,000; Incorporators, F. W. Nevins, President; L. Kimball, Vice-President; Chas. E. Carpenter, Secretary; M. F. Scofield, Treasurer; Jno. H. Kelly and Robert T. Lang.

MR. C. A. CONE has just opened an office at room 8, No. 103 Adams street, Chicago, and will hereafter represent the Findlay Glass & Carbon Co. in this section, and also deal in electrical supplies generally. He reports one sale of 1200 batteries this week and several large deals pending. Mr. Cone was formerly with the Electrical Supply Co., of this city, and claims the honor of having been one of the organizers of the Chicago Electric Club. His many friends throughout the West unite in wishing him success.

MR. WILLIAM HAND, formerly superintendent of the construction work of the Leonard & Izard Co., at Pittsburg, is now in the Chicago office of that company, occupying the position formerly held by Mr. Noe. Mr. Noe has gone to take a position in the Toronto office of the Leonard & Izard Co.

THE MORRISON ELECTRIC LIGHT CO. has been formed at Morrison, Ill., to furnish light, heat and power; Capital stock, $25,000; Incorporators, E. A. Smith, O. H. Brown, G. H. Brown.

THE SPERRY ELECTRIC COMPANY, Chicago, have just installed a fifty light high tension dynamo in the station of the Merchants Arc Light & Power Co. in this city. This dynamo is of the same type as the smaller machines made by the Sperry Company and is certainly a handsome machine.

THE WESTERN ELECTRIC CO., Chicago, are adding two stories to their large factory on Clinton street. That this is necessary speaks highly for the work of this company. With their facilities thus enlarged they will be better able to care for the growing business and promptly meet all demands made upon them.

MR. A. H. LEWIS, manager of the Chicago office of the C. & C. Electric Motor Co., reports the sales of the past week to be the best ever made from this office in a similar period of time. The prominence given to electricity as a motive power by the electric street railway agitation throughout the country has given an impetus to motor work generally which makes the prospects bright for motor companies. Mr. Lewis has just returned from New York and says the C. & C. factory is working to its full capacity.

THE LEONARD & IZARD CO., Chicago, are wiring the new Wisconsin Central depot at this city, for 4,000 incandescent lights, also for an arc lighting plant. This depot is the finest occupied by any railroad company in the West.

F. M. I.

GUTTA PERCHA AND INDIA RUBBER.

Most every one thinks that India Rubber and Gutta Percha are the same, or at least very similar substances. This error is a very common one, and to many it will be a surprise to learn that the two gums are quite dissimilar, as will be seen from the following characteristics.

India Rubber or caoutchouc is from the milk-white sap of the *Sephonca Cahuca* tree of South America, which is prepared for market by coagulation and heat. It is of a soft gummy nature, not tenacious, but very elastic. It is easily decomposed by oily substances, and does not stand acids well.

Gutta percha is found only in the East Indies. Is from the *Isonandra* or Gutta tree, a brownish gum which solidifies by exposure to the air, and is scraped from the tree with a considerable bark adhering, which the gatherers prefer to sell with the gum.

The gutta percha of commerce is fibrous and tenacious, and with little flexibility and no elasticity. It is acid proof and stands oils much better than rubber. Although it softens at comparatively low temperatures, it may be melted and cooled several times without injury. It is used for many purposes besides insulation.

India rubber, as is well known, is used extensively for electrical insulation. Gutta percha, however, is preferred for submarine cable insulation on account of its great resistance to deterioration. Probably the largest user of gutta percha in this country is the Bishop Gutta Percha Company of this city, the well-known manufacturers of insulated wires.

KILLED IN VIOLATING HIS OWN RULES.—The president of an electric street railroad in Ohio was not satisfied with making a rule that passengers must not get off the front platform of his cars, because it is dangerous. He went still further and demonstrated the soundness of his rule by stepping off one of the front platforms and getting killed himself.

A GOOD IDEA.—An Ansonia, Ct., druggist has an electric bell in a cabinet containing poisons. When the door is opened the bell rings, reminding the compounder what he is handling.

A MATCHLESS LIGHT—The electric light.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED MARCH 25TH.

423,897. Constant Current Motor. William Baxter, Jr., Baltimore, Md. Filed March 22d, 1889. This motor is equipped with a centrifugal governor and one or more auxiliary brushes. These brushes are attached to the terminals of the field coils and are moved by the governor, which movement is varied by the changes in load, thus maintaining a constant speed.

423,901. Multiplex Synchronous Telegraph. Robert G. Brown, Brooklyn, N. Y. Filed April 27, 1889.

423,902. Multiplex Synchronous Telegraph. Robert G. Brown, Brooklyn, N. Y. Filed April 27, 1889.

423,903. Synchronous Multiplex Telegraph. Robert G. Brown, Brooklyn, N. Y. Filed July 3, 1889. These three patents cover new combinations in multiplex sychronous telegraphy, of instruments, switches, etc.

423,909. Regulator for Dynamos. Henry W. Cooley, Boston, Mass. Filed June 12, 1889. This invention consists of a method of r gulating the output of the machine according to the demand. An auxiliary coil is wound on and connected with the armature, whereby the main current is opposed by that generated in the auxiliary coil, forcing the brushes forward or backward according to the load on the machine.

423,912. Commutator Brush. Philip Diehl, Elizabeth, N. J. Filed January 27, 1890. This invention consists of a hollow brush in the interior of which are placed loose rolling contact devices, a portion of which lie next to the commutator.



423,912.—COMMUTATOR BRUSH.

423,956. Electric Forging Machine. Robt. Ross, Vergennes, Vt., assignor of five-eighths to John I. Gilbert, Malone, N. Y.; Eliza J. Ross, administratrix of said Robert Ross, deceased. Filed June 14, 1889. In this invention the operation of the forging machinery opens and closes an electric circuit which intermittently passes through the metal being worked.

423,959. Therapeutic Galvanic Apparatus. Theodore Schmauser, Allegheny, Pa. Filed Dec. 3, 1889.

423,965. Electric Valve Controller. Elihu Thomson, Lynn, Mass. Filed Nov. 28, 1887. This invention consists essentially of an oscillating receptable, partly filled with volatile liquid, through which an electrical heating coil passes. The receptacle is attached to the valve mechanism in such a manner that the variation in the temperature of the liquid operates the valve.

423,966. Method of Electric Soldering, Cementing, etc. Elihu Thomson, Lynn, Mass. Filed Aug. 16, 1889.

423,967. Apparatus for Electric Soldering and Cementing. Elihu Thomson, Lynn, Mass. Original application filed Aug. 16, 1889. Divided and this application filed Oct. 16, 1889. These two inventions cover methods for soldering by passing electric currents in close proximity to the metals to be soldered.

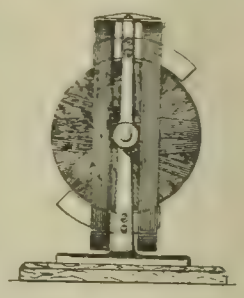
423,975. Controller for Electric Motors, Merle J. Wightman, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Sept. 24, 1889. This invention provides means for short-circuiting a section of the field winding when the motor circuit is broken and means for cutting out such section when the resistance has been cut down to the minimum.

423,991. Dynamo Electric Machine. Sebastian Z. de Ferranti, Hampstead, County of Middlesex, England. Filed Sept. 16, 1889. The novelty in this invention consists of means for sliding the field magnets away from the armature, which is mounted on fixed bearings, so that access may be had to the armature.

424,006. Telegraphy. Charles Langdon-Davies, London, England, assignor to the Phonophore Syndicate (Limited), same place. Filed Oct. 1, 1888. Patented in England, Germany, France. the East Indies, Belgium, Italy, Spain, and in Canada. This system is of the synchronous vibrations class, the vibrations being produced by an induction coil.

424,012. Electro-Medical Chair. Marian A. MacMaster, Utica, N. Y. Filed Oct. 3, 1889.

424,036. Electro-Magnetic Motor. Nikola Tesla, New York, N. Y., assignor to the Tesla



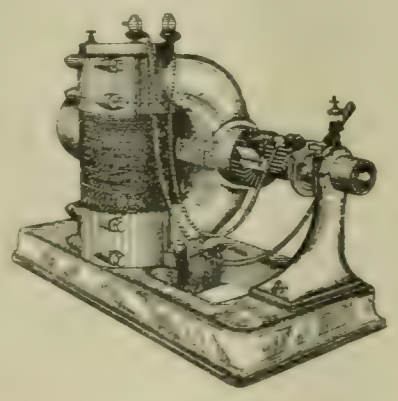
424,036.—ELECTRO-MAGNETIC MOTOR.

Electric Company, same place. Filed May 20, 1889. In an alternating current motor, the combination, with the armature and field cores of stationary energizing coils enveloping the said cores and adapted to produce polarities or poles in both, the field cores extending out from the coils and constructed so as to exhibit the magnetic effect imparted to them after the fall or cessation of current impulse producing such effect.

424,047. Electric Radiator. Henry H. Butterfield and Willis Mitchell, Waterville, Me., assignors to the Butterfield & Mitchell Electric Cooking and Heating Company, same place. Filed Nov. 1, 1889.

424,057. Underground Conduit for Electric Wires or Cables. Charles G. Gilman, Eldora, Iowa. Filed Aug. 28, 1889. This conduit has an inner tube of metal covered with an outer tube of porous earthenware with an intermediate layer of asphaltum.

424,065. Dynamo Electric Machines. Chas. J. Jenney, Indianapolis, Ind. Filed April 16, 1889. The combination of the field magnet core, an armature located to one side of said core, and pole pieces expanding in the direction of the axis of the armature, and extending from the ends of said core in substantially the natural direction of the principal lines of force of the field magnet to near said armature.



424,065.—DYNAMO ELECTRIC MACHINE.

424,070. Electric Locomotive. George W. Mansfield, Boston, Mass. Filed Dec. 1, 1888. In a combination of running gear of the vehicle and a motor supporting frame swung to the running gear appropriately to allow the axles or trucks thereof and said supporting frame to swing or turn relatively to each other in taking a curve.

424,082. Electric Railway. Walter Thompson, Meriden, Conn. Filed July 11, 1889. Claim reads: An electric railway trolley having a plurality of contacts for making contact with a plurality of current-supplying conductors and provided with a member projecting free beyond said contacts and appropriate to take it between the conductors for guarding against the displacement of the trolley and the conductors.

424,110. Coupling for Trolley Wires. Sam'l Harris, Cleveland, Ohio, assignor to Tom L. Johnson, same place. Filed Nov. 18, 1889.

424,152. Secondary Battery. Harry H. Wardwell, Lake Village, N. H. Filed Oct. 14, 1889. This is a method of perforating the plates to insure the retention of the active material.

424,182. Circuit Closer. Joseph A. Dempf, Washington, D. C. Filed Jan. 9 1890.

424,206. Electric Railway Car. Rudolph M. Hunter, Philadelphia, Pa. Original application filed Sept. 23, 1886. Divided and another application filed June 1, 1887. Again divided and this application filed Feb. 18, 1888. The motor's shaft extends from axle to axle and has a worm on each end meshing with the worm wheels to drive both axles simultaneously.

424,207. Electrically-Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa. Filed June 5, 1889. The combination of two axles of a car with two independent electric motors coupled to drive different axles, and flexible electrical connections between the motors.

424,209. Quadruplex Relay. Francis W. Jones, New York, N. Y. Filed July 13, 1889. This relay has three sets of magnets, and was shown in a recent article in this paper describing Mr. Jones' quadruplex.

424,219. Electric Alarm for Letter Boxes. Wesly G. Reed, Toronto, Ontario, Canada. Filed Dec. 28, 1889.

424,229. Fuse-Plug. John A. Seely, New York, N. Y. Filed Nov. 26, 1889.

424,268. Electro-Magnetic Watch-clock. Rufus B. Carr, Boston, Mass. assignor of one-half to Albert Howard, same place. Filed Dec. 13 1889. This is an improved watchman's clock, the records being punctured on a strip of paper moving at a constant and regular speed.

424 273. Electric Time-Dial. Charles A. Colby and James C. Strong, Buffalo, N. Y. Filed Aug. 7, 1889.

424,295. Electric Stop-Motion for Knitting-Machines. John P. Haslam, Wilmington, Del., assignor of three-fourths to Francis F. Gallagher, Samuel L. Foster and John T. Ahrens, all of same place. Filed June 25, 1889.

424,298. Electric Railway. John C. Henry, Kansas City, Mo. Filed Jan. 16, 1885. An improvement in overhead contact devices.

424,310. Multiple Switch-Board. Milo G. Kellogg, Hyde Park, Ill. Filed Dec. 8, 1887. This is a telephone exchange switch board with improvements for facilitating switching operations.

424,338. Electric Meter. William McKinney, Philadelphia, Pa. Filed Aug. 19, 1889. Worms and worm wheels are operated by the action of electro-magnets, and with proper registering apparatus show the amount of current used.

424,339. Isolated System of Electric Lighting. James F. McLaughlin, Philadelphia, Pa. Filed Dec. 7, 1889. A system of electric lighting consisting, essentially, of a hydraulic motor, a dynamo-electric generator driven by the same, a secondary battery adapted to be charged by the dynamo and to discharge into the light-circuits, and a combined switch and valve for simultaneously controlling the circuits and the feed-water for the motor.

424,340. Electric Railway. James F. McLaughlin, Philadelphia, Pa. Filed Dec. 27, 1889. This is an underground conduit railway with improved means for making contact with the conductors and of draining the conduit.

ELECTRIC LIGHT PLANT PROPOSALS.

Sealed proposals for the construction of an electric light system, as per specification on file with village recorder, will be received by the Common Council of the village of Litchfield, Minn., until seven o'clock, P. M., standard time, March 31, 1890, when said proposals will be opened in the presence of the bidders, said proposals to be accompanied by a clearing-house check for $250 as a guarantee of good faith, the same to be returned when proposal is rejected or accepted, and a satisfactory bond deposited with the Common Council of said village.

RICHARD WELCH,
Village Recorder, Litchfield, Minn.

The Mayor and City Council of Collinsville, Ill., will receive proposals for the erection and maintenance of an electric lighting plant, under franchises to be granted by the city. Bids may be submitted for the plans and directed to the city clerk under seal, and will be opened on Friday, the 18th day of April, 1890, at 7.30 P. M., at the council chamber, in the presence of such bidders as may choose to be present. The council reserves the right to reject any and all bids. Information and specifications may be obtained on application to the undersigned.

JAMES N. PEERS, City Clerk.

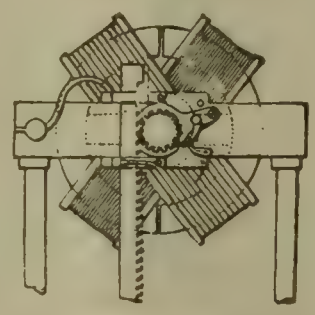
The City of Asheville, N. C., invites proposals for lighting by electricity the said city for a period of two years from October 1, 1890. Proposals to contemplate an option giving the city the right to purchase the plant at expiration of the period mentioned. Time for receiving bids is limited to May 1, 1890. The right is reserved to reject any or all bids, and to waive any defects. CHARLES D. BLANTON, Mayor.
P. N. MILLER, City Clerk.

WATER WORKS AND ELECTRIC LIGHTS.—The mayor and City Council of Collinsville, Ill., will receive proposals for the erection and maintenance of a system of water works and an electric lighting plant, under franchises to be granted by the city. Bids may be submitted for the plans separately or together, and directed to the city clerk under seal, and will be opened on Friday, the 18th day of April, 1890, at 7:30 P. M., at the Council chamber in the presence of such bidders as may choose to be present. The Council reserves the right to reject any and all bids. Information and specifications may be obtained on application to the undersigned.

JAMES N. PEERS, City Clerk.

THE SCHNEIDER ARC LAMP.

The mechanism of the Schneider arc lamp consists of a toothed rack gearing into a rachet wheel. Upon the axis of this latter are mounted two coils, one of which is traversed by the main and the other by the shunt current. These coils actuate two semi-circular cores, arranged with their similar poles opposite one another. The relative influence of the two coils is altered by the variations in the length of the arc; this causes the armatures to rotate and restore the proper distance between the carbons.—London *Electrician*.



THE SCHNEIDER ARC LAMP.

ANSWERS TO INQUIRIES.

AYLMER.—Tin and lead are the component metals of the wire used in safety catches. We are not able to learn that the company referred to uses any other. The information might be given on application at their office.—ED. ELECTRIC AGE.

HYSTERESIS.—In alternating currents the effect of rapid and successive reversal of magnetism in the iron parts causes the latter to become heated. This phenomenon is known as "hysteresis." In order to reduce this to a minimum the iron used is as soft as possible, and where practicable the parts are laminated. The effect of lamination is to interrupt Foucault, or eddy currents, which cause the increase of temperature.

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Bottone—Elec. Instrument Making	$1 20
Du Moncel—Electro-magnets, trans. by Wharton	75
Fabie—History of Elec Telegraphy	3 00
Hedges—Elec. Light Precautions	1 00
Holmes—Electric Lighting	1 00
Hospitalier—Domestic Electricity	3 00
Munro and Jamieson Pocket-book	2 50
Solomons, Sir D.—Accumulators	1 25
Stephens—Electric Lighting	1 00
Walker—Dynamo Building	80

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62 South Canal Street, Chicago, Ill.

—THE—
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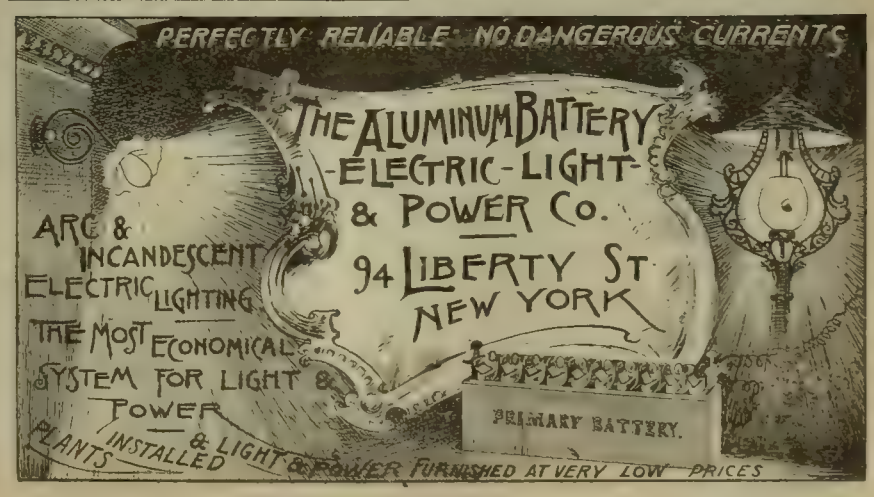
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R J. GRAY, Manager, Advertising Dept.

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NEW YORK, APRIL 12, 1890.

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A SUGGESTION FOR IMPROVEMENT IN BRIDGE CAR TRAFFIC.

The thousands of people who daily travel over the Brooklyn bridge on the cable cars are subject at all times to delay through accident to the cable or its machinery. Every little while something or another gives way and traffic is practically suspended until the break can be repaired. These delays, too, usually happen during the hours when the travel is greatest, and causes the greatest amount of inconvenience. Cables may do well enough for roads that are not subject to such great demand for power as the bridge system is, but for this great highway something more reliable ought to be substituted for the cable. Did it ever occur to the bridge trustees that electricity might solve the problem they have been wrestling with since the cars were first put into commission? There is no doubt whatever that electricity would be better adapted to the bridge traffic than power in any other form. The cable is unreliable, and locomotives are noisy and dirty. It would be an easy matter to substitute electric power and it would be more reliable. This is a matter that affects the convenience and welfare of thousands of people, and in behalf of the suffering, but patient public we offer this suggestion, trusting that the bridge trustees will give the matter their earnest consideration.

THE EDISON BROOKLYN COMPANY.—The officers of the Edison Electric Illuminating Company, of Brooklyn, have issued cards of invitation to their friends to visit and inspect the Electrical station and showrooms of that company on the evenings of April 8th and 10th. The station is located at 358-362 Pearl street.

PROPOSED STATE BOARD OF ELECTRICAL CONTROL.

A bill was introduced in the Assembly at Albany, on April 4th, to create a State Board of Electrical Control, which shall consist of three commissioners at a salary of $8,000 a year each, with five years' terms. They are to be appointed by the Governor, and the bill provides that they shall be chosen from the party casting the largest number of votes for Governor at the last election, and one shall be an electrical expert. The board shall have a secretary at $4,000 a year. If the expert commissioner is from one political party, the secretary must be from the other. The secretary shall be the executive officer of the board. The board can summon witnesses, who may be liable to action for contempt. Neither the secretary nor the commissioners shall be employed by or have any interest in any firm or corporation having to do with electrical matters. The board shall have the supervision of all telegraph, telephonic, electric wires, motors, subway conductors or conduit associations, and all corporations or associations using electric fluid for public use or commerce; shall keep itself informed how these enterprises are conducted as regards security for life and property and accommodation of the public; and shall also investigate accidents. No exclusive privilege shall be granted any company or person by which a monopoly may be created or competition prevented on equal terms. The board must enforce the law and prevent unjust discriminations, and at its instance the attorney-general shall bring action. It may order repairs or provide for a change of methods of operation of stations or terminal facilities. The Supreme Court may compel compliance. The sum of $50,000 annually is appropriated for the commission, which shall be laid as a tax on electrical companies.

OF INTEREST TO ELECTRIC LIGHT PEOPLE.—Last December the *Engineering and Building Record* of this city, offered cash prizes for the best designs for pumping stations and water towers. One hundred and twelve designs were submitted, and the award of prizes has just been made by the committee selected for the purpose. It is to be regretted that the attention of electric light people was not called to this exhibition, as the designs would have been very suggestive to those contemplating the erection of light stations or power houses. The contest was successful in bringing out many very beautiful and artistic designs and the conception of the affair was a brilliant one.

INTERNATIONAL ELECTRICAL EXHIBITION.—Herr von Müller, of Munich, formerly manager of the "Allgemeine Elektaizitats-Gesellschaft" of Berlin, has been chosen to superintend the work connected with the International Electrical Exhibition to be held in Frankfort-on-the-Main, in 1891. Herr von Müller, who took a leading part in the Munich Electrical Exhibition of 1882, contributing not a little to its success, will shortly make a tour of Europe in order to personally promote the interests of the undertaking.

THE WEEKLY ELECTRICAL ENGINEER.—*The Electrical Engineer*, of this city, on April 2d, appeared for the first time as a weekly, and its contents were of high-class electrical literature. The editorial work is looked after by Messrs. T. C. Martin and Jos. Wetzler, both of whom are well-known and able journalists, and in the hands of these two gentlemen the prosperity of *The Electrical Engineer*, under the new conditions, is assured.

PLEASED WITH ELECTRIC CARS.—Boston Electric street cars are so pleasant, says an exchange, that they are becoming the fashionable vehicle for opera patrons.

HONORS FOR MR. EDISON.—Mr. Edison has been made an honorary member of the Berlin Electrical Society.

THE SUBWAY MATTER.—The General Term, on April 3d, settled the order restraining the Board of Electrical control from awarding the proposed contract to the Standard Subway Company and prescribing the changes which must be made in the contract to make it legal. One of these changes is to name the streets in which the company agrees to build subways. Another is to provide that the company shall not mortgage its subways when built for more than fifty per cent. of their actual cost, so that if the city decides to buy them there will be some limit to the bonded indebtedness to be assumed. Another change is to specify a time for the completion of the subways specifically named.

A BEAUTIFUL SCENE.—The Woman's Exchange Electrical Exhibition was formally opened at the Lenox Lyceum, corner Madison Avenue and 59th Street, this city, on Monday night, April 7th, amid a blaze of electric glory. A large number of prominent people of New York were present, including Mr. T. A. Edison and ladies. Prof. C. F. Brackett made one of the opening addresses. The scene was a charming one, and Mr. Edison remarked that the effect of the electric light display surpassed that of the Paris Exposition last year. In the centre of the hall was a tower 25 feet high and 8 feet in diameter, around which, arranged spirally, were many hundreds of tiny electric lamps, and from the top of which hung twelve ropes of similax, with similar lamps intertwined at regular distances. These lamps were lighted and extinguished in time corresponding with the rythm of the opening piece of music, and the effect was beautiful.

Five thousand lamps, arranged in fanciful shapes, illuminated the large hall with a light of wonderful softness. The entire Edison Exhibit from the Paris Exposition was displayed, and there were also many phonographs in operation which rendered choice musical selections. Thirty-five long-distance telephones were connected with various places of entertainment in this city and Boston, and the singing, etc., at each place was reproduced with considerable success.

Among other attractions are a miniature electric railroad, a doll's theatorium, and a glimpse into the twentieth century.

There was great enthusiasm, and the exhibition which opened so auspiciously stands unique as an entertainment. It will continue six weeks, and is for the benefit of the Woman's Exchange.

PROPOSED BUILDING FOR THE PATENT OFFICE.—The House Committee on Patents has introduced a bill which provides for the creation of a Commission composed of the Secretaries of the Interior and War and the Attorney General, with authority to select a site and to erect thereon a suitable building for the use of the Patent Office. An appropriation of $3,000,000 is made for this purpose. It may not be generally known that the Patent Office receives annually a large sum in the shape of fees from inventors for the issuance of letters patent and from the sale of its publications, and that the sum now in the Treasury to the credit of the Patent Office is about $2,500,000 It will be seen, therefore, that the amount named in the bill for the construction of a building is not largely in excess of that which legitimately belongs to the Patent Office and which was evidently created to meet just such an emergency as now confronts it. There should be no delay in the passage of the bill. For a number of years the Patent Office building has been so crowded as to render it not only uncomfortable for the people employed there, but to seriously interfere with the progress of business. This is due mainly to the fact of the legitimate growth of the business of the office, and, to some extent, to the crowding of other divisions of the Interior Department upon the space that should be given to the Patent Office. Not only are the rooms uncomfortably crowded, but considerable space in the corridors is occupied, and clerks are located in basement rooms that are ruinous to health and damaging to property.

SOME POINTS IN DYNAMO AND MOTOR DESIGN.*

(Continued from page 5, issue of April 9th.)

8. THE LEAD TO BE GIVEN BY ARMATURES.

Assuming that a machine is properly designed, a position can be found for the brushes where the sparking is nil. If, on the other hand, the machine is badly designed, or if the current carried by the armature is too great, a sparkless collection will be found impossible from the excessive distortion produced by the armature field. There is for every machine a certain limiting number of ampere-turns which the armature can carry, beyond which we cannot go without effecting some radical alteration in the design.

Now it is manifestly of the very greatest importance to know to what extent an armature can be loaded for a given field. It will be understood that the cross induction—that is, the lines of force which can be induced by the armature winding—depends upon the number of ampère-turns on the armature, and upon the magnetic resistances of the various parts which make up the cross circuit. Undoubtedly the induction follows the same law for the cross as for the forward circuit, though it is difficult to determine with accuracy either its magnitude or direction. But we know that by far the largest portion of the resistance is encountered in the air-gap, and that increasing the length of the gap diminishes almost in inverse ratio the cross induction. We know also that the cross induction depends on the width of the air gap, for the greater the cross-section of the gap, the greater the cross induction for a given cross section of armature core and a given magnetizing force. It depends also, but to a less extent, on the induction in the core.

The forward induction we can give to a machine may be considered as proportional to the cross-section of the armature core; for if the magnets are large enough, with sufficient magnetizing force, we can always in normal types get an induction from 16,000 to 17,000 C.-G.-S. per square centimetre.

Now the distortion of the field depends upon the ratio of the cross to the forward induction. In actual machines we have not, of course, two sets of lines crossing each other, but the tendency to produce a cross induction is manifested in a distortion produced in the forward lines. It is to prevent the sparking which would ensue, due to this distortion, that a lead is given.

The cross induction may be reduced in double magnet machines by thinning down the magnets as shown in Fig. 3. This illustrates a type of magnet I designed in 1884, which gave first-class results, to the great surprise of many who believed that no good effects could be obtained without massive pole-pieces, irrespective of the configuration of the magnetic circuit otherwise. For the reasons given in Section 3, it is undesirable to reduce the section of single-magnet machines with this object. Another plan for reducing cross induction is in making the air-gap increase from the crown of the poles towards the tips, as was done by Messrs. Paterson and Cooper in the Lumley machines before I joined them, and as is done in some of the Manchester machines for another purpose.

As both forward and cross induction are proportional to one length of the armature, we need not consider that dimension here, but simply confine ourselves to the cross-section of the armature and poles as shown by the several drawings. A lead being given to the brushes, it will be observed that the convolutions lying between the two horizontal lines *a b* and *c d*, Fig. 19, directly oppose the forward induction along *e f* and *g h*, since the current flows in them in the opposite direction to the current round the magnets. The lines of force which would be sent in an opposite direction may be called the backward induction. This, *per se*, is of little consequence, as it can be compensated by additional turns on the magnets, but the distortion of the field to which its existence is due is of enormous importance.

It is not my intention to take up time with any calculations respecting the actual number of cross lines which would be induced by the current flowing in the armature, or to try and map out the exact distribution of the field as modified by cross induction. For at present I will be content with the statement—which is, of course, open to criticism—that, roughly, the cross induction is proportional to the ampere turns on the armature and to the width of the poles, measured parallel to the direction of rotation, and inversely proportional to the length of the air-gap, *i.e.*, the distance between the polar surface and the surface of the armature core. Calling A_2 the ampere-turns on the armature, x the width of the air-gap, and l its length, the tendency to induce cross lines is measured by $\frac{A_2 x}{l}$; and since the forward induction is proportional to the radial depth of the core r for all sizes of machines, the ratio between the above value and r should be similar. In other words, the ampère-turns which can be carried by the armature are proportional to the radial depth of the core and to the length of the air-gap, and inversely as the width of of the pole; whence

$$A_2 x = \frac{rl}{x}$$

9. MAGNETIZING FORCE REQUIRED TO COMPENSATE THE BACKWARD INDUCTION.

The weakening of the field by the current flowing in armatures wound on the Hefner von Alteneck principal has been studied by Drs. J.

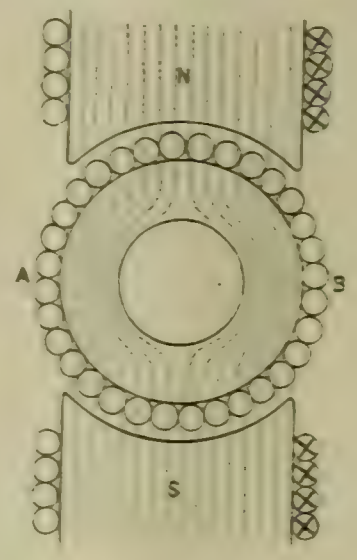


FIG. 19.

and E. Hopkinson; but from the fact that the lead upon which the weakening depends is, in Gramme-wound armatures, much greater and to a large extent indeterminate, it follows that, in designing, some approximate rule must be employed to fit the types of machines in which these are employed. We may estimate the effect of weakening in two ways: first, we may excite the magnets with a constant current, and measure the fall of E.M.F. due to the armature current; or, secondly, we may, by increasing the magnetizing force, keep the E.M.F. up to the same value when a current flows as when the machine is working at no load, measuring the ampère turns required to effect this compensation. The latter is the proper course to adopt, since having pre-determined the magnetizing force required for the induction in the armature at full load, on the assumption that there are no disturbing reactions, we wish to know what addition is to be made to the force so determined. The weakening of the field is much greater in cylinder than in drum machines, owing to the greater lead required to obtain a sparkless collection; accordingly the magnetizing force necessary to compensate the backward induction must be greater for cylinders than for drums. Its actual value depends, necessarily, on several things besides the ampère-turns on the armature, such as the degree of saturation employed, the ratio of armature to field section, the shape of the pole-pieces, and the magnitude of the stray field. The particulars relating to the degree of saturation, the sections, stray field, etc., of the Phœnix machines have already been given, and from actual practice we find that there has to be added to the magnetizing force, in order to compensate the backward induction in these machines, ·33 of the ampère turns on the armature. By the ampère-turns on the armature is meant, as already stated, the product of the number of external conductors and half the total current. This is for a single horse-shoe machine. If there is a divided magnetic circuit constituted by two horse-shoes, with their like poles butting, the number of ampere-turns here given has to be wound on each horse-shoe.

I have met with some very curious rules for determining the compensating turns. These generally take the form of adding to the magnetizing force determined for the required induction at full load such additional ampère-turns as will increase the induction about five per cent. It is assumed that at full load the E.M.F. will be as desired, the five per cent. extra being for compensation. This method is, of course, incorrect, for the magnetizing force added should be for a given machine some function of the armature windings. I believe that for most Gramme-wound machines the value of the compensation co-efficient here given will hold good. The compensation co-efficient for drum machines I have not yet been able to determine.

10. TOTAL MAGNETIZING FORCE.

To the magnetizing force required for a simple magnetic circuit as given in 1, we have to add the force required to compensate the backward induction, as given above. The equation for the magnetizing force now becomes for cylinder machines—

$$A_1 = Lf\left(\frac{N}{a}\right) + L_1 \cdot 8\,\frac{a_1 N}{a_1} - L_2 f\left(\frac{a_1 N}{a_2}\right) - L_3 f\left(\frac{a_2 N}{a_3}\right) + \ldots + \cdot 33\, A_2 .$$

where A_2 is the number of ampère turns on the armature.

If the machine is to be shunt-wound, and N is the induction corresponding to the E.M.F. at full load, A_1 gives the ampère-turns on the shunt. If it is to be compound wound, and N is the induction at full load, A_1 is the number of ampère-turns on the series and shunt-winding added. The ampère-turns for the shunt alone are obtained by substituting for the induction at full load the induction on open circuit, the armature co-efficient being of course here omitted. As a matter of fact, the value of a_2 increases between o load and full load, but for reasons already given this may in the calculation be neglected.

If the series coils are connected in series, to get the number of compensating turns on each horse shoe we have only to multiply the external conductors on the armature by ·165. It may be mentioned in passing that in the Phœnix dynamos the total series convolutions for ordinary compound machines are uniformly ·3 of the convolutions on the armature; this, multiplied by the current, being the magnetizing force necessary to overcome the resistance of the armature and the series coils, and to compensate the backward induction. It will thus be seen that rather more convolutions are required for the latter purpose than for the former, and I think that in most dynamos of medium size the relation is very similar. The only extraordinary relation I know of is in the Victoria machine, where the compensating turns, it

*Paper read by W. B. Esson before the English Institution of Electrical Engineers.

stead of being a little greater than the turns required to overcome the resistance of the armature and series coil, are three times as great.

II. WORKING TEMPERATURE.

The ultimate rise in temperature of coils wound with double-cotton-covered wire, varnished on the exterior, is, approximately in degrees centigrade,

$$c^\circ = \frac{w\ 355}{s},$$

where w is the rate at which energy is dissipated in watts, and s the cooling surface in square centimetres. If, for the latter, we substitute square inches, s_1, the equation is

$$c^\circ = \frac{w\ 55}{s_1}.$$

The co-efficients have been obtained from practice, but they are liable to some uncertainty. In the cases from which they have been derived the coils were wound on formers of sheet iron, which fitted close to the magnets. These formers were fitted with brass end flanges, and in the spaces between the flanges and the wire, also between the body and the wire, was a thick layer of insulating material. The surface of the end flanges is not included as making up s or s_1, nor is the inside surface of the former next the magnet. Though insulated so well thermally, there is certainly a flow of heat towards the interior of the magnets and towards the end flanges, so that, as a matter of fact, the virtual cooling surface is greater than given above. Its value it is, however, difficult to determine, while the above equation is approximately true for machines of medium size, and may be used for all cases in which the coils do not exceed 2½ or 3 inches in thickness.

For armatures—which in rotating induce a current of air—the equation is different and the co efficient given above may have a much lower value, according to the velocity and ventilation. For armatures the surface velocity of which is 50 feet per second (3,000 feet per minute), and the exterior diameter of the core 1½ times the interior, the length being about equal to the diameter, the rise is, approximately,

$$c^\circ = \frac{w\ 225}{s},$$

or,

$$c^\circ = \frac{w\ 35}{s_1},$$

accordingly as the surface is taken in square centimetres or square inches. Here the whole of the cooling surface inside, outside, and at the ends is counted, w being the total watts dissipated in both electrical waste and hysteresis. The latter must, under the circumstances, be neglected, as it may reach 20 per cent. or more of the total. In giving the above equation, it should be stated that the armatures of the machines which furnished the results are closed at the commutator end, except at the periphery, where a draught of air through the centre from the pulley end is expelled. For slow-speed machines the co-efficient is necessarily higher, and a larger surface must be allowed, or special means adopted, in the shape of vanes or blades, to force a draught through the armatures. Experience can be the only guide here.

Considerable difference of opinion exists with reference to the temperature rise which should be permitted in dynamos. The rise of about 11° C. allowed by the Admiralty is admitted by all engineers to be absurdly low; while, on the other hand, the machines sent out by some manufacturers get at their normal output dangerously near the temperature at which the insulating material would become useless. We have to steer between these two extremes, working far under the critical temperature, but, at the same time, not making machines too costly on account of the excessive surface allowed. It will be observed that from the manufacturer's point of view the settlement of this point is of great importance, since a competitor, by allowing a greater temperature rise, may put in a machine of less weight, and therefore less costly, though not necessarily less efficient.

In any case, the ultimate temperature of the machine ought not to rise above a certain value, whatever the temperature of the room in which it works. In my opinion, an ultimate temperature of from 70° to 75° C. may be permitted with perfect safety, but this should not be exceeded. Independently of the ultimate temperature, the rise in working should not be too great, and accordingly we have in the Phœnix dynamo fixed this limit at from 30° to 35° C. Machines working in atmospheres up to 35° C. have a cooling surface, therefore, which will give in continuous working a rise of 35° C.; when the temperature is higher the cooling surface is increased, so that the maximum temperature does not exceed 70° C., the limit given. It will be seen from the formula that for a rise of 35° C. in the magnets, the cooling surface is 10 square centimetres (1·56 square inches) per watt.

For armatures having the proportion stated, the surface requires to be about 7·3 square centimetres (1·13 square inches) per watt; but here it is less easy to formulate rules. Both interior and exterior surfaces are ventilated by the motion, the former generally being of a broken character, which aids the cooling. The temperature of these surfaces does not measure the temperature of the bottom layers of wire or of the armature core itself, and when I speak of a temperature of 70° C., I mean, of course, that of the hottest part. The difference of temperature between the interior of the core and the outside surfaces, in a machine of given carcase dimensions, depends on the gauge of wire with which the armature is wound. Obviously, the difference of temperature required to produce a given flow of heat depends upon the thermal resistance encountered, and, therefore, on the number of layers of badly conducting substance, in the shape of cotton covering, through which the flow takes place. For this reason, an armature wound with one layer of coarse wire requires a less cooling surface per watt to keep down the internal temperature than an armature wound with fine wire, even if the mass of copper is similar. In practice, allowance for this is made by working the small-gauge wires to a less current-density. On account of the flow of heat being obstructed by badly conducting substance, armatures with cores constructed of wire always get hotter inside than those with plate cores.

Of course it will be understood that the co-efficient given for the rise of temperature will be greater for those armatures in which the central opening in the core is less than two-thirds of its external diameter. Where, for instance, it is half the external diameter, the inside radiating surface is diminished to three-fourths of that specified, and the temperature rise will be proportionally higher, unless a stronger draught of air is sent through the centre of the armature.

12-LOAD DIAGRAMS.

A dynamo having been completed, its performance should be recorded in such a manner that we shall be able to tell at a glance what a machine of similar carcase dimensions will under any circumstance give. First, the machine is run on open circuit, and the relation between the ampère-turns on the magnets and the E.M.F. established. In Fig. 20, the curve A, B shows this, abscissæ giving ampère-turns, and ordinates the E.M.F. While running at the same speed, take the greatest permissible current from the armature, and, keeping this constant, take observations of the magnetizing force and E.M.F., the field being weakened down step by step until it is just possible by adjustment of the brushes to run without sparking. For each reading the brushes will have been adjusted to the sparkless position, and the curve expressing the relation between the magnetizing force and E.M.F. when the maximum current flows may be plotted as at Q, H. The curve stops at H, because, with a further weakening of the field, a non-sparking position cannot be obtained. Repeat the experiment for a less current in the armature, then for a smaller still, until there is a series of curves—Q H, E F, C D—as shown, representing the relation between the magnetizing force and the E.M.F. for several different values of the ampère-turns on the armature. It will be observed that as the ampère-turns on the armature get less, the curve can be carried lower, or, in other words, we can weaken the field to a greater extent before arriving at the sparking point.

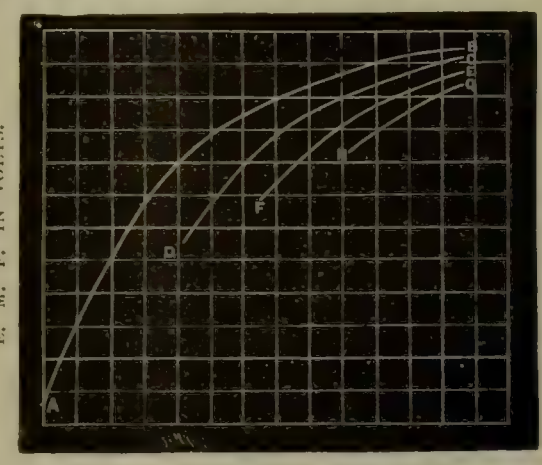


FIG. 20—AMPERE TURNS ON MAGNETS.

This load diagram tells us everything we wish to know about the magnetic circuit of a machine having these particular dimensions, and about the interference of the armature on the field circuit. It tells us the ampère-turns required for any induction on open circuit, or, in other words, the magnetizing force required for the shunt only if the machine is to be compounded; it tells us how many ampère-turns must be added to raise the E.M.F. by a required amount with any current flowing, or to compensate any armature load; it tells us how we can over-compound the machine; and, lastly, just how far we can weaken the field for any load without producing sparking. That we can by its aid

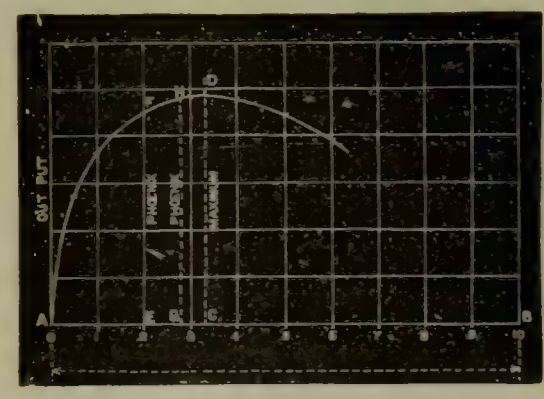


FIG. 21—HALF THE RADIAL DEPTH OF CORE.

calculate with accuracy the windings of any machine which requires the same carcase will be sufficiently obvious without further explanation.

13.—THE BEST RELATION BETWEEN THE IRON AND COPPER IN THE ARMATURE.

It is of some importance to know the best relation between the thickness of the iron core and the depth of the winding which will give in armatures the best results for given dimensions. Suppose we have a cylinder armature of certain radial depth over the winding; while keeping this depth the same, we may vary the iron and copper of which it consists within wide limits. The question is, what relation of copper to iron will give the best results, premising that, however the relation is varied, the temperature shall remain the same. The cooling surface we will take to be unaltered, and this means neglecting hysteresis—for a reason

(*Continued on Page* 8.)

CHICAGO NOTES.

35 Commercial Bank Bldg.,
Chicago, April 5, 1890.

Mr. L. W. Wolfe and Mr. F. K. Rosebury, of Omaha, were in town this week.

Mr. W. D. McQuesten, electrical engineer, of 15 Cortlandt street, New York, stopped in Chicago during the week.

Mount Clemens, Mich. is now lighted by a 27-light arc plant. The electric company also put in a 600 light incandescent plant, 587 lights of which were taken the first week.

The Illinois Steel Co. will light their mills at Bay View, Wis., with 35 arc and 50 incandescent lights of the Thomson-Houston system.

Mr. J. H. Reid, Chicago, reports the sale of a plant of 250 lights of the Mather system to the Goodrich Transportation Co., to be installed on a new steamer being built by the Goodrich Co.

The American Electric Supply Co. was formed at Chicago, to manufacture all kinds of electrical apparatus; capital stock, $250,000; incorporators, F. E. Shaw, William Martin, W. O. Johnson.

The Oakland Gas Light & Heat Co. have ordered an additional 35 light arc dynamo of the Thomson-Houston make.

New Companies.—The Electro-Depositing Co., of St. Louis; capital, $20,000; incorporators, Theodore and John Plate, A. Mohr. Garrett Electric Light Co., Garrett, Ind.; capital stock, $10,000.; incorporators, F. W. Brandt, F. E. Davenport, W. H. McIntyre. Citizen's Electric Light Co., Independence, Mo.; capital, $25,000; incorporators, I. N. Rodgers, W. A. Cunningham, W. S. McCoy, Chas. Gudgell.

Mr. Chas. E. Gregory, of the Sperry Electric Co., Chicago, has accepted the management of the Hyde Park Electric Light & Power Co. This company was formed last fall and are now operating a plant of 100 lights of the Sperry system in the recently annexed suburb of Hyde Park. Mr. Gregory will still retain his position with the Sperry Electric Co. The Thomson-Houston Electric Co. report the sale from their Chicago office of a 300 light incandescent to the confectionery store of John Kranz, 80 Adams street, Chicago, also the sale of two 50 light arc and two 650 light alternating current incandescent machines to the Laredo Improvement Co., to be used in lighting the city of Laredo, Texas.

Electric Lighting Companies.—The following companies have been formed: Electric Light & Water Co., of Tomahawk, Wis.; capital stock, $25,000; incorporators, W. H. Bradley, Milo Woodbury, Fred. H. Miller. Milwaukee Light & Power Co., Milwaukee, Wis.; capital stock, $500,000, divided into 20,000 shares; incorporators, J. J. Kempf, W. H. Earles, Chas. Stolper.

A. H. Revell & Co., Chicago, will use electricity as a motive power in the future, having exchanged their gas engine for a Thomson-Houston 10 H.-P. motor.

St. Charles, Mo.—Christian Bode has received the contract for the construction of the electric light power house for the sum of $1,999. The structure is to be completed by May 10.

The Durango Electric Light Co. and the Aguas-Calientes Electric Light Co., of East St. Louis, have been formed with capital stock of $150,000 each; incorporators, Theodore Plate, John Plate, Albert Schenck. The former will carry on electric light and power work at Durango, Mex., and the latter at Aguas-Calientes, Mex.

Afton, Iowa, will soon have a 500 light Edison incandescent plant. The plant will be controlled by the city; 32 candle-power lamps being used for street lighting and 16 candle-power for domestic and commercial purposes.

The West Side Railway Co., of Milwaukee, Wis., commenced running cars on their line this week. Twenty cars are in operation on this line, the Sprague system being employed. Iron poles are used throughout the centre line making the system a very handsome and substantial one.

H. A. Seymour, the patent attorney of New York, spent some days in the great city this week on important electro-legal business.

The Davidson Theatre, Milwaukee, Wis., is to be lighted by 1,600 incandescent lights and 10 arc lights. The contract for this installation was given to Mr. J. H. Reid, of Chicago, and includes the Mather incandescent and the Easton Arc system.

The Sioux City, Iowa, Electric Street Railway has just commenced operation. The line is fifteen miles in length and was installed by the Sprague Electric Equipment Company. Twenty-five of the Pullman's company's finest make of cars are employed and the entire plant is said to be a model one. A telegram from the president of the company, Mr. James F. Peavey, under date of March 31, says: "Tried cars yesterday and run most satisfactory in every way. Pleased."

The National Electric Construction Company have been awarded the contract for installing a 300 light incandescent dynamo of the Thomson-Houston make in the new Inter-Ocean building just being completed at Chicago.

J. Grant & Company, 103 Adams street, Chicago, report great demand for the McIntosh-Seymour engine which they manufacture. Mr. Glasier representing this company has been located in Chicago but a couple of months, but has met with much encouragement and made a number of large sales in the West. It is claimed that the McIntosh-Seymour engine is one of the best made and especially adapted for electric work. It is highly recommended by some of the leading electrical companies.

Mr. J. H. Reid, 11 Metropolitan Block, Chicago, manager of the Mather Electric Company, has been appointed general sales agent for the Easton system of arc lighting for the entire territory west of Ohio. Mr. Reid will shortly remove to new and enlarged quarters and will carry in stock machines and lamps of both systems which he represents.

St. Louis, Mo., Electric Street Railways.—A great step in the right direction is the passage by the St. Louis City Council of an ordinance authorizing the electric equipment of the Lindell Railway system, the Market street and Laclede avenue divisions of the Missouri railroad, the three southwest lines of the Union Depot Railroad Company, and the Mound City line. The *Globe-Democrat*, of March 30, devotes three columns to a description of the proposed railroads, from which it is learned that by the end of the summer ninety-two miles of electric street railway will probably be in operation in that city and by January 1, 1891, it is claimed there will not be a horse-car line in operation in St. Louis. It is the intention of the companies to light the cars by incandescent lights and heat them in winter by electric heaters. The Sprague system will be used on the Lindell line, the Short system on the People's line, and the Thomson-Houston system on the Union Depot lines.

The Capital City Street Railway Company has been formed at Little Rock, Ark., with H. G. Allis as President; George B. Rose, Vice-President; H. P. Bradford, Secretary and Treasurer. The capital stock of the company is $300,000. The company was formed for the purpose of purchasing the franchises of the Little Rock Street Railway Co., and the Citizens' Railway Co., and thus effecting a consolidation of the street railway interests of Little Rock.

The National Engineering Bureau has been established with headquarters at the Rookery Building, Chicago, George S. Baker, President; Thos. G. Grier and James A. Lounsbury, electrical engineers. Mr. Grier was formerly with the Marr Construction Company, and Mr. Lounsbury with the Westinghouse Electric Company. The new company will do a general electrical engineering and construction business, and as Messrs. Grier and Lounsbury can point to some excellent installations they have made in the past they will undoubtedly meet with encouragement and success in their new undertaking.

Dr. Philip Atkinson, who has been selected by the Mechanics' Institute, to treat the subject of electricity in a series of four lectures, delivered the second in the series on Wednesday evening at the Athenæum. The subject was "Cell and Battery Formation," and the audience room was well filled. The next lecture will be given on the evening of April 16, Subject: "The Storage Battery."

The Evanston Electric Plant has been turned over to the Evanston Electric Illuminating Company by the Marr Construction of Minneapolis, and is now in full operation. 750 Westinghouse incandescent and ninety Waterhouse arc lights are in use. The work of installation was carried on under the supervision of Mr. Thomas G. Grier, of the Marr Company, and the excellent character of the work may be inferred from the fact that during the recent severe storm not an accident happened to the wires of the company.

Mr. J. L. Barclay, manager of the Sprague Electric Equipment Company, in this city, has adopted a novel device for adding to the attractiveness of his office in the Rialto Building. On entering, the visitor sees a bright bed of coals heaped in the grate before him making him at once feel warm and at home. A closer inspection, however, reveals the fact that no unpleasant gases or coal dust can escape from the fire nor any excessive degree of heat, as the radiant energy is furnished by two incandescent lights encased in ruby globes over which are heaped bits of broken glass, the effect being quite realistic.

F. M. I.

THE BISHOP GUTTA PERCHA COMPANY'S WHITE CORE WIRE.

The matter of insulation of submarine cables and electric wires for various other purposes is one of great importance, and has received the attention of inventors for years. The only reliable insulating material is gutta percha and India rubber. Gutta percha is the best and India rubber ranks next. India rubber is very refractory unless vulcanized, and the sulphur necessary for vulcanizing is a deadly enemy to copper (as may be observed in samples of all wires insulated with rubber compounds where the vulcanized coat is placed directly on the wire). The Bishop Gutta Percha Company, of this city, overcome this objection in a very effective manner. Their white core wire is a notable example of this method. The copper conductor is first given a coat of tin; then a coat of rubber cement is applied; then rubber compound without sulphur, and finally, for protection, a vulcanizing coat and rubber tape or braid. It is then vulcanized with great care so as not to be liable to crack. These wires are the best made for aerial or underground work, and the injurious effect above spoken of is entirely obviated. Wires treated in this way are practicably indestructible in the ordinary sense, and the trouble caused by the deterioration of wires insulated in the ordinary manner is effectually overcome.

ACTION OF ACCUMULATOR CELLS WITH DYNAMO.*

When a dynamo is charging accumulator cells used in conjunction with electric lighting the E.M.F. on the lines is raised at least 10 per cent., and this may cause injury to, or may break the lamps. This rise of pressure is of no consequence when charging ceases before lighting hours, but in general there is no certainty of this being done; therefore, measures have to be taken to keep at all times the E.M.F. within the proper limits. Dynamos give different E.M.F's. for different currents taken from them when running at full speed. These variations may be drawn diagramatically, represented by curves called "characteristics," and every dynamo has its own peculiar curve. A perfect machine would give the same E.M.F. for all currents when running at one speed and the curve would become a straight line. Good dynamos have curves approaching this form for all currents within their capacity. The shunt-wound dynamo is best suited for charging an accumulator. The series and compound-wound dynamos are liable to have the polarities of their field magnets reversed, should the E.M.F. at the terminals approach very near to, or fall below that of the cells, when great damage may be caused before the cut-outs have had time to act.

In a series wound machine the E.M.F. rises with an increased current; in a shunt-wound dynamo the reverse takes place, and the compound machine is wound partly series, partly shunt, so that the E.M.F. is practically constant at a particular speed for all currents. Only the shunt dynamo claims special attention here. This dynamo has a falling curve (*i. e.*, the E.M.F. falls as the current in the outside circuit is increased), due to three reasons; First, the armature absorbs more E.M.F. as the current is increased; second, as the outside resistance is lowered the shunt current becomes less and the field weakens; third, the current in the armature reacts upon the field. As the outside resistance is increased, the E.M.F. rises to the work. Many have supposed that a shunt machine will always respond to the work in a definite and suitable manner. This is not the case in good dynamos, because by reason of their construction the curve is nearly straight for all currents within their capacity, and such modern dynamos are in general use, although those with falling curves have certain advantages in small installations where waste is not of great consequence. If the terminals of a shunt dynamo are short circuited no current flows, because no current traverses the shunt circuit to create a field.

Dynamos give a different E.M.F. in proportion to the speed, but, if a much higher E.M.F. be required than was originally intended, then two things must be considered. The first is to ascertain whether the armature is strong enough to withstand the increased speed; and secondly, whether it will become necessary that the shunt resistance should be increased by inserting an outside resistance to prevent too much current passing and the wire becoming too hot.

In dynamos intended to run at two speeds it is usual to place the shunts parallel for slow rates and series for fast; in this way the use of an outside resistance is avoided. The E.M.F. and speed are not exactly proportional, for as the E.M.F. rises more current is sent round the field magnets, and the field becoming stronger the E.M.F. has an increase due to this cause also, inasmuch the iron of the magnets is not near saturation point in modern dynamos, except where they have been made for some special purpose. Yet, within small limits, the speed and E.M.F. may be taken as varying together directly, after the speed for which the machine was intended to run has been reached. The relations between the speed (limited by the strength of the armature), field, and resistance of the armature are the data which determine the E.M.F. and curve; and the diameter of the armature wire limits the current, which can be produced without injury to the machine. The general behavior and qualities of the dynamo have now been considered.

As to the cells, their E.M.F. is practically constant, but rises somewhat as the charging proceeds, and mostly at the end of the charge.

Three things may occur when the dynamo and cells are combined:

1. The dynamo may have an E.M.F. higher than that of the cells. In this event they will charge.

2. The E.M.F. of the two may be equal, consequently no current passes.

3. The E.M.F. of the dynamo may be less than that of the accumulator; or, in other words, it would be more correct to say that the building and dynamo leads are one and the same, with the accumulator placed between them in the same way as a lamp; it is necessary to examine what occurs when a current is flowing in these mains. Case 3 may be passed over, because, should it occur, it must be regarded as due to neglect or accident.

In case 1 it is evident that, so long as the E.M.F. is higher than that of the cells, all currents going to house mains must come from the dynamos; this, in fact, supplies the light and charges at the same time.

In case 2 half the current is supplied from the cells and half from the dynamos. But it does not, in practice, necessarily follow in this proportion, unless the resistance of the dynamo leads be extremely small and the internal resistance of the battery very low.

There is, however, one more case in considering the house leads. It is possible to raise the E.M.F. of the dynamo slightly above that of the cells, so as not appreciably to charge them, and yet supply the current to the house. This is termed the "balancing point," and the advantage is gained of obtaining a steady light. The charging current must not be switched on until the E.M.F. of the dynamo is higher than that of the cells, say from 5 to 10 per cent.; and the proper moment to switch on may be ascertained by observing a voltmeter. For the voltmeter may be substituted two lamps similar to each other placed side by side, one lit from the dynamo and one from the cells. The current is switched on when the lamp from the dynamo is observed to be the brighter one. But the best way is to have an automatic switch putting on the current when the correct E.M.F. is reached. Such an instrument consists of an E.M.F. regulator which sends a current to the mercurial switch when the E.M.F. is sufficiently high, and another current when it falls below the proper amount; thus making or breaking, by means of this controlled switch, the dynamo and accumulator circuit. The switch is made two-way to permit the current from the dynamo, when the charging current is broken, going through a resistance, passing a current equal to that for charging the cells, whereby shock to the machinery is avoided. Hence no difference is produced in the load at the moment of putting the current to the accumulator.

The construction of the E.M.F. regulator is as follows: A coil having a resistance of about 4,000 ohms surrounds two soft iron bars, one movable horizontally, being pivoted. For convenience the coil is divided into four sections, and is joined, voltmeter fashion, and those two points upon the mains where the charges in E.M.F. are to actuate the instrument. The bars of soft iron are bent in such a manner as to resemble when joined, two elongated letter "U's" with their curved ends joined together. When a current passes through the coil the whole system becomes magnetic; and in consequence of the peculiar form given to the bars, the movable one will be dispelled by repulsion and not by attraction, since the polarities at each end of the instrument are the same for both bars, the effect at one end being doubled by that at the other extremity. The movable bar at one end carries an adjustable weight similar to that of a steelyard. At the other it carries a short rod to which is attached a contact arrangement consisting of a holder with a thick wire of platinum in it. This movable swinging contact piece may touch an upper or a lower platinum contact fixed to the frame of the instrument. Its action is thus: in a 100-volt installation, if the weight is so adjusted that 110 volts is the pressure of the current traversing the coil, then the swinging contact touches the lower fixed contact, and a current passes through the movable arm to this fixed contact, and onwards through a wire to one end of the coil upon the magnet forming part of the controlled switch, which has the other extremity connected with the opposite lead, thereby causing the switch to act and place the dynamo on to the accumulator. When the E.M.F. falls below 108, the repulsion between the fixed and movable magnets is no longer powerful enough to overcome the weight, and the movable contact comes against the upper fixed contact, and a current is sent to the magnet coil on the controlled switch through another wire, which causes it to react in the reverse way, and the dynamo is taken off the cells. The weight may be adjusted for the instrument to work at any other E.M.F., but, if employed on circuit of very low pressure, naturally the coil would be wound with a lower resistance. The difference in the pressure between the putting on and taking off the cells from the dynamo is regulated by adjusting the difference between the upper and lower fixed contacts which permits of the movable contacts having a longer or shorter free swing. The longer the swing the greater will be the difference.

* Electric Light Installations and Management of Accumulators.

ELECTRIC CARS IN SIOUX CITY.—The electric street railway in Sioux City, Iowa, was tested on March 30th, and everything worked satisfactorily. A motor car was run over the line and created great enthusiasm among the citizens. The system used is that of the Sprague Electric Railway and Motor Company, and the plant cost $250,000. The system covers fifteen miles of track, much of it being double. Iron supporting posts are used in the business section of the town, and wooden ones outside. The power is derived from a 350 horse-power engine, and two Edison dynamos will be used. Each car will be lighted with three Edison incandescent lamps. It is expected that the line will be in full operation by the middle of the month. The rolling stock equipment will consist of 25 motor cars, 25 passenger coaches, and five combination motor and passenger cars. The citizens are jubilant over their electric road. Even the street car horses and mules have caught the infection, as noted by the reporter of a local daily paper. He is a keen observer, and remarks that these much abused animals "wore an expression of rest and peace on their faces."

MR. EDISON'S EARLY LAMPS.—In his early experiments with the incandescent lamp Mr. Edison used platinum, using fine wire of that material coiled into a spiral, so as to concentrate the heat, and produce incandescence. The same current, when the wire was stretched out, produced only a red heat. A metal rod, placed inside the coil, was so arranged that when the temperature approached the point of fusion, the expansion of the rod closed a short circuit, which reduced the current. The contraction of the rod produced by the cooling opened the circuit and increased the current, and consequently greater incandescence followed.

BRANCH OFFICE OPENED.—The Aluminum Battery, Electric Light and Power Company, of 96 Liberty street, New York, opened a branch office at Newark, N. J., April 7th. It is situated at the corner of Broad and Mechanic streets. This is the second branch office opened by this company, the first one being at New Haven, Conn.

VALUE OF A DYNE.—One dyne equals .00000224 + lb. One pound equals 445,900 dynes, approximately.

THE CONDENSER AND THE TANGENT GALVANOMETER.

A condenser consists of a number of alternate layers of tin foil and paraffined paper or some other dielectric, arranged in such a manner as to fulfill the requirements of a Leyden Jar. (Fig. 1). The straight vertical lines represent the sheets of tin foil and the spaces between them the paraffined paper. One series of plates indicated by the lower projecting lines, and which constitutes the outer coating of the condenser, is fastened together and attached to one of the binding posts *G* connected with the ground. The other series (corresponding with the inner coating of the Leyden Jar) is bunched together in sets, each set being attached to its respective plug block bearing the figures which correspond with the number of plates in that particular set.

The number of such plates usually employed in a condenser of the Western Union pattern is 100 (except where a higher capacity is required) divided up into series of 4, 8, 16, 32, and 40. When the plugs are all inserted the condenser measures its full capacity, but will have only a fractional part of its value when any of the holes remain unplugged. For instance, if the total capacity of the condenser be five microfarads



FIG. 1

(M. F.'s) the respective value of each plugged series will be as follows:

4 sheets =	$\frac{4}{100}$ of 5 M. F. =	.2 M. F.
8 sheets =	$\frac{8}{100}$ of 5 M. F. =	.4 M. F.
16 sheets =	$\frac{16}{100}$ of 5 M. F. =	.8 M. F.
32 sheets =	$\frac{32}{100}$ of 5 M. F. =	1.6 M. F.
40 sheets =	$\frac{40}{100}$ of 5 M. F. =	2.0 M. F.
100 sheets =	Total,	5.0 M. F.

A microfarad is the one millionth part of a farad, which is the unit of capacity, and is equal to the charge which would be produced in a condenser of unit capacity by an electromotive force of one volt acting through a resistance of one ohm in a second of time.

The object of the condenser has been briefly stated in its connection with duplex and quadruplex working, and it need only be remarked here that when a current of electricity flows from a battery into that series of plates connected with the line side of the condenser, it acts inductively across the dielectric upon the opposite plates connected with the ground, causing each series to become charged with an unlike kind of electricity. The reciprocal attraction of these two different charges permits the electricities to accumulate and become fixed upon the opposite surfaces of the plates until connection with the battery is broken. When this occurs the fixed electricities are released and the discharge which takes place is utilized to overcome the effects of a similar discharge taking place from the line wire.

THE TANGENT GALVANOMETER.

In Fig. 2 is shown the arrangement and connections of the coils and resistances of a very useful and convenient form of tangent galvanometer in use at many of the large offices of the Western Union Telegraph Co. for general testing purposes.

It is provided with five coils of wire of 0, 1, 10, 50, and 200 ohms resistance respectively, wound in a groove in the circumference of a ring, which is the essential feature of this kind of galvanometer. The method of connecting up the various coils with their brass blocks, correspondingly numbered, will be sufficiently understood by reference to the figure. There are also three resistance coils of 10,500, and 5,000 ohms respectively, placed in the base of the instrument and arranged in the manner seen at the right hand side of the figure Any of the last-named coils can be cut out of circuit by inserting a plug in its proper place.

A current entering the right hand terminal post of the galvanometer and leaving by the left hand terminal, with the plugs inserted as shown, would short circuit all the coils on the right, and simply pass through the 0 coil of the galvanometer, which consists of a copper strip offering practically no resistance to the current This coil is chiefly used for battery measure-

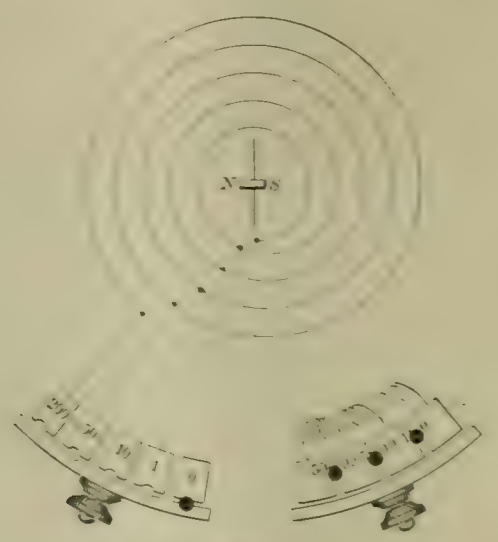


FIG. 2

ments and for currents of great strength, which would too powerfully affect the needle in passing through a larger number of convolutions. By removing the plug from 0 and inserting it in any of the other plug holes, the coil or coils, whose total resistance is marked opposite, are included in the circuit.

The small magnetic needle *NS* is placed horizontally in the centre of the circle and should stand parallel to the coils after taking up its natural position in the magnetic meridian, or, in other words, when it is pointing north and south. The needle is provided with an index pointer, attached at right angles to it, for reading off the deflections of the needle on either of the scales provided for that purpose. One of these scales is graduated to true or geographical degrees and the other to divisions proportional to the tangents of those degrees.

Now, as the currents deflecting the needle are proportional to the tangents of the angles of deflection, it will be necessary, if we take our readings on the degree scale, to convert those readings to tangents by reference to a table of tangents and then work out the formula having reference to the strength of currents. If, for example, one current gives a deflection of 10° and another of 20° their relative strength will be as

$$\tan 10^\circ : \tan 20^\circ.$$

Now, $\tan 10^\circ = .176$, and $\tan 20^\circ = .364$; therefore the strengths are as 1 : 2.07 (nearly).

If, however, the readings be taken on the tangent scale no reductions are necessary, as the deflections are accurately proportional to the tangents, and a current which drives the needle through twenty such divisions will have double the strength of one which drives it through only ten divisions, and so on, so that for equal increments of current there are equal increments of deflection.

The tangent divisions are, however, much closer together than those of the ordinary degrees, and the liability to error in taking observations is greater, hence it is considered desirable, when time is no object, to use the degree scale and work out the results in the manner described.

THE LONG DISTANCE TELEPHONE

When the long-distance telephone system was established it was predicted by many enthusiasts that the business of the telegraph companies would be to a great extent absorbed by the telephone. This prophecy, however, never materialized. On the contrary, the long distance telephone has actually increased the business for the telegraph companies. In a recent conversation with a prominent officer of the long distance telephone company a representative of the ELECTRIC AGE learned some very interesting facts. During the conversation on the above-named subject the gentleman in question stated that the long-distance telephone had not robbed anybody or any company of his or its business or any portion of it. The telephone had created a business of its own, for the transaction of which no other known medium of communication could be used. An instance of this was a recent meeting of directors of a large corporation. The meeting was held in New York and there were two or three directors in Boston who found it quite impossible to get to New York, but whose presence at the meeting was necessary. The long-distance telephone was brought to the rescue of the directors in their dilemma. The Boston directors were previously notified to be on hand at the appointed hour, in their Boston office, that the meeting would be held, and that the telephone would be used for the purpose of communication between the separated parties. The transactions of the meeting were accordingly heard by the Boston gentlemen over the telephone, and they were kept as well posted of everything that was done as though they were present in New York in person. The Boston party cast their votes over the telephone, which were duly recorded "The Courts have held that telephonic affirmations are legal," said the gentleman, "so there is no reason why a quorum cannot be made up in this way at any time, and a meeting held."

"Now, this is an example of one class of business that the long-distance telephone has created for itself," continued the speaker. "No telegraph nor mail service could answer the purpose to which the telephone was put in this case."

The official told of another case of peculiar use to which the telephone was put. A merchant in this city who had a long distance telephone in his office wanted to close a business transaction with a gentleman who was present in the former's office. The merchant's partner was in Philadelphia, and it was necessary for him to be a party to the transaction. The telephone was brought into use and the two partners closed the deal with the third party Before the telephone was pressed into service, however, the New York partner came to the telephone headquarters and requested that the mouth-piece of his 'phone be adjusted in such a way that he could talk to his partner and at the same time look directly into the face of the gentleman with whom the transaction was to be carried on. His reason for this was that when he transacted any business with any man he wanted to look the man square in the face, and the way the mouth-piece was then placed, he

could not do that and talk to his partner at the same time. The position of the mouth-piece was changed to suit him, and the deal was made to his entire satisfaction in consequence.

The nearest approach to infringement on the telegraph business is the use of the telephone for newspaper press dispatches. This service is as yet, however, limited. A Philadelphia daily paper gets some of its news by telephone direct from New York, and heads such "By Telephone." Probably the first instance of such use of the telephone is that between Chicago and Racine, Wis. The Associated Press has for some years been sending news to a Racine paper by telephone. The United Press serves papers in Port Jervis, Middletown and Poughkeepsie, N. Y., by telephone from Newburgh.

After the interviews THE ELECTRIC AGE representative conversed over the telephone with a gentleman in Boston, and the clearness with which the words were reproduced was remarkable. The same was the case in subsequent conversation with Troy, N. Y. There was an entire absence of all the inductive effects so common on local telephones In this connection the officers of the American Bell Telephone Company say thatbefore long the telephone system of New York will be a joy instead of a nuisance. It is much more satisfactory to talk with Boston or Philadelphia than between any two points in the city. This is because the longest circuits are metallic, while most of the local circuits are completed by a ground connection. With such a circuit induction is inevitable, so the company is gradually making its local circuits all metallic.

LINK BELTING.

For the successful operation of a dynamo it is absolutely necessary that the speed of the armature should be steady. The transference of the power of the engine to the dynamo is usually effected by belting, and great care is necessary to avoid any unevenness in the motion. Defects in the construction of belting are liable to cause variations in the speed of the armature, and frequently a bad joint in the belt is sufficient to affect the light in circuit by the jar produced in the armature by the poor joint. Many improvements have been made in the manufacture of belting with a view to obviating all of these difficulties, but the most successful results have been obtained by the American Leather Link Belt Company, of this city. Their link belting is well known, and is very extensively used in electric light stations.

Belting made from links of leather is an old device, and was originally intended to utilize

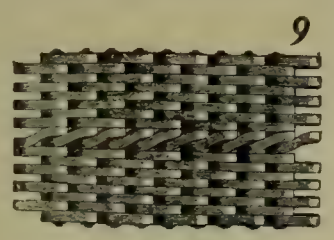


FIG. 1.

scrap-leather; but it was soon found that such a grade of stock would not answer for the belt made by this company, and in their American Patent Joint Link Belt they use only the most solid parts of pure oak tanned leather, each piece being carefully selected before the links are cut.

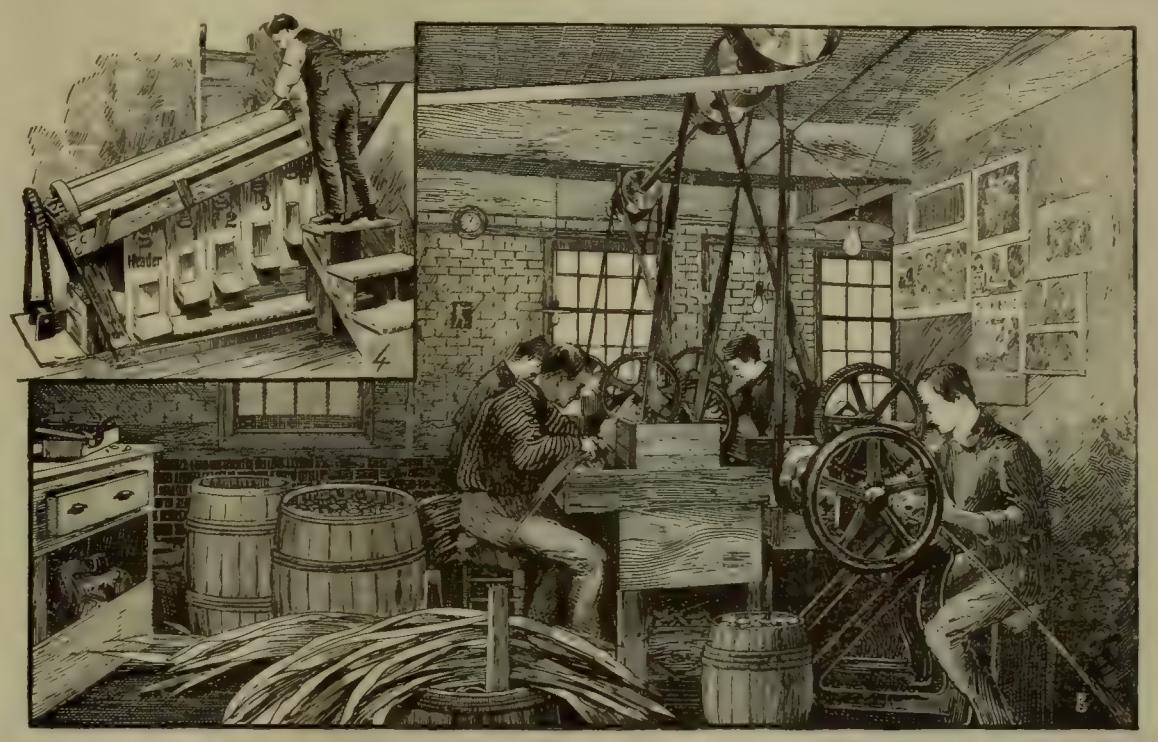
When the President of the company, Mr. Charles A. Schieren, undertook to introduce the "Original" Link Belt into this country, he found that the belt as then made, with one bolt to its entire width, was not sufficiently well adapted to positions where the pulleys were crowned, and after various trials and experiments the American Patent Joint was finally adopted as being far superior to any other, in retaining an equal strength in all parts of the belt and insuring a perfect adaptation to the crowning of a pulley, besides bringing the belt to a bearing surface of its entire width; and now, after three years' trial, this American Joint (see Fig. 1) has proven an entire success.

The leather is carefully selected, only the most solid being used. It is then cut into links, the machinery for this work being of special design and is now considered the most complete machinery in existence for the purpose (see Fig. 2).

making the belt ready for the last but one of the most important features, that of sand papering and stretching. This sand-papering brings each link down to a perfect bearing surface leaving it perfectly smooth, and taking from the belt all possible stretch.

A bolt cutting and a burr machine have lately been added to the plant, as they were found necessary in order to get wire of a uniform temper and to enable the company to fill orders for odd widths more promptly.

The use of link belting has the advantage of



FIGS. 2 AND 3—ASSORTING AND CUTTING MACHINES.

causing less strain on the machinery and keeping the heating of the bearings at a minimum, and for the reasons already mentioned it is of special value in the operation of dynamos.

After the links are cut they next pass through the assorting machine, a most effective arrangement (Fig. 3), which assorts them very accurately into five different thicknesses; the thickest links are used for headers or outside links, and are counter-sunk on the drilling machine (Fig. 4) to bring the bolt end or burr flush with edge of belt.

After this assortment they pass to the building up tables (Fig. 5), which are adjustable, and allow the making of a belt from two to



FIGS. 4 AND 5—DRILLING MACHINE AND BUILDING UP.

twenty-four inches in width, and in clamping are held in proper position for riveting. This machine required a great deal of study to bring it to its present state of perfection.

After the belts are riveted they are passed through the laying over or flattening machine which throws back the hinge or joint into place,

EDISON ENGLISH PATENTS.—It is said that the Edison-Swan Company, of London, are taking steps to enforce their rights under Edison's "feeder" patent of 1880. In commenting on the subject the London *Electrician* of March 14th, says: "Although it may be said of this, as indeed of almost every other patent in existence, that anyone setting himself to solve the particular problem in question would probably have arrived at the same result; it must be admitted that Edison had at a very early date grasped the difficulties of the case and the best way of overcoming them."

SOME POINTS ON DYNAMO AND MOTOR DESIGN.

(*Continued from page 5*).

given presently—that the heat generated in the winding shall be constant. Since the waste is constant, the point of maximum efficiency coincides, then, with that of maximum output. If the copper on the outside of the armature is considered as a shell of t thickness, we may, within the limits of our enquiry, take the current that may be carried to generate the same heat $= \sqrt{t}$. The E.M.F. produced will be proportional to the radial depth of the armature core r, and assuming in each case the same degree of saturation, the greatest output for a given radial depth of armature is obtained when $r\sqrt{t}$ is a maximum. This occurs when the exterior layer of copper is about one-fourth the depth of the armature core, the output for different proportions between iron and copper being shown by the curve, fig. 21. In the diagram the base line, A, B, represents half the radial depth of the armature over the winding, distances measured from left to right giving the thickness of the exterior shell of copper. The ordinates represent the output. A dotted line, C, D, is erected at the point of maximum. It may be assumed, without any great error, that the weight per unit length of circumference is constant, however the proportions vary, so that the curve may be taken to represent maximum output for a given weight as well as for given dimensions. With a square or bar winding this is about correct.

It will be observed that the relation of copper to iron can be varied considerably without making much difference to the output. An armature, for instance, in which the core is six times the thickness of the copper, gives the same efficiency as one in which the relation is 2.75, and the output is in each case only 3 per cent. below the maximum. The relation for greatest efficiency is quite independent of the degree of saturation to which the core is carried, or the temperature at which the machine is worked.

The effect of hysteresis is to reduce the height of the ordinates, and to displace the point of maximum efficiency to the right. The current which can be taken from the armature is a little greater than $\sqrt{t}$, on account of the heat from hysteresis diminishing as the core is reduced in thickness. But imagining that in all cases the core is saturated to the same degree, the difference in the amount of heat generated from this source is, within the limits of practice, so small a percentage of the whole that its effect on the shape of the curve may be quite neglected.

Machines are not always designed so that the proportions give maximum output, since other considerations arise besides that of the best result from the armature considered by itself. The question of magnetizing the core has to receive attention, and the question is resolved into, what is the best proportion for the machine, considered as a whole? The answer to this depends entirely upon the design. In the Phœnix dynamos we work between the limits given by the two vertical dotted lines, E, F, and G H, in fig. 21, finding that there we obtain the best results. If we worked to the right we should get a greater output, we should have a greater air gap, a diminished flux through the armature core, but, on account of the increased stray field, about the same flux in the magnets. The magnetizing force and the compensating turns on the magnets would be increased somewhat, while the cross induction would remain about the same. As regards this last point, it is worthy of note that the tendency to sparking, with the usual clearance spaces remain about the same for considerable variation in the proportion of copper to iron. Increasing the copper does not increase the length of the air gap in the same ratio, but in a ratio rather greater than $\sqrt{t}$, or than the current which can be taken from the armature. At the same time the radial depth of the core is diminished the final result being that $\frac{A_2 \; w'}{r}$ is about constant within the limits of practice. For drum armatures the relation for maximum output can be similarly determined, and similar conditions fix the limit of departure from the maximum. One point with reference to these considerations should be noticed, and that is, that neither for cylinders nor drums does the point of maximum efficiency or output coincide with the point at which $\frac{\text{watts}}{\text{weight of copper}}$ or $\frac{\text{volts}}{\text{yards of copper}}$ is a maximum, and that these ratios, as applied to compare the performance of dynamos, are accordingly misleading. Given a limiting temperature, the only factors upon which the commercial value of machines should be based are cost and commercial efficiency. Whether the magnets shall be made of wrought or cast iron, whether there shall be a large amount of copper or a small amount, are questions for the manufacturer to decide. In some cases it may pay him to increase the copper and use cast iron, in other cases diminish the copper and use wrought iron. But the finished product is to be judged by its cost to purchase and its cost to run.

14. Motor Designing.

These considerations naturally bring us to the subject of motor designing, about which there has been expressed from time to time a good deal of difference in opinion. From the preceding section it will be perceived how far we can go in the direction of getting an increased output from a given weight of armature; and it will have been understood from Section 4 that with somewhat lighter field magnets and a reduced saturation in the armature, a larger yield can be obtained for the total weight, though smaller for the armature itself. As a general rule, the question of weight does not enter into dynamo designing, except in so far as cost is affected, and a lighter machine means a somewhat increased cost for the output. But in motors it is sometimes necessary to keep the weight as low as possible, and the point to be emphasized here is that in designing light weight motors we proceed upon lines precisely similar to those adopted in designing light-weight dynamos.

It has been asserted that in motors the armatures ought to be larger compared with the field magnet than in dynamos; and by "larger" must be meant either that the armature cross section is greater, or that the ampère-turns on it are more numerous. As regards the former, it has been shown in Section 4 to what extent the relation between the cross sections of the armature and fields influences the dynamo, and the same reasoning applies to motors; as regards the latter, curiously enough, the examples which I have given in Tables II. and III. show no overloading, but about the same number of ampère-turns is carried as by dynamo armatures—a fact which does not favor the "large armature" school.

My own experiments with series machines, in which the brushes had equal lead and trail when running as dynamo and motor, seems to show that the difference in the E.M.F. generated under these two circumstances is negligible. In Table IV. are given the results.

The cores of the Gramme and Pacinotti armatures were constructed of iron washers separated from each other by paper, while the Bürgin armature consisted of a series of hexagonal rings made of iron wire, each forced on to a six armed gun metal spider. The small differences in the last column may be readily accounted for in the case of the Gramme and

Table IV.—Series Machines Run as Generator and Motor.

Machine	Revolutions per minute	V_1	V_2	C.	$V_1 + CR$	$V_2 - CR$.	Diff
				Gramme Armature.			
Phœnix	820	58	136	12.0	98.00	96.00	−2.00
	1,700	134	168	5.0	150.60	151.30	0.70
	1,800	146	168	4.5	151.00	153.00	2.00
				Pacinotti Armature.			
Phœnix	820	47	80	4.5	63.00	64.00	1.00
	940	58	96	5.0	75.30	78.70	3.40
	1,295	87	130	6.0	107.70	109.30	1.60
	1,430	104	152	6.75	127.30	128.63	1.26
	1,520	106	158	6.75	131.13	132.87	1.74
				Bürgin Armature.			
Bürgin	500	16	116	14.0	64.67	67.40	2.73
	640	36	130	12.5	79.46	81.54	7.08
	720	60	98	4.25	74.11	83.89	9.78
	780	59	148	10.0	93.77	103.23	9.46
	850	66	142	9.0	97.30	110.70	13.40
	840	72	118	4.5	87.00	103.00	16.00
	860	70	144	8.75	100.40	113.60	13.20
	1,100	104	152	4.75	119.77	136.23	16.46
	1,180	114	164	5.0	130.60	147.40	17.20

V^1 = Difference of potentials at terminals as generator.
V^2 = Difference of potentials at terminals as motor.
C = Current, in ampères
R = Resistance of machine in ohms.

Pacinotti armatures by errors of observations, as several things had to be measured simultaneously; but no allowance for errors can account for the difference in the case of the Bürgin machine. I talked over these experiments at the time with Mr. Kapp, who suggested that the difference might be due to parasitic currents arising from imperfect lamination, the forcing of the hexagonal rings on the spiders bringing the wires of the core into actual contact at the corners. When the currents are flowing in the same direction through the machine, the armature rotates with reference to the field in the opposite direction of course as generator and motor. Now, apart from the question of parasitic currents, with an irregularly formed armature like the Bürgin—and the Brush with its eight or twelve projections would come in the same category—one is not surprised at a difference in the E.M.F., the wonder would be if the direction of rotation did not alter the field. But with a Pacinotti ring in which the slots are many and close together, the influence on the field is slight and with smooth Gramme armatures the field is not affected by the direction of rotation at all, so we get the same E.M.F. produced as generator and motor.

It must be remembered that the effect of the armature current on the field in cylinder machines is by no means small, as will have been observed by the number of compensating turns required to neutralize it. A machine having 13,500 turns on its armature would have about 20,000 on its field magnets, out of which about 4,500 are compensating turns. I mention this to show that the results in Table IV. were not obtained from machines in which the armature effect was negligible, or anything approaching it. The saturation of the core was about 17,000 C.G.S. units.

If a machine is run at the same speed as dynamo and motor, provided the currents in the fields and armature are similar, it will always have a higher efficiency as a motor. If E is the E.M.F. generated by the machine, c the current (imagine it series wound), and R the resistance, the electrical efficiency as dynamo and motor are in the ratio of $\frac{cE - c^2R}{cE}$ to $\frac{cE}{cE + c^2R}$ the latter being the greater quantity. If we designate all the other losses save that due to the resistance by p, then for the commercial efficiency we have $\frac{cE - c^2R}{cE + p}$ and $\frac{cE - p}{cE + cR}$. If p had the same value as c^2R, the efficiency of dynamo and motor would be similar; but since p has always a lower value than c^2R, the motor has still the advantage.

(*To be continued.*)

ELECTRIC WELDING.

Speaking of electric welding, says an exchange, an English scientific journal bewails the fact that the United States is so far ahead of England in its practical application. Welding by electricity opens up a new and vast field of enterprise the limits of which cannot be seen, and it is a matter of congratulation that we were first in the field, and are now foremost in its practical application and development. Briefly, electric welding consists of permanently joining metals by softening their ends by the intense heat generated through the resistance offered, at the point of junction, to an electric current, and then pressing them together. The current necessary to effect this result is one of low pressure but large volume. It is difficult to understand that a current of electricity that is sufficient to fuse the ends of bars of iron two inches in diameter and to melt them together, so to speak, is not in the least dangerous to handle. In fact no appreciable shock whatever would be felt in receiving a full current of this kind, because the difference of potential wherein lies the danger to life, would be so small. Electric heat depends upon quantity more than quality, if the untechnical term may be allowed. Electricity in sufficient quantity to light half the city, or melt an iron bar like a tallow candle, could be produced by filling the dome of the State House with the proper solution and placing therein the proper metals; yet its intensity would be slight—but one volt—and would not in the least affect the human body. The current generally used for electric welding, however, is not of voltaic origin, but is generated by the dynamo, the high tension current of which is transformed into one of low tension and large volume by means of a converter, which can be wound to reduce the pressure to any desired tension and proportionally increase the volume. In some machines the dynamo is combined with the welding apparatus, the armature containing two separate windings, one of fine wire, in series with the field magnet coils, and another of very low resistance, being formed of U-shaped bars of copper. No commutation is necessary, as the alternating current is well adapted to heating, and the terminals are therefore connected directly with the clamps that hold the bar, or whatever is to be welded, to the welder. Another style of machine receives its electric heating energy from a separate dynamo, which may also operate several more welding machines. The former is called the direct system, and the latter the indirect system. In the direct system the current may be regulated by a resistance placed in the shunts of the exciter. The wire or bars or whatever is to be welded is fastened to the clamps, the amount of the piece of metal left projecting varying according to its diameter, the object in this being to allow for the conduction of heat away by the clamps themselves. The actual operation consists in bringing the ends of the metals together and then turning on the current As the current passes across the juncture the resistance offered there to its passage causes friction enough to raise the temperature sufficiently to soften the metals at those points. When they become soft enough they are pressed slightly together completing the weld. At the moment of the completion of the weld the current is automically cut off without the attention of the operator being necessary. This welding may be used by the jeweller for his delicate work or to join the links of a massive cable chain. Wheel, tires and axles, wires of all kinds, tubes where inequalities in the interior are not wanted, riveting of boiler plates, girders, etc, bars of copper, iron, etc., in fact everything where a perfect weld, homogenous with the solid parts is required. The welding machine may also be employed in heating bars for the purpose of bending, twisting, or forging them. Investigation by naval officers recently resulted in a report recommending that welding machines be made a part of the war ship's equipment doing away with the present cumbrous and inadequate blacksmith's shop. By its aid costly steel tools, that had to be thrown away when but half worn, can be welded to a bar of iron and great saving made. Prof. Alexander B. Kennedy, late of the University College, London, is now in the United States, studying electric welding as practised here, in the interests of a syndicate of English capitalists, who have purchased the patent rights of England and propose to begin operations as soon as Mr. Kennedy makes the result of his investigations known.

Mr. Edison's New Laboratory at Charlotte.—Mr. Thomas A. Edison is impressed with the idea of mineral richness in the Appalachian range and has established a laboratory at Charlotte, N. C. Mr. Edison is particularly attracted by the gold sulphurets, which he proposes to separate from the baser materials by the aid of electricity, dispensing with the old chlorine process, which costs from $6 to $7 per ton. Electricity, according to Mr. Edison, is much the cheaper agent, and by its use ores containing but a small per cent. of the sort for metal can be worked with profit when it could not before be used. His process of eliminating phosphorus from iron magnetites and his method of concentrating iron ores having too small a percentage of metal to be worked by the ordinary process, if successful, will have a direct bearing on the mineral development of the South. The low grade sulphur ores of the South carry nickel, gold, silver, copper and tin, and this erstwhile worthless ore Mr. Edison proposes to transmute into deposits of immense value.

A Large Electric Road Enterprise.—It is said that Jay Gould and Cyrus W. Field have a scheme in hand for connecting near Long Island towns with Brooklyn by means of extensions to the electric railroad now owned by them, which connects east New York and Jamaica. Experience has shown that electric railroads extending outward into the suburban towns from a large city invariably advances the price of real estate along the route and home-seekers from the city are attracted by the better building conditions.

Boston Electric Cars.—Much dissatisfaction is expressed in Boston over the compulsory slow speed of the electric cars in certain parts of the city. The ordinance recently passed by the city council prohibits a greater speed than seven miles an hour, and why this restriction is placed on electric cars when horse cars were permitted to travel at greater speed in some quarters, is a mystery. Experience has proved that electric cars are more easily brought under control than are horse cars, hence it cannot be urged against them that they are more dangerous than the latter.

Lighting Carriages by Electricity.—Colonel North, who is in Paris, has had his private carriage lighted by electricity with energy furnished by storage batteries which are placed outside under the driver's feet. The lamp can, of course, be turned off or on at pleasure. In front of the driver is also a dial on which such legends as "Stop," "Home," "Drive fast," etc., appear on pressing a button on the inside.

Electricity *vs.* Steam.—It is stated by a prominent coal dealer of Elmwood, Ill., that electricity applied to certain work in mining reduces the cost to a remarkable extent, the relative cost being, citing the driving of pumps by steam and by electricity, $1,200 by steam and $390 by elecrricity. The cost of operation is much less, and that of extension still more so.

An Old Light.—The arc light is of greater antiquity than is generally supposed. It was known at the time of Noah.

ELECTRIC LIGHTS IN BERLIN.

In Berlin the wires have been carried underground from the start, and no difficulty has been experienced. Instead of adding new ugliness to the streets, the arc lights of Berlin are things of beauty, an artistic embellishment to the city. Unter den Linden is probably the most brilliantly and beautifully illuminated street in the world. Along each side and down the centre the arc lights are set even more closely together than ordinary gas lamps, and the effect at night is that of great strings of white, gleaming pearls. The posts consists of great iron standards, with tasteful ornamentation and curving over at the top. Here the globe is suspended, inclosed in a coarse network, so that, in case it breaks, the pieces of glass may not fall on passers. From the globe there hangs a light chain, with a ring in the end, and there are counterbalancing weights inside the post, so that the lamp is quickly and easily attended to by pulling it down with a light stick, with a hook in the end; a great improvement, in the economy of time and trouble, over clumsy methods of either climbing the post or lowering the light by an unwieldy andugly crane.

Default on Electric Accumulator Bonds.—Oliver J. Geer and D. Fahnestock, as mortgage trustees, have brought suit in the Supreme Court against the Electrical Accumulator Company to have a receiver appointed, and to restrain stockholders from interfering with the company's property. Several years ago the company executed a mortgage for $1,000,000 upon its New York and New Jersey property and its patents to secure first mortgage bonds, which have been issued to the amount of $957,400. Default has been made in the redemption of the interest coupons of June and December, 1889.

Telephone Prosperity.—Some interesting figures are presented in the annual report of the Bell Telephone Company. The net earnings were increased in a manner very satisfactory to the shareholders. The report shows that there are no less than 444,861 telephones under rental, and a wire mileage of 193,213. There are 27,676 miles of wire underground. When it is considered that the telephone industry is scracely a dozen years of age its phenomenal development might be classed as one of the modern wonders.

Electric Railway in Victoria.—The new electric street railway at Victoria, B. C., has been completed. Tests have been made and everything found to work well. It is said a uniform speed of twelve miles per hour will be maintained. Each car weighs six tons and can comfortably carry from twenty-six to thirty-five passengers. The citizens are elated over the event.

Specimen of an English Joke.—Electricity is evidently becoming popularized, as it is now forming the subject for jokes in the comic papers. The following is a specimen:—"Old Mr. Testy (*returning to his room after paying the hotel bill*): 'Don't touch me! I'm not sure about my insulation, and I've just been so heavily charged that I'm dangerous."

The Telephone in Denmark.—The government of Denmark has erected fifty telephone stations, chiefly on the west coast of Jutland, for the use of fishermen, who are thus able to communicate with the fish dealers at a distance and secure better prices. All the life-boat stations in the country are also connected by telegraph and telephone.

Telephone Infringements.—The American Bell Telephone Company has begun equity proceedings in the United States Court for injunctions to restrain twenty-seven parties from using telephones alleged to be infringements upon the company's patents.

To Preserve Specimens of a Language.—The phonograph is to be utilized in preserving the language of the Passamaquoddy Indians, by a plan arranged by the Massachusetts Society.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED APRIL 1st.

424,363. Thermostat. William F. Singer, Carthage, assignor to the Singer Fire Alarm Company, of Buffalo. (Limited). Buffalo, N. Y. Filed Mar. 11, 1889. Renewed Feb. 27, 1890.

424,364. Electric Railway. Edmund P. Slentz, Idlewood, and James B. McGrew, Pittsburg, Pa., assignors of three eighths to John A. Snee, Pittsburg, Pa. Filed Aug. 13, 1889. This is an improvement in the method of carrying currents in underground troughs and means for utilizing the same.

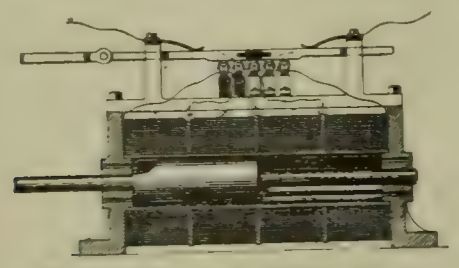
424,371. Removable Truck for Electric Cars. John Stephenson, New York, N. Y. Filed Jan. 2, 1890.

424,372. Electric-Car Truck. John Stephenson, New York, N. Y. Filed Jan. 16, 1890.

424,373. Electric-car-truck Frame. John Stephenson, New York, N. Y. Filed Jan. 16, 1890.

424,374. Trolley Bridge. John Stephenson, New York, N. Y. Filed Feb. 4, 1890.

424,380. Combined Conduit and Overhead System for Electric Railways. Charles J. Van Depoele, Chicago, Ill. Filed June 6, 1888.



NO. 424 535.—ELECIRIC MOTOR.

An electric-railway system comprising an underground conduit extending along a portion of the line of way, a vertically-movable contact-making device therefor, and an inclined plane at the terminus of the conduit for automatically ejecting the contact device.

424,381. Trolley-Arm for Electric Railway Cars. Charles J. Van Depoele, Lynn, Mass. Filed Oct. 17, 1889. The combination with a trolley-arm and means for imparting an upward pressure thereto, of a check-line connected to its outer or free end and acting to limit the upward movement thereof, and a supplemental cord or loop on said check-line, and a hook for engaging the loop when the trolley-arm is in horizontal position.

424,387. Burglar-Alarm. Nelson M. Watson, Ecorse, assignor of two thirds to John B. Goundry and William A. Chamberlain, both of Denton, Mich. Filed Oct. 15, 1889.

424,401. Electric Meter. William J. Bagby, Atlanta, Ga. Filed Nov. 18, 1889.

424,403. Electric Heating and Cooking Device. Henry R. Butterfield, Waterville, Me., assignor to the Butterfield & Mitchell Electric Cooking and Heating Company, same place.

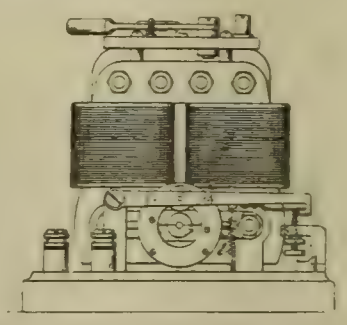
424,404. Electric Flat Iron. Henry R. Butterfield and Willis Mitchell, Waterville, Me. Filed Jan. 3, 1890. The heat is maintained by an electric current passing through a coil in the interior of the iron.

424,406. Commutator. William F. D. Crane, Philadelphia, Pa. Filed Jan. 10, 1890. A Commutator for a dynamo electric machine or motor, having its commutator-segments clamped between heavy molded or cast rings of vitreous or earthy material.

424,436. Electric Railway Motor. Frank J. Sprague, New York, N. Y., assignor to the Sprague Electric Railway and Motor Company, same place. Filed Mar. 30, 1889. The combination, with a wheeled truck or vehicle, of a plurality of independently flexible-supported electric motors thereon, and independent power-transmitting connections between the armature-shafts of said motors and the wheels of said truck or vehicle, substantially as set forth.

424,493. Tablet for Telephones. John B. Morris, Cincinnati, Ohio. Filed Sept. 9, 1889.

424,535. Electric Motor. Leo Bock, Jr., New York, N. Y., assignor by direct and mesne assignments, to himself and Charles L.



NO. 424,595.—REGULATION FOR ELECTRIC MOTORS.

Wright, same place. Filed Apr. 13, 1889. The combination, with a reciprocating armature, of a series of solenoids acting thereon to cause its reciprocation, and circuit-connections and contact devices whereby the direction of current in the solenoids is reversed and the polarity of the armature thereby reversed during its reciprocation.

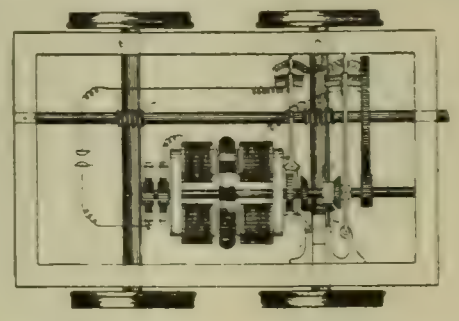
424,544. Marine Electric Light. Alexander G. Donnelly, New York, N. Y., assignor of one-half to Alden Solmans, South Norwalk, Conn. Filed May 4, 1889. This is a system of illuminating harbors or channels by electric lights placed on buoys, and by means of proper conductors connected with a source of electricity on shore.

424,562. Lightning-Arrester. Osborn P. Loomis, Brooklyn, N. Y., assignor to the Eureka Electric Company, of New York. Filed Aug. 19, 1889.

424,563. Lightning-Arrester. Osborn P. Loomis, Brooklyn, N. Y., assignor to the Eureka Electric Company, of New York. Filed Aug. 19, 1889.

424,575. Electrical Insulation. Thomas S. Reed, Jersey City, N. J. Filed Dec. 5, 1888. This invention consists of covering conductors with a layer of filaments or spun glass, and braided with textile fibre for protection.

424,595. Regulation of Electric Motors. Sigmund Bergmann, New York, N. Y., and



NO. 424,699.—ELECTRIC CAR MOTOR.

George S. Scott, Lakewood, N. J. Filed Nov. 23, 1889. Claim 1 reads: The combination, with an electric motor, of a regulator consisting of arms pivoted in place at one end, a spring for drawing the same together, a projection from each of said arms together forming an expansible cylinder or wheel, and a lever or arm extending over said projections in the direction of the arms, and arranged in the electric circuit.

424,606. Choking Electric-Magnet. Ludwig Gutman, Fort Wayne, Ind. Filed Dec. 12, 1888.

424,607. Method of Operating Electric Railways. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, Boston, Mass. Original application filed Nov. 30, 1886. Divided and other application filed Apr. 2, 1889. Again divided and this application filed Oct. 10, 1889. This is a method of controlling two or more electric motors in multiple-arc connection, by shunting more or less of the current around said motors, according as the numbers of said motors in circuit decrease or increase.

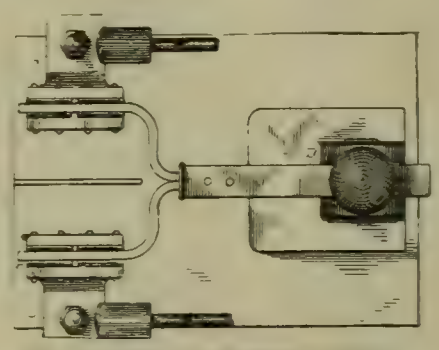
424,617. Thermostat. William P. Powers, La Crosse, Wis. Filed Nov. 26, 1889.

424,635. Electric Call. Frank B. Wood, New York, N. Y. Filed June 22, 1888.

424,665. Safety Device for Electric Circuits. Charles G. Young, New York, N. Y. Filed Jan. 22, 1890. This invention consists of a means of opening the main line at the generator on the rupture of the former.

424,695. Suspended Switch and Traveling Contact for Electric Railways. Charles J. Van Depoele, Lynn, Mass. Original application filed Mar. 12, 1887. Divided and this application filed Oct. 22, 1888. This invention provides means for crossing overhead conductors and for switching.

424,699. Electric-Car Motor. Edward M. Bentley, New York, N. Y. Original application



NO. 424,739.—ELECTRIC SWITCH.

filed July 10, 1885. Divided and this application filed July 30, 1887. This is a method of reversing the direction of a car driven by an electric motor by disconnecting the motor, at the same time regulating the motor to prevent racing, and then connecting the motor with the propelling mechanism in the reverse sense.

424,703. Electro-Magnet. George D. Clarke, Chicago, Ill. Filed Mar. 30, 1889.

424,725. Electric Indicator. Major D. Porter, Newton, Mass., assignor to the Porter Electric Messenger Company, of New York. Filed Aug. 10, 1885.

424,726. Electric Indicator. Major. D. Porter, Brooklyn, N. Y., assignor to the Porter Electric Messenger Company, of New York. Filed Oct. 17, 1885.

424,729. Electric Trap. Francois Scherer, Paris, France. Filed Dec. 14, 1889.

424,734. Electric Motor. Lawrence T. Smith, Providence, R. I. Filed Dec. 26, 1888. This is an electric motor having the cores of the armature and field-coil composed of non-magnetic material, and having the winding of the drum armature arranged to form a closed coil, and, further having the conductors arranged to receive at the same instant an alternating current of electricity.

424,739. Electric Switch. Charles S. Van Nuis, New Brunswick, N. J. Filed Sept. 28, 1889. This switch has two pairs of spring plates, each pair forming one terminal of a circuit. The blades of the forked connector enter between the plates of each terminal completing the circuit.

424,751. Electrical Conductor. John A. Barret, Brooklyn, N. Y. Filed Nov. 6, 1889.

424,752. Arc Lamp. Ralph H. Beach, St. Paul, Minn., assignor to Charles F. Diether, Samuel B. Diether, and Peter Ruenitz, all of same place. Filed Aug. 12, 1889. This is an improvement in the feed mechanism of arc lamps.

ANSWERS TO INQUIRIES.

Editor ELECTRIC AGE.—Can you tell me through the columns of your valuable and interesting paper what is the first instance on record of the application of electricity to the propulsion of boats? JOHN MCHENRY, Pimlico.

ANSWER.—Jacobi, in 1839, propelled a boat along the river Neva, at the rate of three miles per hour, with an electro-magnetic engine of about one horse power. He used for the purpose sixty-four large Daniels' cells. This we believe to be the first case on record.—ED. ELECTRIC AGE.

I have been informed that copper bands or ribbons are used sometimes in place of wire in dynamo armatures. Is that so? If so, why? Please enlighten A STUDENT.

ANSWER.—Yes; bands are generally used on dynamos of low electromotive force, and where large currents are required, for such work as electro-plating, etc.—Ed. ELECTRIC AGE.

M. H. R —The electric lights on the Brooklyn bridge are arranged in two circuits. Each circuit includes every alternate lamp; hence, in case of a break on one circuit every second lamp only goes out, while the alternate lamps remain lighted.—Ed. ELECTRIC AGE.

HOW INCANDESCENT LAMPS ARE MADE.—The process of making Edison incandescent lamps is an interesting one. The filaments are made of bamboo taken from the interior of the cane, that part of the plant being the most fibrous, and better suited for the purpose. After the cane has been cut in sections of the required length, and the hard outer surface removed, it is split and shaved into flat strips, which are then pressed between dies, which cut out filaments of the required length. These are placed in nickel molds, in grooves of the horse shoe form, and closed to exclude the air. The molds are then placed in muffles and the filaments carbonized at a very high temperature. They are then attached to their platinum wire supports by electro-copper plating, and introduced into the little lamp globes. The lamp is then attached to a Sprengel air-pump, and, during the process of exhaustion the filament is alternately heated and cooled by an electric current. This removes all the occluded gases which remain after the carbonizing, and renders the carbon homogeneous, elastic and refractory at a high degree of temperature. Imperfect and defective carbons will be destroyed before this stage of development is reached.

THE NEW PHOTOGRAPHY.—Photography is certainly a most interesting and delightful study, and the results obtained by means of the improved system of film photography are so beautiful, and the apparatus employed so simple, it is no wonder thousands of our most cultured people are becoming enthusiastic amateurs. The most ingenious, and it seems by far the most popular camera in use among experts and amateurs alike, is the Kodak a little instrument measuring but 3¼ x 3½ x 6½ inches, and weighing only 32 ounces. It is a complete photographic outfit, with lens, instantaneous shutter and material for making one hundred negatives, and so compact and neat in appearance, that any lady can carry it without making herself in the least conspicuous. The Eastman Co. of Rochester, N. Y., are the makers, to whose advertisement in another column, we call attention.

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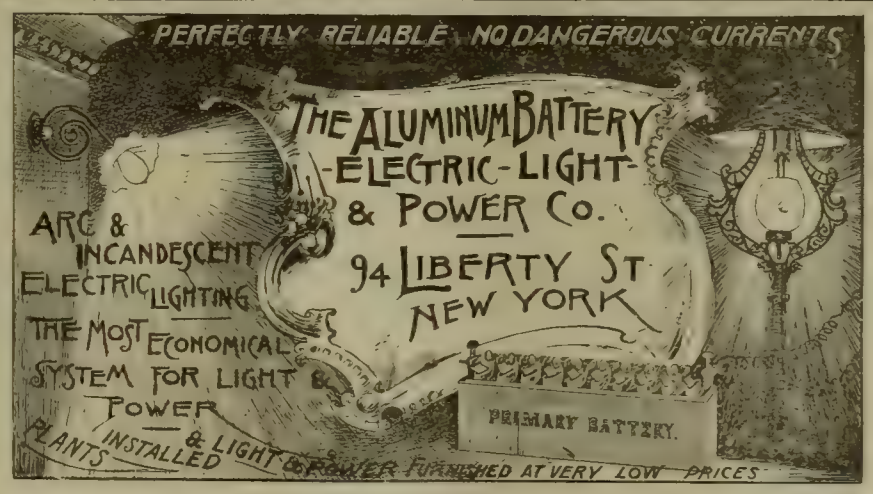
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NEW YORK, APRIL 19, 1890.

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THE STANDARD SUBWAY COMPANY GIVES IT UP.

There was an interesting assortment of lawyers at the meeting of the Board of Electrical Control, on April 8, but the Mayor looked in vain for Wheeler H. Peckham, the counsel for the Standard Electrical Subway Company. The absence of Mr. Peckman denoted a sudden lack of interest in the proceedings of the Board, and a few of the knowing ones remarked that the Standard Company had evidently grown tired of the legal obstructions placed in its way of getting a share of the subway contracts, and was disposed to retire from the contest.

"Is Mr. Peckham present?" asked the Mayor, anxiously.

Mr. Hardy, the Secretary of the Standard Company, replied that Mr. Peckham was in Albany.

"Do you know what the Standard Company propose to do?" the Mayor asked.

"I can do nothing in the absence of Mr. Peckham," replied Mr. Hardy.

"I think it amounts to this," retorted the Mayor, impatiently, "that the Standard Company will not carry out its arrangement with this Board. The city has been acting in good faith throughout this whole matter, in hopes of getting a good contract executed. Now the Board finds that its action is retarded because the Standard Company has no counsel here. This does not seem to me to be a proper way of doing business."

Lawyer Lauterbach of the Consolidated Company said that he had received an intimation that the Standard Company was not willing to comply with the terms of the new contract as amended by the Court, and that this leaves his company ready to obey the orders of the Board.

"Well," said the Mayor, dryly, "I think that if the Standard people wanted to drop the matter they might have written me a letter to that effect."

On his motion the resolution to contract with the Standard Company was rescinded by a unanimous vote. This leaves the Consolidated Company free to go ahead with the work.

Public Works Commissioner Gilroy asked that no subways should be built in streets which have recently been repaved, and the Board promised to see that these streets are avoided.

Manager Crocker of the Edison Company was told that he could go ahead and build the subways for his company as soon as the streets were selected.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

IMPORTANT MEETING OF THE EXECUTIVE COMMITTEE.—CHANGES AND APPOINTMENTS.

A meeting of the executive committee of the National Electric Light Association was held at the Electric Club, New York, Monday, April 14. The following named gentlemen were present: C. R. Huntley, chairman; Marsden J. Perry, president; James English, M. J. Francisco, John A. Seely, A. F. Mason and A. V. Garratt, secretary.

The resignation of Mr. M. D. Law was received and accepted. The vacancy was filled by the unanimous election of Mr. C. H. Wilmerding, of the Chicago Arc Light and Power Co., of Chicago.

Mr. R. W. Ryan was chosen official stenographer for the Cape May meeting.

The secretary was instructed to ascertain if the association can legally use an official seal. the following committee was appointed to procure papers for the next convention: J. E. Lockwood, C. H. Wilmerding, Dr. A. F. Mason, resolved that the secretary under advice and consent of the president be empowered to contract the placing of such advertisement as he can procure to publish in connection with the official proceedings. The following entertainment committee was appointed for the next convention: F. T. Walton, chairman; A. J. DeCamp, J. J. Burleigh, J. A. Seely and the Secretary of the association.

The secretary and treasurer, Mr. Allan V. Garratt, tendered his resignation, to take effect June 15th. President Marsden J. Perry appointed as his successor Mr. Allen R. Foote, of Washington.

ACTIVITY IN ELECTRICAL INDUSTRIES.—Our Chicago and Boston letters this week contain much interesting news from these sections. There is much activity in the electrical industries both in the East and the West, but this is true of the country at large. In some lines, however, these two quarters are in advance of New York. Strange as it may seem, New York has not yet an electric road. not even in the remote suburbs, while Boston is having a successful experience with them. Chicago is pushing electricity everywhere, and, in electrical matters, as in everything else, she is trying to set the pace. Our letters from these great centres of industry will keep our readers fully informed of what is going on in the electrical field in those sections, and will cover everything that is new and interesting

THE ELECTRIC LIGHT IN MADRID.—The Electrical Supply Company of Spain have advertised that they are ready to supply electricity for light and power in Madrid. Their circular announces that their charge for electric lighting is one halfpenny per lamp-hour of 10 candles, and 1s. 4d. per 1,000 watt-hours. It is probable that these prices will be reduced in view of the competition which is expected.

CARBON.—The electrical resistance of carbon is 250 times greater than that of platinum. Carbon is absolutely infusible.

THE FAST SENDING TOURNAMENT.

The National Fast Telegraphing Tournament, which has been the absorbing topic of conversation in telegraphic circles for the past three months, took place at Hardman Hall, corner of 5th avenue and 19th street, during the afternoon and evening of April 10th. It was the most successful affair of the kind on record, and the interest and enthusiasm among telegraphers was intense, not only in this city, but everywhere in the land. The record of this tournament will go into history as the most remarkable in the annals of telegraphy on account of the wonderful performance of a comparatively unknown and unheard of contestant, who came from Hartford, Conn. He made his appearance quietly and was hardly noticed; but when he got started in his sending his wonderul speed commanded instant attention and when his five minutes were up he had 258 words to his credit. The following is a snmmary of the contest by classes.

Ladies' class; open to all.—First prize, $50; won by K. B. Stephenson, who sent 217 words. Second prize, $40; won by Miss B. M. Dennis, 212 words and 4 characters. Third prize, $20; won by Miss E. R. Vanselow, 210 words and 4 characters. Miss T. V. Frochel was awarded the United Press prize for excellence combined with speed.

Old timers' class; open to all who were in the service prior to 1865.—First prize, $50; won by A. S. Ayres, 229 words. Second prize, $40; won by Fred. Catlin, 217 words. The United Press prize of $25 for excellence combined with speed went to Mr. Ayres.

Class A; open to all.—Fist prize, $100; to B. R. Pollock, jr., 260 words. Second prize, $70; W. M Gibson, 239 words. Third prize, $30; F. J. Kihm, 238 words. The United Press prize, $25, under same conditions as previous ones, was awarded to W. L. Waugh.

Class B; open to all, barring those who have sent 500 inside of 11 minutes.—First prize, $85; F. L. Catlin, 251 words. Second prize, $65; W. L. Waugh, 229 words. Third prize, $30; Frank English, 215 words. The United Press prize, same as the preceding ones and under the same conditions was captured by James P. Bradt.

The prizes offered by A. B. Chandler, president of the Postal Telegraph Cable Co., and Fred Catlin, $20 in all, for most perfect sending regardless of speed, was awarded to A. S. Ayres.

The prize of $20, offered by the same gentlemen to the receiving operator who made the best pen and ink copy from Mr. Waugh's transmission, in class B, was won by Thomas R. Taltavall.

In class A the judges were divided as to whom the prizes should go, and could arrive at no agreement. It was finally decided to have the four leading ones send over again, which resulted in the distribution of the prizes in the manner named.

The Judges were Thomas R. Taltavall, editor of THE ELECTRIC AGE; W. P. Phillips, general manager of The United Press; Geo. H. Usher, manager of the Postal Telegraph Office, 187 Broadway; Geo. E. Holbrook, of the New York *World*, and E. F. Howell, official tester of the Western Union Tel. Co. Mr. W. J. Johnston, of the *Electrical World*, acted as timekeeper and Mr. C. W. Price, of the *Electrical Review*, as starter and master of ceremonies.

Many prominent telegraph people and outsiders were present, and the contest was a great success in every respect.

Hon. Wm. Henry Smith, general manager of the Associated Press, will offer three prizes of $100, $75 and $50, respectively, to be contested for in the fall on the Associated Press western wire, which runs from New York to Minneapolis, a distance of 1,500 miles or more. The contest will be open to all, and the test is to be a practical Each contestant will send for fifteen minutes or half an hour depending on the number of entries, and the prizes will be awarded on the basis of fast sending, excellence and ability to work long distances. The plans are not yet matured. They will be announced at a later date. This test will prove the real worth of the contestants as practical operators.

Among those present at the contest were: E. H. Johnson, President of the Interior Conduit and Insulating Company, an old operator; Gen. T. T. Eckert, T. T. Eckert, Jr., A. S. Brown, J. H. Bunnell, T. G. Smith, of The E. S. Greeley Co.; P. V. DeGraw and A. L. Suesman, of the United Press, old and well-known operators; H. H. Ward. the cashier of the W. U.; J. H. Emerick; W. H. C. Hargrave and W. N. Gove of the Philadelphia office of the Associated Press, and many others.

DECISION IN AN INTERFERENCE CASE.

Commissioner of Patents Mitchell has rendered a decision in the interference case of Forbes vs. Thomson—being in a method of measuring electricity. This was an appeal from the Primary Examiner dissolving the interference.

The Commissioner overrules the Primary Examiner's decision.

Thomson and Forbes each filed an application claiming an apparatus for carrying into effect a processs which was also disclosed in the respective applications. An interference was declared, and due proceedings having been had priority was adjudged to Thomson upon the record.

At the time when Forbes filed his application for a patent upon the apparatus he also filed an application for a patent upon the process carried into effect by the apparatus. Upon the latter application a patent was granted to Forbes pending the interference already spoken of. Subsequently to the granting of the patent to Forbes for the process, and prior to the issue of the patent to Thomson upon the apparatus for carrying into effect the process, Thomson filed a second application, in which the process itself was claimed.

Upon the filing of Thomson's second application the present interference was declared between the patent to Forbes for the process and Thomson's application claiming the same process, Thomson being made the senior and Forbes the junior party.

The preliminary statements having been filed and approved, a motion to dissolve was made by counsel for Forbes upon the ground, comprehensively stated, that Thomson was not entitled to the benefit of the filing date of his original application disclosing but not claiming the process; that his application should have been rejected upon reference to the patent of Forbes and to certain publications named, and that Thomson should have been required to overcome such references by an antedating oath. In other words, it was claimed that Thomson's application for a process was not lawfully a division of the parent application, although it was such in terms, as has already been seen.

The motion to dissolve was transmitted to the Primary Examiner, who, after hearing the parties, rendered his decision in the following language:

> The motion is granted on the ground that the application of Thomson in interference is not technically a division of the prior case.

Thereupon appeal was taken to the Commissioner by Thomson.

That an interference in fact exists is not disputed, providing Thomson's standing before the office is such as to entitle him to put in interference with a patent granted prior to the filing of his present application. It appears also to be undisputed that Thomson would have the requisite standing if the original application in which he disclosed the process had been accompanied by a corresponding claim.

Rule 116 is as follows:

> In original proceedings in cases of interference the several parties will be presumed to have made the invention in the chronological order in which they filed their completed application for patents clearly illustrating and describing the invention; and the burden of proof will rest upon the party who shall seek to establish a different state of facts.

It is to be noticed that this rule is entirely silent upon the subject of claiming the invention. It expressly states that the several parties will be presumed to have made the invention in the order in which the file completed applications clearly illustrating and describing the invention.

It is certainly difficult to see how an application describing and illustrating an invention can give an interfering party precedence in conducting the controversy if the same application is to be wholly ignored in instituting it. Especially would this seem to be the case where the rival applicant claiming the same invention did not come into the office until subsequently to the filing of the application, to which the rule (114) gives the effect of establishing a *prima facie* case of priority. The better opinion would seem to be that when an application is filed describing and illustrating more than one invention, and during its pendency in the office, another application is filed by the same inventor, stating that it is a division of the original application, and claiming an invention so described and illustrated, the later application is to be considered a divisional application for the purpose of interference proceedings, whether or not the divisional invention was claimed in the first application. I do not mean that no other application can properly be termed divisional except one that meets the foregoing requirements, but only that it would seem that an application complying with those requirements should be recognized as divisional. It would seem that if such an original application could be the basis of a judgment upon the record it ought to afford record evidence that the applicant was at the date of the filing thereof the inventor of what was disclosed therein as against references of a later date, when in connection with a later application, contemporaneously pending, the applicant has sworn that he was the inventor thereof. The only alternative to this view would require an applicant who had disclosed an invention with sufficient clearness to make it the basis of a judgment upon the record in an interference case, to file an antedating oath in order to overcome references of later date than the disclosure. I cannot think that the rule should be construed in such a way as to lead to such an absurdity.

The Commissioner then cites several decisions in similar cases in support of his deductions, and closes his findings as follows:

"In my opinion the second application of Thomson describing itself as a division of the earlier application within the meaning of the rules, and the decision of the Primary Examiner dissolving the interference is overruled."

THE PHONOGRAPH IN HOLLAND.—A company is being formed by electrical engineers in Amsterdam for the purpose of working Edison's phonograph patents. The promoters propose to reduce the price so as to bring the phonograph within the purchasing power of all exchanges. Representatives will be appointed in the provinces to attend to the repairs of hired and sold phonographs.

ELECTRIC BELLS IN OMNIBUSES.—The Brighton omnibuses are to be fitted with electric bells, by means of which passengers, as well as conductor, can signal for the stoppage of the vehicle.

MYRON D. LAW.—Denver, Col., is fortunate indeed to have secured as one of its citizens Mr. Myron D. Law, one of Philadelphia's foremost representatives in the electrical field. As a mark of the great esteem in which he was held by his late associates, a set of resolutions, expressive of regret, and well wishes, was most beautifully drafted, placed in a massive gilt frame, and presented to Mr. Law by the committee.

ELECTRIC LIGHT POPULAR.—The use of electric lights is increasing with great rapidity among the London shopmen. A walk down the Strand or Oxford street after dark will show that every second or third store has now given up gas, which would have been entirely superseded some time ago if it were not so cheap. Many of the other large cities in England are now using the arc light, and at Brighton it is almost universal.

ELECTRIC LIGHTS AT A BALL.—At a recent ball in London the electric light was arranged to vary in color, being alternately red, blue, green and yellow. The ladies didn't like it, as it ruined in alternation the effect of their costumes.

OF INTEREST TO INVENTORS.

The Commissioner of Patents has overruled the action of the Primary Examiner in rejecting certain claims in application for a patent upon the ground that the use of the terms *means* and *mechanism* in such claims renders them vague and indefinite.

We give the main points of his decision, which will be of interest to inventors in electricity. The Commissioner says:

No general rule can be laid down for governing the employment in the claims of patents of such words as "means," "mechanism," and "appliances." It is the object of the law as it is the solicitude of this office, to protect inventors and guard their inventions. This object is best secured in the case of patents which represent the maturity of an art by taking care that claims shall be drawn with all reasonable restrictions, so that they shall be valid in spite of everything that is contained in existing patents and of everything previously known or used.

In the case of patents which represent the infancy of an art, or the stage of its earliest practical development, this office is solicitous that the inventor should be accorded a breadth of claim which is commensurate with the extent and importance of the invention which he desires and is entitled to protect. While the office will insist upon as much defiteness in the language of the claim as the statute calls for, it will also, if it properly discharge its function as the protector of the inventor, leave something to the salutary and benignant agency of construction in the courts.

While the statute as interpreted by the courts is not inconsistent with the allowance of the controverted claims, yet the tendency to employ in claims such words as have been under consideration should not be encouraged.

There is a permissible latitude of choice in the use of language which may be safely accorded to the inventor or his solicitor without violating the statute, and without detriment to that branch of the public service which has for its object not only to grant Letters Patent for new inventions, but to grant them at the earliest possible date.

Where in a claim the language qualifying the word "means" was employed to set forth function, and contained no limitation whatever in respect to the construction or mode of operation as distinguished from the result, and the word "means" designated that portion of the claim in which the novelty resided. *Held*, that such claim was vague and indefinite and should not be allowed.

Where in a claim the language following the word "means" and "mechanism" was employed to set forth function, but contained limiting or qualifying words other than those which set forth the result accomplished. *Held*, that such claim was not vague and indefinite.

ELECTRICITY *vs.* MULES.—An old plantation hand went to Atlanta and saw street-cars for the first time. They were drawn by mules. When he made his next visit the company had introduced electricity as the motive power. It was too much for "Uncle." He was scared when he saw the car go without mules.

"Whar's dem mules?"

A policeman who stood there said:

"*They've freed the mules.*"

Lost in wonder the freedman said:

"What a mighty party dat Republican party is. Fust dey freed the colored man, and den dey freed the mules!"

LENZ'S LAW.—In all cases of electro-magnetic induction the induced currents have such a direction that their reaction tends to stop the motion which produces them. Any conductor moved forcibly across the lines of force of a magnetic field experiences a mechanical resistance due to the induced currents which oppose its motion.

PUBLIC STREET LIGHTING IN NEW YORK.*

The first movement looking to the public ghting of New York by the electric light was a esolution adopted by the Common Council in ebruary, 1879, requesting the Gas Commission to have experiments made to test the practiability of lighting" the streets and parks of the ty with the electric light, and to determine the elative cost of gas and electricity for this purpose. s the experiments were to be made without exense to the city, nothing was done under the reolution.

Early in November, 1880, however, the Brush lectric Light Company asked permission to rect lamp-posts on Broadway, from Fourteenth reet to Thirty-fourth street, for the purpose of emonstrating the suitability of the electric light or street illumination. This request was granted, nd on the 15th of January following, 22 arc mps were lighted by the company, and connued without expense to the city until the 1st of ne. While these lamps were far from perfect, the xperiment promised sufficiently well to warrant he Gas Commission in making a contract with the rush Company. Fifty-five lamps were lighted nder this contract at the rate of $7,400 per nnum.

Another contract was made with the Brush Comany for 1882, and also one with the United tates Electric Illuminating Company. The price aid by the city was 70 cents per lamp per night, r $255.50 per annum. This continued to be the rice up to May 1, 1887, the number of lamps eing increased each year. Thus, on the 31st of ecember, 1882, there were 128 electric arc lamps use; in 1884, 647 lamps; in 1886, 711 lamps; nd in 1888, 1,328 lamps.

Previous to 1887, the contracts were awarded the two companies already mentioned; but a umber of new companies now entered the field, nd the contract price in 1887 varied from 19½ nts to 50 cents per lamp per night. The rices paid in 1888 varied from 32 cents to 60 nts per lamp per night, the average being 35 5/16 cents.

To arrive at the comparative cost of gas and ectric light for street illumination we take the ars 1885 and 1888—in the former the price eing 70 cents per lamp per night, while in the latr it averaged 35 5/16 cents.

The number of gas lamps replaced by each ectric light will naturally be subject to some riation, but the average, based upon the introuction of a large number of electric lights is 4½ s lamps for each electric lamp. At the close of 885 there were 708 electric lamps in use, equivant to 3,186 gas lamps. The cost of the electric mps at $255.50 each, on the supposition that no ductions were made for extinguishments, would ve been $180.894. The price paid for the gas mps replaced was $17.50 each per annum, and to this we add $1.60 for supplies, etc., we obin $19.10 as the cost of each gas lamp, or $60,-2.60 for the total number of lamps replaced. he lighting by electric lamps, therefore, cost 20,041, or 66 per cent. more than would have en paid for the less brilliant illumination by s. On the 31st of December, 1888, there were 328 electric lamps in use, at the average price of 28.48 per annum, or a total cost of $170,621.44. hey replaced 5,976 gas lamps, costing with supies, etc., $19.14 each per year, or a total cost of 14,380.64. In this case where the prices arged for both gas and electric lamps were about low as we may expect to see them—for the pres-t at least—the excess in cost of the electric mps over the gas lamps was $56,240.80, or out 33 per cent. It is therefore apparent that atever may be the advantages of the electric ht over the ordinary gas lamp for street illumi-tion, we are obliged to pay liberally for these vantages; and it becomes a question to what tent it is desirable to replace gas lamps by the more intense but less reliable electric lamps by an increase of one-third in cost.

As showing the demand for this greater illumination, it is interesting to note that in 1885 the Common Council passed various resolutions requesting the Gas Commission to light certain streets and avenues with the electric light. The superintendent of lamps and gas estimated that had it been possible to comply with these requests, it would have taken over 2,000 lamps, costing $526,840, and have replaced gas lamps costing $89,862.50, an excess in cost of the electric light over the gas lamps of $436,977.50—more than one-half of the entire appropriation for public lighting.

As regards comparative illumination, it is not necessary to say that the electric light is much superior to gas—indeed in New York the street lighting by gas is not what it ought to be. The first contract made with the New York Gas Light Company in 1823 specified the burner to be used as one capable of passing three feet of gas per hour; and while repeated efforts have been made to increase the capacity of the burner to 4, 5 or 6 feet per hour, we are, in this respect, precisely where we were more than 60 years ago. And yet during this period the candle-power of the gas supplied has been nearly doubled, so that to-day our street lamps give a light of from 10 to 16 candles for 3 feet of gas.

In the early days of electric lighting it was commonly said that the ordinary arc lamp gave a light of 2,000 candles, but such is not and has never been the case. The arc lamp gives less light horizontally than in a downward direction, and when these lamps were first put upon the market some one measured or, more probably, estimated the intensity in a horizontal direction at 500 candles, and then, to make a good showing, multiplied it by four, making the 2,000 candles. While the 500 candles was pretty clever guessing, there was no good reason whatever for multiplying it by four any more than by 360.

As the amount of light thrown upon the walk and roadway is of more importance than that emitted in a horizontal direction, the present city contracts with the electric light companies require that the lamps shall give a light of at least 1,000 candles at an angle of 40 degrees below the horizontal. Measurements which have been made of the lamps of some of the companies give from 1,300 to 500 candles.

Of late an attempt has been made by one of the gas companies to introduce a large regenerative gas burner—the Gordon—for street illumination. It has been tried on parts of Fifth and Madison avenues, and Forty-ninth and Fiftieth streets, with very satisfactory results and without expense to the city. An arrangement was made to light Lenox avenue from One Hundred and Tenth street to One Hundred and Twenty-ninth street, with 75 of these lamps during the month of December. The expense of this installation, however, which is $5 per lamp per month, will doubtless prevent its extension.

The recent extinguishing of most of the electric lamps, and the consequent darkness on many of our thoroughfares, calls public attention especially to this subject of street lighting, and shows the importance of keeping the gas lamps in a condition or immediate use, certainly until the electric light has become more thoroughly domesticated.

PROOF OF DEATH BY ELECTRICITY.—It is claimed that in electricity we have an infallible means of determining whether or not the vital spark left the body in case of supposed death. Two or three hours after death or after the stoppage of the heart the muscular system loses its electric excitability. When stimulated by electricity the limbs no longer contract. Therefore if five or six hours after the signs of life have departed, faranism, as the treatment, produces no contractile response, the spark had fled beyond a doubt, as no faint trance or coma can prevent the manifestations of electric muscular contractility.

LARGE ELECTRIC RAILROAD CONTRACT.

The largest and most important deal in electric street railroad matters that has ever been consummated in the United States was made March 26th between the Brush Electric Light Company, of Cleveland, and a Philadelphia syndicate.

The contract calls for the furnishing of 200 motors, a generating station with a 1,200 horse power capacity and fifty-five miles of track. This contract is for Rochester, N. Y., the street railroad franchises of which are owned by the Philadelphia syndicate. They are also owners of the franchises for Louisville, Ky., Buffalo, Pittsburg, Newark, N. J., and several other cities. The entire company is composed of Philadelphia capitalists, with the exception of Mr. H. Sellers McKee, who is a resident of Pittsburg and a chief owner in the stocks.

They also closed contract with "Tom" Johnson for twenty motors, a generating station with 400 horse power capacity and eighteen miles of track for his new electric street railroad at Johnstown, Pa. Mr. Johnson contemplates putting in a complete plant of the latest improved and best electrical appliances. The tracks at Johnstown will be laid with the heaviest girder rail manufactured by the Johnson Railroad Iron Manufacturing Company of that place and weighs eighty pounds to the yard. On all of his motors hereafter Johnson will have the new Short system motor.

In order to get out these orders on time the company will be compelled to run their factory night and day and will employ two forces of men. They will be compelled to put in more machinery and will have double the facilities they now employ. As soon as possible they will erect a large building opposite the factory, which will have the same capacity that their present shops have. In the latter the department devoted to incandescent lights will be removed and in place will be machinery for facilitating the building of motors. The company expect to be able to turn out four complete motors a day when they have made all contemplated improvements.

The Philadelphia people have appointed a committee of experts to choose a system for the fitting out of the street railroads in the cities named. They have unanimously decided for the Short system, invented by Professor Short, expert electrician for the Brush Company. The experts who are examining it say that it is a marvel of completeness.

PELTIER EFFECT.—One of the most curious effects of electricity is that known as Peltier effect. If we take a bismuth-antimony pair and put them in circuit with a battery, and the current from the battery is in such direction that it passes from bismuth to antimony, heat is absorbed at the junction of the two metals and the temperature is reduced. If we reverse the current so that it will pass from antimony to bismuth heat is evolved at the juncture and the temperature rises. The phenomenon of heating, or cooling, by a current where it passes the junction of two dissimilar metals, is known as the "Peltier Effect." This phenomenon was discovered in 1834 by Peltier, and was named after him to distinguish it from the ordinary heating of a circuit where it offers a resistance to the current, which is sometimes called the "Joule Effect." The Peltier effect is different from the evolution of heat in a conductor of high resistance, because (1) the Peltier effect is reversible, the current heating or cooling the junction according to its direction, whereas a current meeting with resistance in a thin wire heats it in whichever direction it moves; and (2) the amount of heat evolved or absorbed in the Peltier effect is proportional simply to the strength of the current, and not to the square of that strength as the heat of resistance is. The reduction of temperature has in this manner been carried to such an extent that water has been frozen in cavities made in the metals at the point of junction.

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* Extract from paper by E. G. Love, Ph. D., in *The ngineering and Building Record.*

EASTERN NOTES.

BOSTON, April 11th.

At a regular meeting of the Business Men's Association of Franklin, Mass., last Tuesday evening, it was unanimously resolved that an electric street railway between Wrentham and Franklin would benefit the business of both towns, and to request the Selectmen to grant a franchise under proper restrictions. This action was taken in view of the fact that a Boston company proposes to build the road.

The work of laying the rails for the new electric railway of the Newton Street Railway Company between Waltham and West Newton is progressing rapidly. The return wire is being run over the sleepers instead of underneath, and the rails are not connected by iron girders, as is the case with the electric lines in Boston.

The British cable steamer Minia, Capt. Trott, belonging to the Direct Cable Company, arrived off Rye last week, to repair the cable which has become so badly chafed by ledges some distance out that messages could be sent in only one direction. The cable was fished up one mile and a quarter from shore and the injury located, but owing to the roughness of the sea work was abandoned, and the Minia put into harbor for shelter. Work will be resumed when the weather permits.

Among the petitions presented to the Board of Aldermen last Monday were one from L. Foster Morse, and others, asking that the standing regulations of the Board of Aldermen be so amended as to allow street cars to run at a rate of speed, not exceeding twelve miles an hour, on Shawmut Avenue south of its junction with Tremont street. It was referred to the committee of the whole and a public hearing ordered.

Shepard, Norwell & Co.'s petition, containing over 300 names, asking for an increase in the speed of electric cars, was similarly treated. Both petitions bear the names of a large number of business men.

Thomas Savage, Esq., of Boston, counsel for John W. Mackay, the California millionaire, entered suit last Monday in the Superior Court of Suffolk County, to recover a judgment for $287,313.36, which was accorded to Mr. Mackay by the Superior Court of New York in a suit brought by him against the Commercial Telegram Company. A large portion of the property of the defendant is situated in Boston, and an attachment upon the same has been made.

STATE HOUSE.—The legislative committee on mercantile affairs gave a hearing last Tuesday upon several orders in regard to protecting the public from danger from electric wires. Counsel for companies were present as follows: For the Bell Telephone Company, Geo. A. Bruce, and Fred H. Williams; for the New England Telephone and Telegraph Company, S. L. Powers: for the Edison Company, Mr. Gouch; and for the Westinghouse Company, Ferdinand A. Wyman. Representative Raymond, of Somerville, interested in the Somerville Electric Light Company, urged the necessity of having in every municipality an official with power to remove and relocate dangerous wires. As to an electric commission he thought it would be a tremendous set of red tape for nothing. Samuel L. Powers, representing the N. E. T. & T. Company, told of the efforts which are being made by all companies using such wires to protect the public, and urged the committee to leave matters as they are. He had no objection to the marking of wires to show their ownership, and his company already used insulators with its name stamped on the glass. Senator Coffin, of Suffolk, Representative Moriarty, of Worcester, and others testified to the need of regulation of wires and the hearing was continued.

W. R. McLean, foreman of the car shops of the Thomson-Houston Company of Lynn, and one of the most popular men in the factory, has resigned to accept the position of master mechanic of the street railway in Des Moines, Ia. He will be greatly missed by his business and social acquaintances, and the Des Moines people are to be congratulated on securing the services of so capable an official.

Representatives or the East Side electric road of Brocton are reported to have made offers to the Whitman Street Railway Company for the sale of their bonds. It is understood that the representatives of the Whitman men will not purchase at the figures demanded by the Brocton Company. It is hinted that the Whitman Company stand ready to purchase the stock, provided it can be obtained at a reasonable figure.

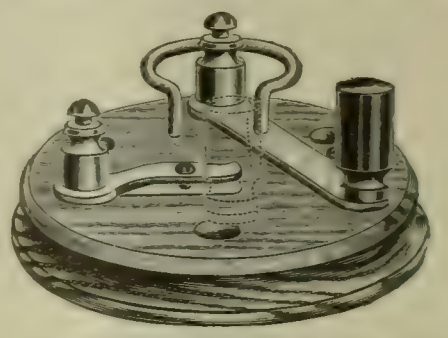
The tow cars on the Cambridge division of the West End Railway which were stopped by order of the Board of Aldermen a few weeks ago commenced running again last Thursday morning. The through line between Harvard square and South Boston commenced running Friday morning on the old time.

F. E. Pettingill, of the firm of Pettingill & Andrews, has returned from his double trip across the Atlantic feeling much improved in health. Mr. Pettingill is one of the most popular men in the trade, and if we can judge by the reception he received on his return to Boston, continued and increased success is assured him when he again starts on the road.

W. J. P.

A NEW SWITCH.

The accompanying cut illustrates a cheap switch that will be found of use in places where a simple make and break switch is required, and where an absolute contact is needed when the switch is closed. The dotted lines show the arm



in the latter position, the arm being forced between two contact straps in such a manner that a large surface bracing is had on both sides. This switch is being introduced by the Central Electric Company of Chicago.

A NEW ELECTRIC ROAD IN THE SOUTH.

We understand that a Northern Syndicate has secured control of the electric interests in the towns of Winston and Salem in North Carolina and that an electric line connecting the two towns will soon be installed. The line will be five miles long, and will include six cars. The Sprague system of overhead wiring will be used. The dynamos will be located in the electric lsght station which will hereafter supply both light and power for the street cars and general industries along the line.

This is probably the first station in the Country from which will be distributed electric power for Street Railway, and general industries, and light by both arc lamps and incandescent.

Among the incorporators of the Company mentioned are, E. H. Johnson, J. H. McClement, F. J. Sprague and E. B. Hawkes,

Although electric roads are now in operation pretty generally throughout the Northern and Western States, the use of electricity as a method of propelling cars, has not as yet met with such wide adoption among the cities of the Southern States.

There are, it is true, a number of cities in the south where there are electric roads in operation, or in process of construction, but the horse and mule are still relied upon in most cities for the operation of the street cars. Northern capital, however, is rapidly developing many of t southern towns, and a few years change a local from a condition of inertness to one of busin and enterprise.

Salem, Winston, is a good example of t progressive town of the new south, and shows its enterprise in electrical undertakings that it fully awake to the latest and modern improvements.

CONDUITS FOR UNDERGROUND.

Mr. Frank Kitton, the insurance inspector the City of Buffalo, in a recent letter on the su ject of underground conduits, says in regard the utility of the Interior Electrical Conduit:

I regard it as one of the greatest advanc made in this direction since the electric lig became a commercial possibility.

The use of the conduit tube provides gr immunity from the dangers that may a through the development of excessive heat conductors of electricity, protects the wires fr mechanical injury and excludes moisture.

The system is so flexible, and possesses su engineering advantages as to commend its ad tion by those seeking a systematic method providing for the wiring of buildings in t course of construction, as well as to others, m especially concerned in the safety of electric lig and power installations.

The Interior Electrical Conduit Company ha taken up the question of underground condu and have developed a perfectly efficient syste The rights for using the system in Detroit, Mic have recently been sold to the Detroit Elect Light and Power Company. The undergrou system has been thoroughly worked out in ev detail and is perfect in every respect.

A PERFECT ARC LAMP FOR INCANDESCENT CIRCUITS.

The Clark Electric Company over a year a introduced an arc lamp adapted for use on inc descent circuits, and since that time they ha made an excellent reputation based solely on real merit of the lamp. These lamps are of single pattern, and have been running conti ously on incandescent circuits giving the b of satisfaction. In fact they have been conce to be the only successful arc lamps made for purpose. Their illumination is of nearly 3,(candle power, and they are remarkably steady a thoroughly reliable in their operation. They g a soft and brilliant white light, and what is a v valuable feature in them is the absencs of nc and hissing so common in arc lamps. Th valuable features render the Clark arc lamp desirable for indoor use as for outdoors and lamps for interiors are handsomely mounted.

Owing to the steadiness of this light colc however delicate, show the same as in daylig This feature in itself is a valuable one, an thoroughly steady arc light would be greatly preciated in many lines of trade for this v reason.

MUNICIPAL ELECTRIC LIGHTING.—Elsewhere this issue will be found a communication from J. Francisco, president of the Rutland (Vt.) El tric Light Company, on the question of Munici control of electric light plants. It is an a argument against such control, and it can be r with profit by those interested in such matte The question is a live one and is receiving c siderable attention in different parts of the coun The sentiment against Municipal control is v strong and pronounced, and many incontroverti arguments put forth in support of the movement

MADRID.—It is announced by *El Telegraph Espagnol* that Dr. Celestino Goni and the Dir tor of Telegraphs have founded an electrical gineering college at Madrid.

PERSONAL NOTE.—Mr. George B. Prescott, the well-known electrician, has been appoin General Agent for Day's Kerite Wires and bles.

WESTERN NOTES.

35 Commercial Bank B'd'g,
Chicago, April 12, 1890.

Mr. W. P. Adams, the Texas representative of e International Thomson-Houston Electric ›mpany, is in the city this week.

Mr. A. B. Gould, of Sioux City, Ia., manager the Gould American District Telegraph Comny, is in town looking after electric light in-ests.

Mr. J. H. Stahley, of the North American ›nstruction Company, is at Harriman, Tenn., stalling a 50-light alternating arc plant of the estinghouse system.

The Duluth, Minn., City Council and the eet railway company seem to be unable to ree as to terms of instal ing an electric rail-y system, and the people may have to submit slow car service for a while yet.

Des Moines, Iowa.—The bill providing for ctrical executions was indefinitely postponed the Iowa Senate on the 9th inst.

A. L. Ide & Son, Springfield, Ill , have just nstructed a new tandem compound engine ›ich is said to be a very fine machine.

The Kansas City Fire and Burglar Alarm mpany has been formed at Kansas City ; capi-. stock, $15,000 ; directors, Alfred H. Cobb, enry McGrew, Edmund R. Wilder, Hector thgood, E. F. Mully, of Kansas City, and Wm. Brown, of Leavenworth.

A. L. Ide, Springfield, Ill., manufacturer of e Ideal Engine, visited Chicago this week.

Mr. James A. Lounsbury, of the National En-neering Bureau, Chicago, is engaged in elec-cal work at Bloomington, Ill., this week.

The Wichita Electric Railway Co., of Wich-, Kansas, whose organization was noted in a cent issue, has for its purpose the consolida-n of the Wichita Street Railway Co. now op-ating 43 horse-cars upon 41 miles of track, d the Riverside and Suburban Railway Co., erating 7 electric motors and 13 trail cars on 15 miles of track equipped by the Thomson-ouston system. The entire equipment of the w company will be by electricity, and they pect to operate between 30 and 40 miles of ad electrically within the next year. A com-ete electrical equipment over the line hereto-re operated by the Wichita Street Railway Co. d a new station plant complete will be re-ired. The system to be employed has not t been decided upon.

The Brush Electric Light Co., of Detroit, ll shortly increase their facilities in that city by e installation of an alternating incandescent ant of 10,000 light capacity, and expect to make me one of the finest and most complete plants the country. Mr. Joseph E. Lockwood, man-er of the Brush Company, has inspected many the most successful plants in the country since e Kansas City Convention and hopes to make the w plant superior to any now in operaton.

The St. Louis Electric Light and Power Com-ny filed a statement of an increase of capital ck from $8,000 to $30,000.

National Electric Light & Power Co., has en formed at Arkansas City, Kansas ; capital ck $50,000 ; directors, J. F. Saunders and W. Thomas, Guthrie, Oklahoma, M. F. Bailey, as. Hutchins, and E. L. McDowel of Arkansas ty.

Mr. E. L. Clark, of Chicago, better known as Poles" among the electrical fraternity, closed s best contract on the 10th inst., and is corre-ondingly happy. Miss Lillian R. Shaw is the ung lady. The ceremony was celebrated at e residence of the bride's parents at Bloming-n, Ill. After a short trip the young couple will to housekeeping on the south side, Chicago. . Clark has the congratulations of all the elec-cal fraternity, to whom he has been so long d favorably known.

Mr. J. H. Reid, of the Mather Electric Company, Chicago, left for Omaha Wednesday, to be gone some days.

W. A. Shelden, general agent of the Schuyler Electric Company is in the city.

Mr. B. J. Arnold, St. Louis Agent of the Thomson-Houston Company, visited Chicago this week.

George Cutter, 80 Adams Street, Chicago, has returned from a two weeks' trip East and reports business good. While at Philadelphia Mr. Cutter became much interested in a new electric water purifier the Stanley Electric Company of that city are bringing out, which he thinks is a very valuable invention.

Mr. E. L. Clark, Rookery Building, Chicago, has received a large order from the Los Angeles Rapid Transit Company, for poles to be used in constructing their line.

Let Electricians Speak. The agitation of the World's Fair question has turned many minds to the problem of providing an attraction that shall throw the Eiffel tower into innocuous dessuetude. One of the latest ideas advanced is to construct a mammoth star, to be called the Star of Empire, of a thousand electric arc lights and place it upon a tower loftier than Eiffel. In the center would be the word "CHICAGO".

The electrical Engineers of America should not let the opportunity pass to make electricity the crowning feature of the exposition, and should devise some plan for impressing upon our foreign visitors the fact that this is the land, as well as the age, of electricity.

The Chicago & Evanston Rapid Transit Street Railway Company, has been formed in this city with a capital stock of $500,000. The incorporators are R. J Randolph, J. W. Smith and T. P. Bailey of the Thomson-Houston Company. It is understood that the Thomson-Houston Company are the chief parties interested and their system will be used. The Thomson-Houston people are reticent, but say that the right of way from Chicago to Evanston has been partially secured and that the road will be built. This road will fill a long felt want and will undoubtedly be welcome to the residents of that beautiful suburb.

The Certificate of Incorporation of "The World's Exposition of 1892" was issued by the Secretary of State at Springfield, Ill., on the 9th inst. ; capital stock $5,000,000 ; the names of the 28,000 stockholders are omitted for obvious reasons.

New Companies. The Oregon Electric Light Company, Oregon, Ill., to furnish light, heat and power ; incorporators F. G. Jones, P. E. Hastings, J. C. Fesler.

Youngstown Electric Light Company was formed at Youngstown, Ohio, with a capital stock of $75,000.

The Thomson-Houston Electric Company report the starting of electric railways of their system at Denver, Col., and San Jose, Cal., this week. They expect to start a line of thirty cars on over twelve miles, and twelve cars on fourteen miles of track at Milwaukee in a few days.

Reports from East Liverpool, O., say a great electrical storm passed over that city on the 8th. The telephone exchange was burned and service destroyed. The operators were compelled to fly from the room.

The Northwest Construction and Supply Company, of St. Paul, Minn., held its annual meeting on last Wednesday. The name of the company was changed to the Northwest Thomson-Houston Company and the number of directors increased from five to seven. The officers elected for the ensuing year are, Lieut. E. R. Gilman, president and general manager; W. G. DeCelle, secretary; G. C. Duffie, treasurer. The board of directors includes the officers and H. K. Gilman, V. M. Watkins, J. B. Tarbox and Thomas C. Sullivan. In the evening a banquet was given at the Hotel Ryan to seventy members and invited guests.

The Aurora City Railway Co., will install a $250,000 electric railway plant of the Thomson-Houston system. The line will be 20 miles in extent, 10 miles of which will be constructed this season. The old fair ground property, consisting of 51 acres, was bought by a syndicate of Aurora gentlemen on the 5th inst., for $15,300 and it is reported that they want it for the electric railway plant.

The Elmer A. Sperry Company, consulting and contracting electrical engineers, Chicago, report their factory full of work, and much business being done.

The Central Electric Company, Chicago, have just issued a small volume which should be in the hands of electricians everywhere. Within a volume of convenient size, to be carried in the pocket, are given carefully prepared tables and plans for wiring all the different systems of lighting, and tables of all kinds useful in connection with electrical work. Much valuable inf rmation is given regarding dynamos, lamps, motors, and steam plants, and indeed any subject likely to be required by the practical electrician in any of the different lines of work.

Noyes Bros., 83–87 Fifth avenue, Chicago, manufacturers of electric and combination fixtures, now have their catalogue ready to mail to the trade. They will be pleased to receive applications for the same.

The Chicago Electric Club held its regular meeting Monday evening, April 7th. Mr. J. K. Pumpelly read a paper entitled "Storage Batteries to the Rescue," presenting in a very interesting manner the need for storage batteries and the work being done, and pointed out the difficulties solved and yet to be solved before the storage battery can be an unqualified success. The discussion which followed was taken part in by Messrs. Sperry, Kempt, DeLand, Bauer, Badt, Degenhardt and President Beach. Many interesting facts were brought out, especially in connection with the use of storage batteries for train lighting. The secretary's report showed the society to be in a very prosperous condition. Six new members were added to the club since the last meeting.

F. M. I.

The Pollak Battery.—A primary battery for domestic lighting has been brought out by M. Pollak, which is without porous pot. The electrodes are of zinc and lead respectively, and the electrolyte is a solution of copper sulphate. The zinc dissolves and copper is deposited on the lead plate. As the makers replace the battery plates, when they are exhausted, only the copper crystals have to be paid for.

Electric Lighting.—The City of Ashville, N. C., invites proposals for lighting by electricity the said city for a period of two years from October 1, 1890. Proposals to contemplate an option giving the city the right to purchase the plant at expiration of the period mentioned. Time for receiving bids is limited to May 1, 1890. The right is reserved to reject any or all bids, and to waive any defects.

Chemical Action of Storage Battery.—The chemical reactions of storage batteries may be divided into three periods, those of charging, of repose and of discharging. During each of these periods a distinct chemical reaction occurs.

The First Incandescent Lamp.—Frederick de Molyens, of Cheltenham, England, was the first inventor of the incandescent lamp. In 1841 he constructed his first incandescent lamp. In it platinum wire was used.

Heat in a Circuit.—The amount of heat developed in a circuit is proportional to the square of the strength of the current.

Electric Lights in Philadelphia.—Philadelphia now reflects the rays of 1,100 electric lights.

SOME POINTS IN DYNAMO AND MOTOR DESIGN.

(*Continued from page 8, issue of Apr. 12*).

15. CONSTANT POTENTIAL MOTORS.

Now, as regards another thing which we have been told sometimes—that the armature and magnet fields are added in a motor—so far is this from being the case, that, under the usual and proper conditions of a trail on the brushes, the weakening of the field due to the current in the armature may play a most important part in the governing of motors at constant speed. In an article contributed to the *Electrician* in 1886, I hinted at this, saying, "By reason of the current in the armature reacting to weaken the field, does not a shunt motor contain within itself the germ of self-regulation, which, by suitable proportion, may be made effective without a series coil at all?" Since that date motors have been constructed in which the truth so foreshadowed has been realized.

As already stated, the E.M.F. of a separately excited dynamo is represented by an inclined line, C D, Fig. 15, the inclination showing the weakening of the field produced by the current in the armature. Run as a motor, with a trail equal to its lead as a dynamo, the E.M.F. generated—called in this case the back E.M.F.—will be the same, being greater, therefore, as the current is smaller, and smaller as the current is larger. A shunt motor connected to mains at a constant difference of potentials has its magnets excited by a constant current, and the back E.M.F. varies in this way. Its value, calling E_1 the difference of potentials at the mains, is $E_1 - C R$, and it is, of course, proportional to the induction through the armature and the speed. Generally we require the latter to be constant, so we write,

$$n \propto \frac{E_1 - C R}{N_1},$$

where N_1 is the resultant induction through the armature due to both fields. As we have seen, N_1 is not a constant: there is a weakening of the field proportional to the current; and for N_1 we can substitute a value, $N - f(c)$, where N is the induction on open circuit, and $f(c)$, that function of the current which represents the weakening effect. Writing

$$n \propto \frac{E_1 - C R}{N - f(c)},$$

is perfectly obvious that if C R bears the same relation to E_1 as $f(c)$ bears to N, the speed n, will be constant, and quite independent of the load. Referring to Fig. 15, the height, o c, may be taken as representing the induction when the motor is running with no load; the sloping line, C D, giving the induction for various currents in the armature. The horizontal line, C E will represent the induction due to the field magnets alone, and the difference of potentials at the mains. If the speed be constant, the length of ordinates between C D and C E represents $f(c)$, and also C R. We see clearly that if the induction is diminished without a proportional reduction of the back E.M.F., the speed will increase; while, on the other hand, if the back E.M.F. goes down without a corresponding decrease in the induction, the speed will be reduced. If it is found that the speed increases as the motor is loaded—and I have seen this—the field must be strengthened, and the turns on the armature reduced, or the armature resistance increased. If the speed gets less, an opposite course must be taken A shunt motor, then, will run at a constant speed on a constant-potential circuit without compound winding or any other device, if the armature field and magnet field are properly proportioned. A position can generally be found for the brushes where the sparking between the load limits is inappreciable, and the motor may be then trusted with perfect confidence to run at a constant speed.

It must not be thought that because a motor transmits power, it is necessary to manipulate electro-mechanical equivalents until we get torque in pound-feet or foot-pounds per revolution, or some other mechanical quantities. This is only a waste of time. In designing a motor, we know the horse-power or watts to be given off on the brake at a certain speed, and if we make the machine run at the proper number of revolutions, and in accordance with the conditions of electrical supply, the torque will come out all right without our troubling about it. Suppose we require W watts to be given out on the brake by a motor working on a constant potential circuit. The power which must be converted in the armature is greater by a certain amount, p, absorbed in friction of journals and brushes, magnetic friction, and parasitic currents. This amount can be foretold to a certain extent, but may be derived from experiments made with machines of the same kind. The power converted being, then, $W + p$ watts: the back E.M.F. being settled as determined by the water allowable in the armature, the current $= \frac{W + p}{E}$ is obtained; the procedure in design now being exactly as for a dynamo to give a current of $\frac{W + p}{E}$ ampères by E volts at the same speed. If these conditions are fulfilled, the torque may be left to itself.

16. CONSTANT-CURRENT DYNAMOS.

There seems to be an impression that dynamos for high differences of potentials cannot be worked successfully with Gramme commutators; the reason for this opinion being, I suppose, the breakdown of some imperfectly constructed machines. That there is no difficulty with the insulation between the conductors and armature core is obvious from the fact that high potential alternating current machines are working successfully with armature sections similarly disposed; the fault appears, therefore, to have been solely with the commutators. I need only reiterate the remark I made here a short time ago—that there is no difficulty whatever in constructing Gramme machines up to 1,000, 1,500, or even 2,000 volts, provided the designer knows what he is about. Many such machines are to be seen in daily work. Mr. Bogue, of New York, gives me particulars of a Wood dynamo manufactured by his company which gives 9.6 ampères, and a difference of potential of 2,640 volts at its terminals; Mr. Henrion, of Nancy, constructs Schuckert machines of 1,000 volts; Messrs. Immisch & Co. have constructed motors as well as dynamos of 1,000 volts; while Messrs. Paterson and Cooper have a large number of machines running at voltages varying from 800 to 1,500. The latter run without sparking at the brushes, and with perfectly smooth commutators.

Several attempts have been made to compound machines for constant current, all of them uniformly unsuccessful. It is beginning to be realized that—Deprez notwithstanding—it cannot be accomplished, and during the next six years the equations for constant current compound winding may finally disappear from our text-books. But it may take longer.

The method of regulation about which I have to make a few remarks is that of rotating the brushes on the commutator, which has proved very successful in some of the machines to which it has been applied. You need scarcely be reminded that if a series-wound machine is directly belted to a separate engine, the combination is almost self-regulating, such small correction as is required being easily effected by a solenoid electrical governor. In such cases the speeds of both engine and dynamo vary as the E.M.F., but generally this arrangement is not permissible, in consequence of several machines being driven from the same counter-shaft; accordingly some device for regulating at constant speed has to be adopted.

In machines in which the current is variable we endeavor, as I have said, to make the self-induction as small as possible, and we work with the brushes somewhere between the polar tips where the field is almost neutral, or only c strength sufficient to overcome the slight effec of self induction, and bring the current up to it normal value before the section leaves th brush. In constant current machines we wo always in the active field under the pole-piece and to prevent the flow of an enormous curre in the section short-circuited by the brush, co siderable self-induction has to be given. Co sider an armature in the field, Fig. 16. Opp site the parts marked N and S the inductio through a section is *nil*; at A and B it is 16,0 17,000, or 18,000 C.G.S., as the case may be- that is, in the machines we have been speakin of hitherto. If we had here a uniform distribu tion of fie'd over the poles, an attempt at co stant current regulation by movement of th brushes would only result in sparking, since i every position the back E.M.F. of self-inductio is different. If the induced E.M.F. were in o position balanced by the E.M.F. of self-indu tion, in other positions it would be over ba anced or under balanced. Another point i that if regulation is attempted by working wi the brushes partly between the polar tips an partly under the poles, the weakening effect the armature current on the fields is subject great variation; accordingly the poles should b extended until the brushes are under them i every position. The essentials for successf regulation will now be apparent. First, th self-induction should balance the field in ever position of the brushes; secondly, the pol should be extended so that the brushes in ever position of working are under them. An exam ination of the curve, Fig. 1, will show that u to an induction of 12,000 or so the co-efficie of self-induction is, roughly, constant; so th an armature core saturated to this degree woul have the same E.M.F. of self-induction for constant current, whatever the position of th brushes. In the Wood dynamo already refere to the induction in the armature is 13,000 p square centimetres, and in the Sperry dynamo which hails from Chicago, it is about 14,00 Mr. Sperry's remarks I give in full in the apper dix, also those of Mr. Bogue concerning th Wood machine. In both these machines th masses of iron in the magnets and pole-piece are disposed so that the field is fairly uniform over the poles; but this is by no means neces sary, provided the E.M.F. of self-induction ba ances the field in every position. Making th field distribuion uniform, and the self-inductio uniform, affords the easiest method, however of attaining the end in view. It remains onl to say that the field at the short-circuited sectio is greatly reduced in strength by the current i the armature, and that the best number of turn per section must be determined by experiment It will be evident that the single magnet type o machine, as illustrated in Fig. 7, is the leas suitable for constant current; and while in America they choose the best form of magnet fo the purpose right away, in this country the at tempts at regulation have been made very ofte by selecting the worst form and chopping awa at the poles until it comes about right.

It is unnecessary to describe the various form of apparatus for shifting the brushes. Briefly they consist of a mechanical device, electricall controlled, whereby the brushes are moved for wards or backwards on the commutator as the current rises or falls slightly. Upon the rapid ity with which this regulator responds to varia tions in the current depends the successful work ing of the machine. If the current is allowe to rise or fall outside a small percentage, th adjustment of the fields is thrown out of bal ance and sparking results. The importance o having a regulator which is sensitive, and act with promptitude, will therefore be apparent.

17. RELATION OF SIZE TO OUTPUT.

Great differences of opinion exist about the re lation of size to output in dynamos. Professo Thompson in his "Dynamo-Electric Machinery," quotes several writers who give the output at fig

ures varying from the square to the fourth power of the linear dimensions, and the subject has been discussed to some extent in this room. Mr. Kapp has worked out the relation, and, assuming that in larger machines the space taken up by the insulation is proportionally less, more copper being accordingly got on the armature, he makes the output for a machine whose linear dimensions are increased n times from n^3 to $n^{3\frac{1}{2}}$, the speed being inversely as the linear dimensions. Prof. Ayrton thinks it ought to be higher than $n^{3\frac{1}{2}}$, while Dr. Hopkinson finds that, everything considered, it comes out about n^3. With the single exception of Dr. Hopkinson, I am not aware that anyone has mentioned *the* consideration which, above all, determines this relation—that is, the interference of the magnet and armature fields.

If the armature of a machine is lenthened, the electrical work which can be performed by it is increased in proportion. The magnetizing force and the ampère turns on the armature remains the same, and the forward and cross induction bear to each other the same ratio. Here the electrical work for the same number of revolutions per minute is proportionate to the weight of the magnetic system, and rather more than proportional to the total weight. The surface velocity of the armature is, of course, unchanged. Let all the linear dimensions of the magnetic system be increased n times. The length of each component of the magnetic circuit being n times longer, the magnetizing force must be n times greater for the same degree of saturation, the total forward induction having n^2 times its former value. The copper on the armature being n times thicker, the ampère turns which may be carried to raise it to the same temperature will be n^3_2, and the output, therefore, at the same number of revolutions per minute, $n^{3\frac{1}{2}}$, the E.M.F. being n^2. If the speed is inversely as the linear dimensions, the output is, obviously, $n^{2\frac{1}{2}}$. Now, in increasing all the linear dimensions —the air gap in proportion—we have increased the tendency to sparking. The lengths of the cross circuits are n times longer; consequently, for n times the ampère turns on this armature, the ratio of the cross induction to the forward induction would be as formerly. But we have put on it n^3_2 ampère turns, and the air gap must be therefore increased in the same proportion, in order that the tendency to sparking may be neutralized. Under these circumstances the magnetizing force will be greater than n; but, taking into account the increased air gap, and the increased compensating ampère turns on the magnets, the weight of copper on these will not be greater than n^3; and this amount we can afford to have on a machine in which the other weights are increased in similar ratio It appears, then, that, with due regard to the balance of the magnet and armature fields, the output is not quite proportional to the weight, if the surface velocity of the armature remains the same, but that for similar machines it increases as the $2\frac{1}{2}$ power of the linear dimensions. Of course this depends to a great extent upon the original machine. If the armature of this is under-loaded, it may be quite possible in the larger machine to take advantage of the condition that less space is taken by the insulation, and so load it to a greater number of ampère turns than n^3_2; but if the balance of fields is to be the same in each, n^3_2 represents the permissible ratio of ampère turns. It will be found, I think, that where the output increases directly as the weight, the surface velocity of the armature is in the larger machines greater.

With these remarks I bring this somewhat lengthy contribution to a conclusion.

Port Said.—A telephone exchange was opened at Port Said on January 28th last by the Telephone Company of Egypt (Limited), and the chief firms and shipping companies have already given their support to the undertaking. Permission has been granted by the Suez Canal Company for a cable to be laid beneath the canal, and those firms and others having establishments on the East Bank will shortly be placed in direct communication with the Central Office, situate in the Boulevard.

ELECTRIC LIGHTS.

DATA REGARDING THE COST OF ELECTRIC LIGHTS AND MUNICIPAL LIGHTING.

To the Editor of The Electric Age:

America is the birthplace of the commercially successful electric light, and in five years the public demand has necessitated the investment of over two hundred millions of dollars to supply the electric lights required. From the experimental plant of ten lights the business has increased to 275,000 arc lamps and over three million incandescent lamps burning nightly in the United States.

This large industry and vast investment has put millions of money into circulation and given employment to over 250,000 men. The benefit to many places cannot be calculated in dollars, while the additional security offered the citizens and the prevention of crime where electric lights are used is of far greater value.

Notwithstanding the benefits derived there has been engendered a spirit of opposition and a seeming attempt to assail the electric light interests of this country by false and deceptive statements as well as invidious comparisons intended to prejudice the general public. The electric light companies have been held up as monopolies, yet with all their extortion the records show that the average return or dividend received by these bloated monopolies has been only about two per cent., thus showing that they have proved of greater benefit to the public than to their stockholders.

A hue and cry has been raised about the dangers of electric lights, and the papers in the cities have devoted column after column to the accidents caused by their use. Why is this when statistics and records show that considering the number of lights and the magnitude of the business, the accidents have been far less than in any other industry?

By the Gas Commissioners' report of Massachusetts it appears that 107 persons were killed last year by inhaling illuminating gas, more than ten times as many as were killed by electricity.

Attempts have been made to antagonize the municipalities and the electric interests and efforts in many cases to force the price of electric lights below the actual cost of producing them. In all these raids the fact that the companies have so largely contributed, as many of them have, to the material development, the commercial prosperity and social progress of the communities or places in which they exist is ignored.

Some party who desires a chance to dispose of a plant or secure a position raises the cry that the municipality should own and furnish the lights; the plea being that it can be done for so much less money.

Can a city secure labor or buy materials or dynamos any cheaper than a corporation, and when as shown the profits or dividends realized by the electric light companies have only averaged 2 per cent. how can a municipality pay 4 or 6 per cent. interest on its bonds and expect to save money by owning the plant and assuming the liabilities and losses which actual experience shows are sure to occur.

Hardly a week passes without some article appearing in the papers purporting to show the cost of the electric lights and the great saving to municipalities by owning the plant; the latest and one that shows an utter ignorance of the facts or experience in the business appears in the New York *Independent.*

This article has display head lines saying: "Cost of electric lights. Boston pays $180 per lamp, and Ypsilanti only $24."

By this statement the reader is lead to believe that Boston is being swindled, and as a proof the cost of lights in Ypsilanti, where the city owns the plant, is given as a comparison.

What are the facts? Boston is furnished with lights all night and every night in the year and the company producing the same have to use steam power with coal $4 or $5 per ton, besides having to pay the city heavy taxes.

Ypsilanti uses water-power costing nothing; burns the lights only twenty nights each month until midnight and uses the buildings belonging to the waterworks of the city and salaries and expenses of men to run the lights are charged to the water department.

In the same article Topeka, Kansas, is cited as the Mecca where lights only cost the city $72 per year for all night.

Topeka purchased an electric light plant of 184 lights for $50,000 and the company or parties who sold the plant to the city represented that the cost of each lamp would be $6 per month or $72 per year. This amount is given in the article referred to as the cost of lights in Topeka. The city officials have found by actual experience, and so report, that the cost of running the lights is $11 per month or $132 per year for each lamp. The Mayor states it as his opinion that it would have been much cheaper in the end for the city to have contracted with the local electric light company for the lights.

Dunkirk, N. Y., is quoted as burning 55 arc lights all night, every night, at a cost of only $36.50 per year; about $3 per month. The cost for the month of October as reported was $225.28, not including superintendent, engineers' and firemen's salaries, interest on plant, depreciation and repairs, as these are paid by the water department. Add to this the salaries of superintendent, engineer, fireman, interest, depreciation, repairs and taxes, which an electric light company would have to pay and which the city does pay, but charges to another department, and the cost is $625 per month for 55 lamps, or over $11 per month per lamp and $132 per year.

These are samples of the comparisions that are being made by the advocates of municipal lighting, and it is surprising that a man who claims to be connected with John Hopkins University should be willing to attach his name to a communication containing so many statements that are manifestly incorrect, misleading and unjust to the electric lighting interests of the country. In connection with municipal lighting, why did he not refer to the largest municipal lighting plant in this country and the operations of the great gas trust of Philadelphia, where the city lost $3,500,000 in six years in owning and operating its own lights; and notwithstanding the city now owns the gas plant, they are contracting with electric light companies to light their streets at a higher rate than is paid by this village.

A great deal has been said about the price charged by the Rutland Electric Light Co. for lighting the streets. Upon investigation, and taking the reports from 136 places using 15,067 street lights, the average cost per lamp is $125 per year. Rutland paid last year $6,500 for 56 lamps burning every night in the year, part until midnight and the balance all night, making the average cost per lamp $116 per year, being $16 per year per lamp less than it cost the city of Topeka for lights and the city owning the plant, and coal in those cities costs about $1.65 per ton, while in Rutland it costs $4.25—nearly three times as much.

The taxpayers of Rutland displayed their wisdom when they voted at the annual meeting, by an overwhelming majority, not to burden the village with an electric light plant.

M. J. Francisco,
President Rutland Electric Light Co.

Working Copper by Electrolysis.—Electricity is now used in working copper by an English inventor, and the results, it is claimed, are alluring. In brief, the copper is electrically deposited from the rough bars upon a revolving mandrel or mould, over the face of which passes a burnisher condensing the copper particles as they are deposited. The material in this way is rendered dense, fibrous and cohesive, and also possesses an otherwise unobtainable strength and ductility, all at a low cost. Seamless pipes of any diameter can thus be produced far cheaper than by any other process.

THE LONDON UNDERGROUND ELECTRIC RAILWAY.

The London *Graphic* of March 15 gives the following additional particulars in regard to the underground electric railway, on which successful tests were made recently, and which were noted at the time in this journal. The illustrations are also taken from the same paper and give a general idea of the character of the road and cars.

This new means for intercommunication between the City and South London, says the *Graphic*, is now rapidly approaching completion. The original Act (1884) empowered its construction from King William street, City, to the Elephant and Castle; but the company subsequently received permission to carry on the line to Clapham Road and Stockwell. The line is a double one; but each pair of rails is laid in a separate tunnel, the two tunnels, of course, running mainly in parallel lines. The City terminus is in King William street, near the Monument. The railway is reached by a circular shaft, down and up which passengers will be conveyed by a hydraulic lift; or they can proceed by stairways, which are also provided. After passing beneath the Thames the successive stations are at Great Dover street, Elephant, New street, Kennington Oval, and Binfield Road, Stockwell. Hydraulic lifts and stairways will be provided at all the stations. The total length of the line is three miles and a quarter, and its two chief peculiarities are the great depth at which it lies beneath the surface, and the employment of electric locomotives. Each engine weighs about ten tons; and the motor, which is of the Edison-Hopkinson type, takes the current from a conductor carried on the wooden sleepers between the rails of the line. The subway is lighted by electric glow-lamps; the brake used will be the Westinghouse automatic; and there will be a three-minute service each way of trains of three coaches, each capable of carrying thirty-four passengers. The line, of which a satisfactory trial was made on March 5, is expected to be open for traffic early in the summer.

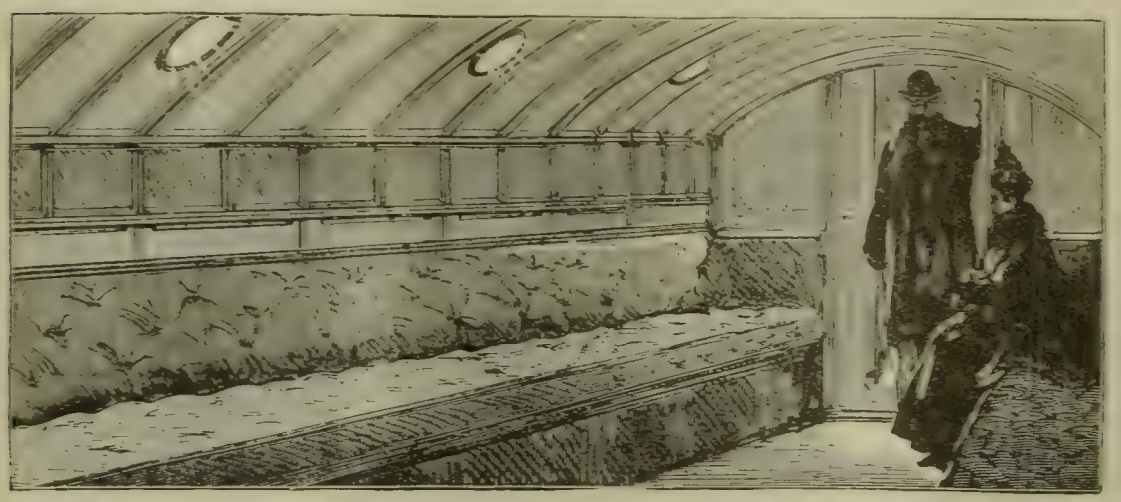


FIG. 1. INTERIOR OF CAR.

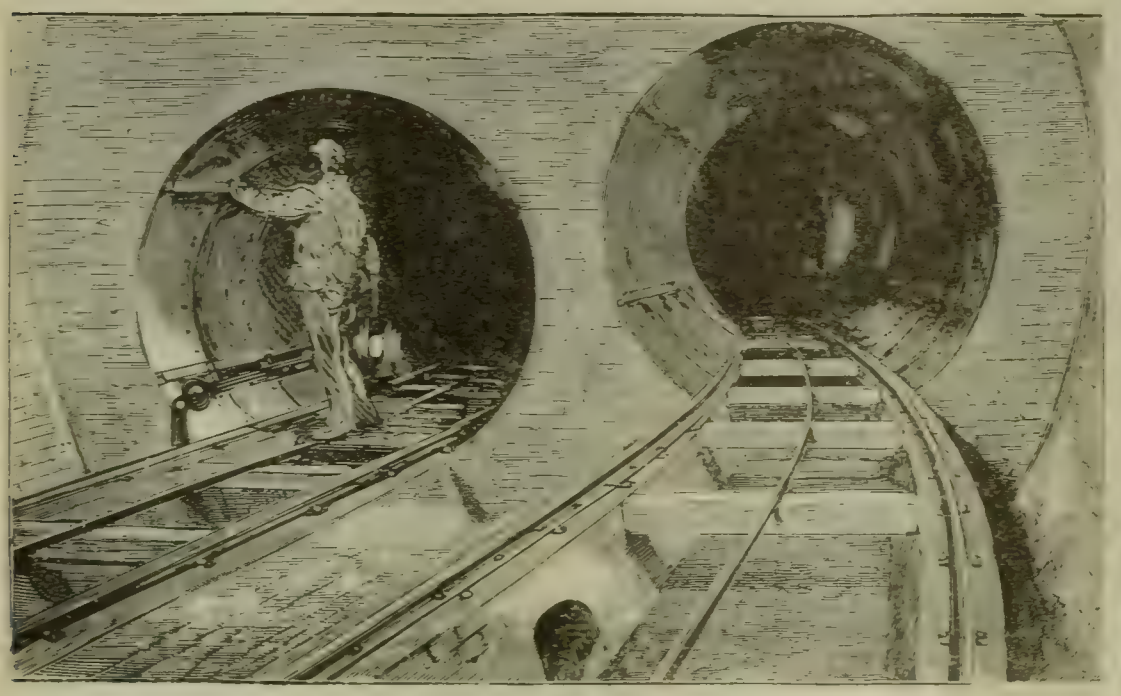


FIG. 2. UP AND DOWN TRACKS.

THE LANGHANS INCANDESCENT LAMP.—Mr. Langhans has recently manufactured an improved filament which will probably be a new development in the manufacture of incandescent lamps. The main characteristics of the Langhans lamp is, that it requires a very low vacuum, corresponding to about 1 mm. atmospheric pressure. So low a vacuum as this entirely obviates the use of the expensive and unhealthy mercury apparatus, as it can be obtained by a mechanical pump specially constructed by Mr. Langhans for the purpose. To achieve this, filaments made of carbons have been superseded by light emitters with a metallic (silicium) conductors. Filaments of this description, it is said, resist a temperature considerably higher than carbon filaments without being attacked by oxygen. This resistance, indeed, is so great, that the silicium filaments will incandese for several minutes in the spent air without being destroyed. Notwithstanding the low vacuum, the life of the carbon filament is said to be equal to that of any of the best makes of carbon; it would be almost possible to do without a vacuum if the conductivity of atmospheric air would not cause too great a loss of heat, and thereby too great a consumption of current. The several processes already employed in coating with silicium the Langhans metallate or mineral filaments are simple and inexpensive, securing great regularity in the coating as well as affording a high degree of certainty in the predetermination of the voltage. Coating carbon filaments with silicium by the Langhans process and patents produces lamps consuming less current than lamps of carbon only, and, moreover requiring but the same low vacuum as the silicium Langhans lamp. It is said that the new lamp takes only 2¾ watts per candle power.



FIG. 3. HYDRAULIC LIFTS.

ELECTRICITY IN WINE VAULTS.—The offices and champagne vaults of MM. Chandon et cie., at Epernay, have recently been provided with a very interesting electric light and power installation. The plant comprises three Babcock and Wilcox boilers, three 60 horse-power Bréguet engines and six dynamos. Three shunt-wound 12-unit Bréguet machines supply the current for the incandescent lighting and storage batteries. Two compound-wound Manchester dynamos giving 250 volts and 55 ampères, supply the current for power purposes, and arc lights are run off a third Manchester dynamo (70 volts×200 ampères). The incandescent lamps are mostly of 16 candle-power, and in the overhead portion of the establishment are fixed in the ordinary manner. In the vaults the wires are bare and of silicium bronze, the lamps being attached to the wires wherever wanted by flexible connectors. The fall of potential in the circuits near the dynamos is limited to two volts; but in those feeding the distant vaults and outhouses a maximum loss of 12 volts is allowed for, the E.M.F. of the dynamos being regulated by varying a resistance in the shunt circuit. The motors, which are of the Raffard type, with Pacinotti-Gramme armatures, are used for a variety of purposes, such as working lifts, pumps, bottle-rinsing machines, etc. Several champagne establishments are putting in electric light and power plants, owing to the many advantages attaching thereto, such as reduction of temperature in the wine vaults, and the time saved by employing electric motors in the various operations of champagne making and bottling.

ELECTRICAL TERMS.

In an article on electrical nomenclature, an exchange says: Electricity itself cannot be defined, for we do not know what it is, though we are acquainted with its effects and are able to change mechanical energy into electrical energy. This is done by means of dynamos and chemical batteries. In the dynamo the essential parts are the armature, the field magnets, the pole-pieces, the commutator and the collecting brushes. The armature is an iron core around which are wound coils of insulated wire. The field magnets are the electro-magnets, constructed of soft iron, which form the poles, are wound with insulated wire, and are employed to produce the magnetic field in the dynamo. The pole pieces are bars of soft iron placed on the poles of the field magnets to confine the limits of the magnetic field. The commutator is the part, generally applied to the armature shaft, made up of segments of thick metal insulated from each other, and connected with the armature coils, its office being to cause the alternating currents produced in the armature coils to flow in one direction. The collecting brushes are the pieces of metal which are pressed against the commutator to carry off the current which results from the difference of potential in the armature coils. The turning of the armature in the field formed by the electro-magnets and the pole-pieces cuts certain lines of magnetic force, which action induces currents of electricity in the armature coils. These are carried by the connections to the different segments of the commutator, if the direct current is required, and taken off by the brush. If an alternating current is wanted the commutator is not used but the brush connects directly with the shaft. Briefly, then, a dynamo is a machine which generates an electrical energy by means of electro-magnetic induction. In the chemical battery electricity is generated by the action of certain chemicals on certain metals—Sulphuric acid on zinc for instance. Electricity, however produced, is identical. The terms static and voltaic electricity at one time meant the manner of producing it, the former term being applied to that produced by friction, and the latter to that produced chemically. A current of electricity produced in any way is measured in ampères. The volt denotes the electro-motive force which is employed to send the current along its conductor; the ohm, the resistance which the current encounters; and the coulomb, the quantity of current which passes through a certain resistance under a certain pressure or electro-motive force. The use of these units of measurement is confusing. It is not uncommon to read of a 2000-volt current. Now this conveys no idea of the strength of the current; it merely states the pressure or electro motive force. It may be a current of no working value, not even cat power; and then again it may be one that has the power to run a half dozen manufactories. In order to know the value of a current its volume as well as pressure must be stated. If it were stated that a current was of 12 ampères and 2,000 volts (the average electric lighting current), or 250 ampères and 500 volts (street railway currents), the value would be seen at once, and its working capacity reduced to figures by multiplying the ampères by the volts, thus $250C \times 500E = 125{,}000$ watts. As 746 watts equal one horse-power, the value of this current in horse-power would be $\frac{125{,}000}{746} = 167\frac{418}{746}$ horse-power. This would be the theoretical strength, but practically some little power is lost in transmission and in application, and it is not the real power. So it would be just as sensible to speak of a 2000-volt current as it would to attempt to give an idea of the quantity of water which flows through a pipe at a named head or pressure without giving the dimensions of the pipe. The other terms, circuit, arc, incandescent, carbons, storage battery, etc., are more easily understood, because the casual observer even can acquire a knowledge of them for the reason that they are always before him and furnish a continual object lesson.

THE BEST TROLLEY SYSTEM.

ONE BY WHICH WIRES ARE CARRIED UNDERGROUND FROM POLE TO POLE.

Madison Buell read a paper on "Rapid Transit," before the Buffalo Electrical Society, April 7, on the above subject.

It was admitted by electrical and other people, the speaker said, that this country had made greater progress in the application of electricity to railways than all the rest of the world. On January 1, 1890, there were 251 roads in operation and under contract, with an aggregate of 1,641 miles and 2,346 cars. The street railway company of Minneapolis threw aside the half million unused cable plant, adopted the electrical system of transit, and has made a big success of it. Yet Buffalo was now going through the chrysalis stages of discussion and arguments relative to the adoption of such a system.

The same arguments, the same objections, had been gone over in nearly 200 towns and cities, and they had been met and answered decisively. The Buffalo Street Railway Company refused to adopt, and wisely too, the cable system, but was willing to adopt the trolley system, subject to certain conditions acceptable to the people of Niagara street. One of the best electricians and railroad men in the country had given his reasons why the storage battery system could not successfully compete with an overhead or direct wire system, and his opinion was confirmed by the best known mathematical and electrical ability, not only of this country but of England. One thing that affected the storage battery system greatly was its own great weight, and as to how it was thus affected the lecturer gave a technical explanation. There was no question that the limitations of the storage battery, so far as street traction was concerned, were pretty clearly fixed, and it could never compete with direct sources of supply.

In a recent number of an electrical journal was an illustration of the new Sprague railway underground work, and this was undoubtedly the system that the Buffalo Street Railroad Company intended to put—or ought to put—on Niagara street. This plan, as described, contemplates carrying double trolley wires between double tracks, with the mains and feeders carried in insulated feeders underground. The sub-feeder wires between the main line and the trolley line will be carried up the interior of the poles in insulated interior conduited pipes. Another set of wires for lights will be supplied from a separate switching circuit running direct from the station and connected with all the series of lights on the poles. The details of this system, it was claimed, give a very excellent form of construction for street railways, making the overhead system entirely unobjectionable and furnishing also the lights for the streets through which the road passes, the control of the lights being from the power station direct.

Holding it to be proved that the pressure of electricity used for the trolley system is not dangerous to life, the lecturer held that the danger to be feared was simply from the network of wire used in its present construction, and their proximity to the electric light wires. The Senate Committee on General Laws having presented to the Senate a report which recommends that all electric light wires be placed under ground the danger constantly menacing the trolley system would be abated.

The railroad people should have authority to move their tracks one foot toward the curbing of the sidewalk. This would be an item of expense which would be vigorously opposed by them, but it would have the effect of giving the citizens a new road the entire route, besides giving a wider space between the two tracks, which would not interfere with the regular traffic of the street. The extra space would be required anyway for safety, as the electrical cars run much faster than the horse cars. The Courts and the Legislature having taken hold of electrical matters and obviated the greater part of the dangers of electric railway traffic, it was only necessary for the Niagara street people to come to some understanding with the street railway officials and arrange the details of a system that will prove beneficial and satisfactory to both parties, and a source of pride to the citizens of Buffalo.

Atmospheric Electricity.—We learn from Kuhlow's, says the London *Electrical Review*, that for a number of years exhaustive information on electricity in storms, with special regard to the influence of atmospheric electricity on the telegraph service and on telegraph apparatus, has been collected by the Imperial Telegraph Department, Berlin. At present, nine hundred telegraph offices have instructions to keep a record of the course, duration, direction, etc., of storms. From the observations made it appears that, while not altogether free from the influence of atmospheric electricity, such influence is materially smaller in the case of underground wires compared with wires above ground. In 1888, 338 interruptions from storms were observed in underground wires, and in the above ground wires 2,375 cases of injury were reported. In regard to town telephone wires, it is worthy of remark that notwithstanding the violence of several of the storms in the towns having a telephone system, the accidents from lightning compared with former years were strikingly few, and the assumption does not, therefore, appear to be without justification that the wires spread over the roofs affords effective protection in equalizing atmospheric electricity. The owners of overhead wires in New York should make use of this plea in the next law case they have.

The Use of the Telephone.—The Stockholm General Telephone Company has introduced a new arrangement for the benefit of subscribers. The telephone company will receive per telephone, telegraphic messages from subscribers, which messages are then transmitted to the telegraph offices free of charge. A small deposit is required as a guarantee for the telegram fees. The telephone company also receives telegrams which have to be forwarded to subscribers in such cases where these live outside the area compassed by the messengers of the telegraph offices.

China Receives the Light.—The new Viceroy of China, Li Hun-Chang, has issued a proclamation intended to smooth the way for the company which is introducing the electric light into the "flowery land." One of the advantages which his Excellency lays stress on is the comparative immuninity from accidental fires it will secure.

Electric Lighting at Rotterdam.—It is said the communal authorities at Rotterdam are studying the question of lighting the city by electricity. Different systems are being tested. Companies are already at work, but all under immediately terminal contracts.

Exhibition. — The International Exhibition which is to be held in July next at the Palais de l'Industrie, Paris, promises to be interesting as regards the electrical exhibits, and some new applications will be shown.

In Favor of the Motor. — The Burlington, Iowa, street railway companies have obtained permission from the Council to use electrictity on their lines.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED APRIL 8TH.

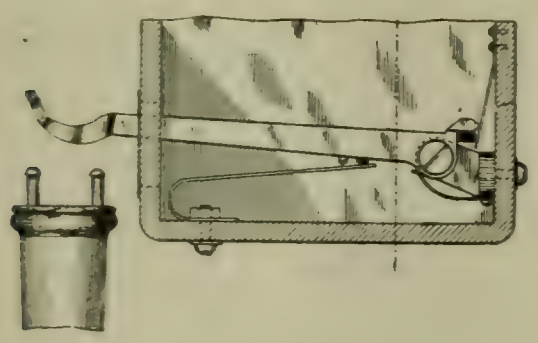
424,778. Ventilating System for Electric Subways. William Gee, New York, N. Y. Filed Nov. 26, 1889. This is a method of ventilation by the use of two pipes, one at the top and at the bottom of the manhole, one pipe being partially, or wholly enclosed within the other, each opening at different levels above the surface of the street.

424,809. Electrode for Secondary Batteries. James F. McLaughlin, Philadelphia, Pa. Filed Dec. 19, 1889.

424,810. Electric locomotive. James F. McLaughlin, Philadelphia, Pa. Filed Jan. 21, 1890. In this locomotive a storage battery is used, and the mechanism includes a clutch adapted to connect the motor armature with the driving wheels and a switch and lever for controlling the current.

424,818. Electric Railway Motor. Frank A. Perret, Brooklyn, N. Y., assignor to the Elektron Manufacturing Company, of New York. Filed Sept. 2, 1889. The armature and field-magnets of this motor are adapted to rotate in opposite directions, and each are independently connected with the running gear of the car.

424,845. Electric Railway. Edward M. Bentley, New York, N. Y. Filed July 30, 1887. In this invention means are provided for laying the electric conductors in an underground conduit.



NO. 425,058.—TELEPHONE SWITCH.

424,848. Electric Railway. Francis O. Blackwell, New York, N. Y., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Aug. 31, 1889. This invention contemplates the use of elevated railroad structures as the supports for the conducting wires.

424,862. Automatic Fire Alarm. Charles A. Cox and Joseph F. Cox, Louisville, Ky. Filed Oct. 11, 1889.

424,866. Arc Light. Julius Dulait, Charleroi, Belgium. Filed April 10, 1889.

424,887. Electric Railway. Walter H. Knight, New York, N. Y. Filed July 10, 1885.

424,888. Electric Railway. Walter H. Knight, New York, N. Y. Original application filed March 13, 1886. Divided and this application filed Dec. 17, 1888. Both of these railways are of the underground class, and means are provided for carrying the currents in underground conduits.

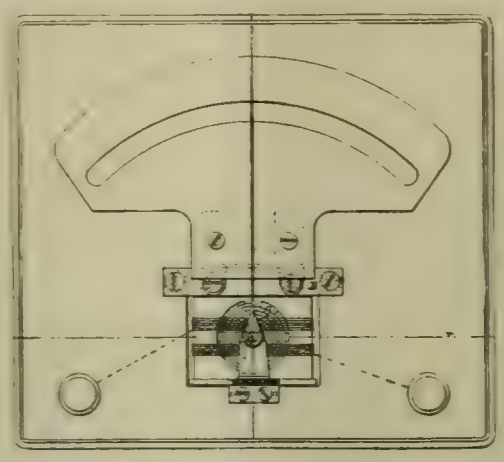
424,891. Method of and Apparatus for Measuring Alternating Currents of Electricity. William Lowrie, Charles J. Hall and Harold W. Kolle, London, County of Middlesex, England. Filed June 12, 1888. Patented in England, France, Belgium and in Italy. This method consists of differentiating the current in opposite directions and utilizing the differentiation to operate an electric motor.

424,910. Contact Device and Switch for Electric Railways. Charles J. Van Depoele, Lynn, Mass. Original application filed Mar. 12, 1887. Divided and this application filed Mar. 21, 1889.

424,911. Electric Railway Motor. Charles J. Van Depoele, Lynn, Mass Filed Oct. 25, 1889.

424,914. Graphophone. John H. White, Washington, D. C. Filed June 29, 1889. The recording of this instrument is done on aluminum.

424,921. Electrical Heater. John V. Capek, New York, N. Y., assignor to himself, and Edward H. Johnson, Greenwich, Conn. Filed Oct. 26, 1889



NO. 425,068.—VOLTMETER.

424,922. Electrical Cooking Stove. John V. Capek, New York, N. Y., assignor to himself and Edward H. Johnson, Greenwich, Conn. Filed Oct. 26, 1889.

424,928. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed July 14, 1885. Divided and another application filed Mar. 12, 1889. Again divided and this application filed Jan. 10, 1890.

424,929. Double-Faced Electric Clock. Erick W. Lindenau, Joliet, Ill , assignor to the Joliet Clock Manufacturing Company, same place. Filed Nov. 2, 1889.

424,956. Graphophony David W. Brown, Washington, D. C. Filed July 3, 1889. This is a method of recording sounds for reproduction.

424,993. Telephone Toll Box and Connection Register. Chas. E. McCluer, Richmond, Va. Filed May 28, 1889.

424,997. Electric Stop Motion for Warping Machines. John E. Prest, Northbridge, Mass. Filed Feb. 20, 1889.

425,004. Electric Alarm Device for Clocks. Robert Schmitz, Cleveland, Ohio. Filed May 20, 1889.

425,038. System of Telpherage. James E. Maynadier, Taunton, Mass. Filed August 10, 1889.

425,058. Telephone Switch. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed February 1, 1888.

425,061. Lightning Arrester. Jas. D. Bishop, Chicago, Ill., assignor to the Western Electric Company, same place. Filed February 3, 1890.

425,066. Balanced Pen for Autographic Telegraphs. Harry Etheridge, Pittsburg, Pa., assignor to the Writing Telegraph Company, New York, N. Y. Filed Oct. 11, 1888.

425,068. Voltmeter. Madison M. Garver, Newark, N. J. Filed December 14, 1889. Claim—1. In an electrical measuring instrument, a coil of wire and a magnet rotary on an axis perpendicular to the periphery of said coil and having its polar extremities in proximity to and facing said periphery.

425,069. Ammeter. Madison M. Garver, Newark, N. J. Filed Dec. 14, 1889.

425,071. Pole for Electric Wires. Levi R. Greene, Boston, Mass. Filed November 25, 1889.

425,076. Electrically Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa., assignor, by mesne assignments, to the Thomson-Houston Electric Company, Boston, Mass. Filed Mar. 18, 1886.

425,077. Electric Railway Car. Rudolph M. Hunter, Philadelphia, Pa. Filed April 19, 1888.

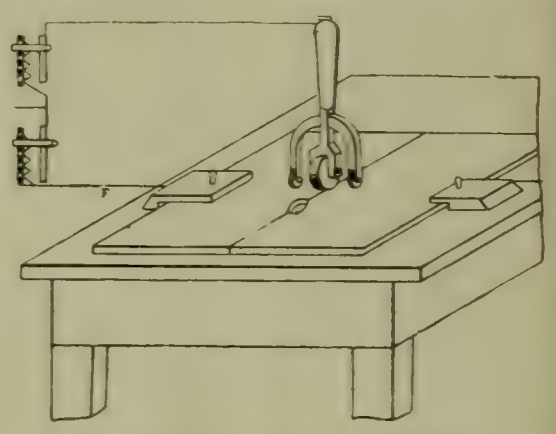
425,078. Electrical Annunciator Drop. Martin Hynes, Boston, Mass. Filed December 14, 1882.

425,086. Central Office System for Autographic Telegraphs. James H. Robinson, Rutherford, N. J., assignor to the Writing Telegraph Company, New York, N. Y. Filed Aug. 30, 1886.

425,089. Thermostat. William F. Singer, Carthage, assignor of one-half to Gilbert L. Haviland, Syracuse, N. Y. Filed December 19, 1889.

425,101. Support for Electric Railway Conductors. Conrad J. Kilian, Milwaukee Wis., assignor of one-half to Dustin Atwood, same place. Filed December 21, 1889.

425,106. Electric Rotary Pump. Emory I. Nichols, San Francisco, Cal., assignor by mesne assigments, to Irvine Stewart and Frank E. Tremper, same place. Filed March 13, 1889. This is an improved rotary pump comprising a fixed hollow shaft having an inlet and outlet port, said shaft having also an eccentric centre with encircling port communicating with the inlet



NO. 425,164.—ELECTRIC WELDING.

and outlet ports, a rim formed with the revoluble shell, and a wrapping of wire upon the rim to form of said shell an electric motor armature.

425,114. Thermostatic Coil. David W. Thompson, Chicago, Ill. Filed July 25, 1889.

425,125. Electric Lighting and Advertising System. Arthur Douglass. Danes Inn, Strand, County of Middlesex, England. Filed Dec. 26, 1889.

425,135. Electrode for Galvanic Batteries. William P. Kookogey, Brooklyn, N. Y., assignor to the Kookogey Chemical Light & Power Company. Filed December 11, 1889. This is a negative element for primary galvanic batteries, consisting of a number of short sections of fine wires or filaments, so as to present a number of points to the electrolyte, said wires or filaments being placed in a vertical position in the battery.

425,143. Burglar Alarm. John Moran, Adair, Mo. Filed December 5, 1889.

425,161. Telephone Toll Box. Harry L. Cassard, Baltimore, Md. Filed October 19, 1889.

425,164. Method of Electric Welding. Chas. L. Coffin, Detroit, Mich. Filed November 6, 1889. The feature in this invention is in traversing the joints to be welded with a roller which acts as a conductor, and is connected with one pole of the generator, while the joint is connected with the opposite pole. The weld is completed by pressure.

A CURIOUS INCIDENT.

At the meeting of the Royal Society of Edinburgh, on March 17th last, the president, William Thomson, read a paper recounting an accidental illustration of the effective ohmic resistance to a transient electric current through a steel bar. He said that at the recent meeting of the British Association at Newcastle Sir William Armstrong told him of a wonderful incident. A bar of steel about a foot long which he was holding in his hand was allowed accidently to come in contact with the two poles of a dynamo in action. He instantly felt a painful sensation of burning, and he let the bar drop. He found his fingers where they had been in contact with the bar severely blistered. The bar was found immediately afterwards to be quite cold. This proved the outer surface of the steel to have been intensely heated, and that not enough of heat was generated to sensibly warm the whole bar. The explanation was to be found in the known laws of diffusion of electric currents through conductors. It seemed to him (the President) to be an illustration of the fundamental principles of the electro-magnetic induction, and he had got permission to communicate the facts to the Society. Lord Armstrong had sent him the bar and some further details. There were two hollows burned out of the metal at the points where the bar touched the poles of the dynamo. Lord Armstrong had held the bar midway between the two marks. It was perfectly cold three or four seconds after he dropped it. The dynamo gave an alternate current of 85 ampères, with a potential of 103 volts. The President did not think this accident alone would prevent electricians from burning their fingers, but that the same experience would have to be gone through by many before caution was learned. The facts were—an exceedingly high temperature for an exceedingly short time in an exceedingly thin skin of metal. The President then showed how the theory involved could be worked out by Maxwell's fundamental equations of electro-magnetism.

ELECTRIC CARS FOR FUNERALS.—A suburban electric road at Pittsburg announces that it will charter cars for funerals to cemeteries along its line.

THE TELEPHONE.—The March *Newsletter* of the National Telephone Exchange Association issued over the signature of General C. H. Barney, Secretary, contains some interesting items, among which we find the following:—The Chicago Telephone Company has notified Prof. Barrett that the patrons of its service have been complaining of trouble on the line since the city began operating its North Side plant, and that the company is satisfied that the interference is due to the operation of the city plant. It was at first thought that the trouble was due to leakage, but examinations by experts of the telephone company have led to the discovery that the trouble was caused by induction. Prof. Barrett replied that he would consider any statements the company would make, as well as any suggestions as to the best method of avoiding the difficulty. He is of the opinion that the trouble is not due to induction.

Telephonic arrangements are steadily extending in England now that the three companies have amalgamated. Direct working has now been established between London and Birmingham, Manchester, Bradford and Leeds. The system is being extended to Glasgow.

In Chaffee *vs.* Telephone and Telegraph Construction Company, Supreme Court of Michigan, it was held that one who erects a building by the side of telegraph and telephone wires, which are on his own land, makes no protest against the maintaining of the wires, allows his tenant in the building to use one of the wires for business purposes, and this goes on for years, making no complaint whatever, cannot recover of the owner of the wires for losses on the building by fire which might have been averted but for the hindrance to the work of the firemen, occasioned by the wires. This judgment was rendered by a divided bench. Campbell, J., dissenting, said that while delay in complaining might cut off a right to sue in equity, "nothing short of a statutory limitation can bar a suit a law; and where a wrongful entry or intrusion is made without license no license can be legally presumed from inaction. It is not in the power of a city to license anyone to damage or encroach on the property of individuals, and no justification can be based on it.

BATTERIES.

Outfits to run INCANDESCENT LAMPS from 25 to 300 hours.

Send for Illustrated Catalogue and Testimonials.

JAS. H. MASON,

Manufacturing Electrician,

Office, 63 Broadway, New York.

Factory, 118-120 PARK AVE., BROOKLYN, N. Y.

Telephone Companies, Supply Houses, Bell Hangers, Physicians, and all users of Open Circuit Batteries, are requested to write the

LAW TELEPHONE CO.,

85 JOHN ST., NEW YORK,

We have something to interest you.

EDISON LAMPS,

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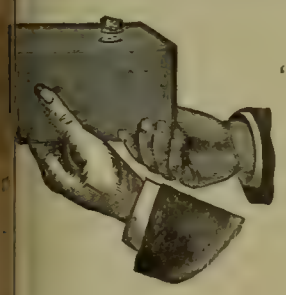
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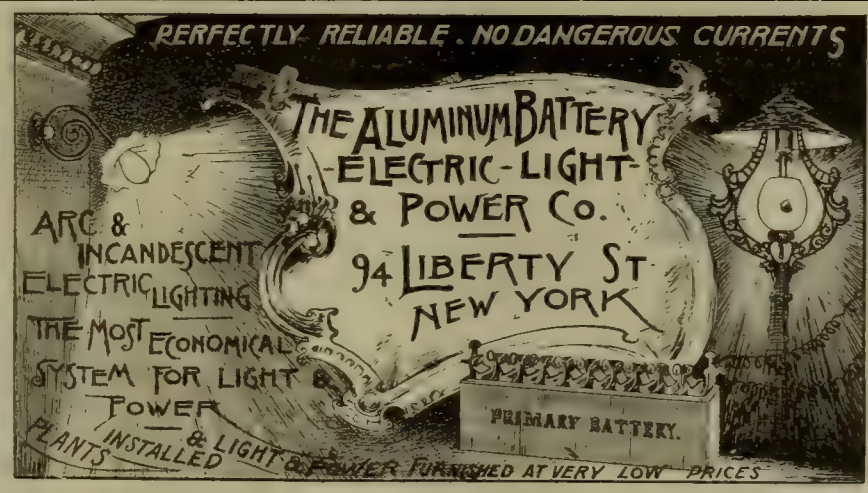
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ELECTRIC CARS ON THE BRIDGE.

A representative of THE ELECTRIC AGE, a few days ago interviewed Mr. Frank J. Sprague, of the Sprague Electric Motor & Railway Company, on the subject suggested by us in our issue of April 12th, of substituting electricity for cable power in the propulsion of the cars on the Brooklyn bridge.

Mr. Sprague thought that the day was not far distant when it would have to be done. The present system was inadequate, and the demand for increased facilities was constantly growing. "One of the great difficulties under the present system," said Mr. Sprague, "is the lack of storage room. When traffic is light there is a large number of cars to be put out of the way. More storage would not increase the traffic facilities, however. It does not seem practicable to get more switching room on the New York side, hence it is impossible to run longer trains, and the headway of the trains now is as short as it is possible to make it under the present conditions. Therefore, under the existing state of affairs, any improvement does not seem possible. The limited switching facilities severely handicaps any effort toward improvement."

"All of these difficulties would be completely overcome by the use of electricity," continued Mr. Sprague. "If electricity were used each car would have its own motor, and would be independent of every other car. In case of accident, if a car should break down for instance, it would be removed without delay and no stoppage of traffic would result. Now, when anything happens to the cable all traffic is suspended until repairs are completed. Under the present arrangement it is a physical impossibility to run trains oftener. When a train arrives at either end after the passengers have been discharged, a locomotive comes along and switches the train to the opposite track. With electricity as the motive power this would not be necessary. A great improvement could be effected at once in this respect by a rearrangement of the platforms. I think the best plan would be to have three platforms arranged parallel to each other, and separated by a space equal to the width of the cars. Then by having the incoming track so arranged that, by means of a switch, the cars could be run in between the first and second (middle), and second and third platforms alternately. Passengers would pass out of the car on one platform, others would be passing in at the same time from the opposite platform, consequently switching from one track to the opposite would be avoided and that much time gained. When the car is filled it could start right back on its return trip and by means of the proper switches pass over to the opposite main track. Under this plan cars could follow each other in quick succession, the first passing in between platforms 1 and 2, and the second between 2 and 3, and so on, and as soon as the first was ready to start back it could pass on and the second would follow in due time.

"The time thus gained," continued Mr. Sprague, "would be very great, and the frequency with which the cars could be run under this plan would provide ample facilities for handling the large crowds."

In answer to a question Mr. Sprague said it would give better service to run cars singly. They could then be handled with greater facility, and if traffic demanded it the cars could be run very close together.

Touching the question of applicability of electric power to bridge traffic, Mr. Sprague said it was entirely practicable. Slight modifications of the ordinary electric street car methods would be necessary, but that was a simple matter. He would utilize the grades on the bridge to a good purpose. By proper means the motors on all the cars going down grade could be turned into dynamos to reinforce the nominal supply current and thus help the up-grade cars. In this way there would be a sort of balance.

Mr. Sprague advocated the overhead conductor system on account of its flexibility. There would be no break of connection with the supply conductor, by using the overhead system.

Speaking of the reliability of electric cars, Mr. Sprague said that he had records of runs by cars equipped with his motors of 18,000 to 20,000 miles without any repairs whatever; and 180 miles a day were regularly run on street railways equipped with his company's motors. As to reliability and safety, there could be no question, and, he said in conclusion, the time will come, and probably very soon, when the bridge cars will be run by electricity, because electricity is the only power that will do the work satisfactorily. It will crowd other power off by its own peculiar fitness.

WEST AFRICAN RUBBER.—An important company has just been formed, says the *London Electrical Review*, for purchasing the valuable concession granted for the sole right of collecting and exporting the India-rubber grown within the territories of the Government of Liberia, west coast of Africa, the concession covering the whole area of the government lands on which the gum elastic rubber tree is found, and it is estimated that a minimum of 2,000 tons can be collected annually. It is stated that brokers in London have offered to take any quantity of the Liberian rubber that be sent them at prices varying from 1s. 6d. to 2s. 9d. per lb.

CITY ELECTRICIAN.—The City Council of Denver, Col., has passed an ordinance creating the office of city electrician. The duties of the officer are to personally inspect the wiring of buildings throughout the city, and see that all precaution is taken against danger.

STOPPING OF THE JULIEN CARS IN BRUSSELS.—A very important decision was arrived at by the Brussels Tramways Company, says a London exchange, at the general meeting held a few days ago. About four years ago the administrative council of the company, on the motion of the president, resolved to introduce traction on one portion of the company's lines, and accordingly three accumulator cars were started. The results obtained with these cars have been unsatisfactory from a financial point of view, although as regards working they were fairly successful, so the company has decided to discontinue running the electric tramcars from the 1st of May next and to return to horse traction. The action of the tramway company in abandoning the electric cars after four years' service will no doubt be the death blow to accumulator traction in Belgium for some time to come. It is to be regretted that these cars will shortly disappear from the Brussels streets, but their failure commercially will doubtless cause the English company working the Julien system to exercise greater care in carrying out the line now under construction in Birmingham.

TREATMENT OF GOITRE BY ELECTRICITY. — Dr. Marano, says an English exchange, reports the complete cure, by electricity, of a goitre of considerable size and three years' duration. The treatment took the form of strong faradic currents externally and electrolysis alternately. For the latter purpose he used five to eight Leclanché's cells, a sponge held between the patient's hands for the positive pole, and connected with the negative pole, a glover's needle, which he inserted into the tumor. On two occasions he connected both poles with needles plunged into the gland. One or two electrolytic and one to three faradic *séances* were given weekly, the former lasting for five minutes, and the latter ten to fifteen. Improvement appeared after first *séance* in the subjective symptoms, a marked diminution of the tumor was visible by the sixth; and though after the first month the progress was less rapid than previously, the swelling ultimately disappeared completely.

OBITUARY.—The death is recorded, at Berlin, of Herr Johann Georg Halske, the co-founder and, for many years, partner of the well-known firm of Siemens and Halske. He was born at Hamburg, on July 30, 1814, and went to Berlin, where he set up an engineers' shop, in 1844. Soon after he made the acquaintance of Werner Siemens, and it was in Halske's workshop that Werner Siemens, assisted by the mechanical skill of the former, was able to work out his first inventions in telegraphy so as to bring them before the public. In 1847 the two men entered into partnership, and laid the foundation of the electrical works which at the present day give employment to thousands of workmen both at Berlin and Charlottenburg, and at several branch establishments. Herr Halske left the firm in 1867, and since then has been an active member of the municipality of Berlin.

GAS LIGHT FOR NEW YORK STREETS HEREAFTER. —The Gas Commission, at its meeting April 18, awarded contracts to the gas companies, which bid for lighting recently, and rejected all of the bids from the electric lighting companies on the ground that they were excessive.

"I am prepared to light the entire city with gas," said Commissioner Gilroy. "It is evident that the electric light companies are in combination, but the city will not give the price they demand for their lamps."

PRACTICAL USES OF ELECTRICITY.—Dr. Schuyler S. Wheeler delivered a lecture on the evening of April 18th, at the Harlem branch of the Young Men's Christian Association. His subject was "Practical Uses of Electricity," and he illustrated his remarks with several experiments.

A BILL FOR ELECTRIC TRACTION.—The North Metropolitan Tramways Company of London has obtained the bill for the application of electric traction to the whole of their system.

BIOGRAPHICAL SKETCHES.

GEORGE FREDERICK SHAVER.

George Frederick Shaver, the well-known electrician, engineer and inventor, was born at Ripley, Chautauqua County, New York, Nov. 4th, 1855. At an early age he showed a bias toward mechanical invention, and before he was 17 years of age he had invented many useful devices and constructed boats, etc., in a manner worthy of a skilled mechanic. When 19 years of age he began his studies and experiments in electricity, having learned telegraphy, and accepted a position on the Lake Shore & Michigan Southern Railway. During these years Mr. Shaver took out his first patent, which was on a sled-propelling device. This was succeeded by many other inventions of more or less value, among which being a telephone transmitter, an automatic incandescent light governor, a safety appliance for snow-plows (now in use on the above-named road),



GEORGE FREDERICK SHAVER.

a compound automatic mail-bag catch for exchanging mails from trains going at a high rate of speed, an electric typewriter, one of the first acid transmitters for telephones, and the self-righting and self-bailing surf or life boat, which is now in use by the United States, English and Canadian governments. In 1878 Mr. Shaver commenced work on the telephone system, which has made him known throughout the civilized world. Mr. Shaver's latest achievement in telephone research is called the molecular telephone. It is an instrument of wonderful power and sensitiveness, and although it is but a few months old it has already been adopted by the United States government, by many railways and private individuals. Another useful device of late invention is a pocket type-writer, weighing but 15 ounces, which is made to travel automatically across a sheet of paper, doing as good work as the larger and more expensive type-writers. All inventors do their inventive thinking at odd hours and times. Mr. Shaver's time for mental activity is between three and six o'clock in the morning and his latest triumph of inventive skill is evidence that this peculiar habit of doing his most important mental work at a time when other mortals are fast asleep has been applied to a good purpose. The molecular telephone has a prosperous career before it.

Buying a Big Electric Light Plant.—A press dispatch from Pittsburg, on April 16th, says: The Westinghouse Electric Company is negotiating for the purchase of the Brush electric light plant in Baltimore. For a controlling interest the purchasers guarantee six per cent. on $600,000 of stock and five per cent. on $200,000 of bonds. In accordance with the deal the Brush Company issues $1,000,000 in common stock, for $250,000 of which the Westinghouse pays in cash or additional plant, the remainder of $750,000 to be sold in the market and to receive whatever dividends the business may pay. The deal may depend on the ability to get a renewal of the contract to light Baltimore.

How to Fix Magnetic Curves.—In M. Korobow's process a plate of glass is warmed and covered with paraffin in a thin layer. The image is formed with iron filings, in the usual manner, on the cooled paraffin. To fix the curves, the plate of glass is again warmed. Finally, the surface of the paraffin is covered with white paint, so that the curves appear black on a white ground. Very well defined figures may thus be obtained. A similar and simpler process consists in covering one surface of stiff white paper with a layer of paraffin, by warming, spreading the filings over the cooled surface, and fixing them with heat.

Prof. Tyndall in Politics.—In a recent speech delivered in England, Professor Tyndall said that, politically, he was an enemy of Mr. Gladstone, but personally he would risk his own life to save Gladstone's.

THE POLECHKO DISC DYNAMO.

The following details relating to this dynamo were given by its designer at the recent congress of Russian naturalists. The inventor seems to have attempted to design a commercial dynamo on the principle of Barlow's wheel. The armature of M. Polechko's dynamo (*see* figure) consists of a single piece of metal, one metre in diameter, insulated from the shaft, and cut radially into 350 segments, separated from one another by fibre to within 13 centimetres of the shaft. The periphery of the disc is furnished with a steel rim, insulated from the disc itself, and widened out on either side of the disc, so as to serve as a collector.

In a machine of this character, the E.M.F. which can be usefully induced along a segment may be calculated as follows: Let a_1 be the radius of the disc, and a the radius of the centre portion. Then the length of the conductor l within the magnetic field is

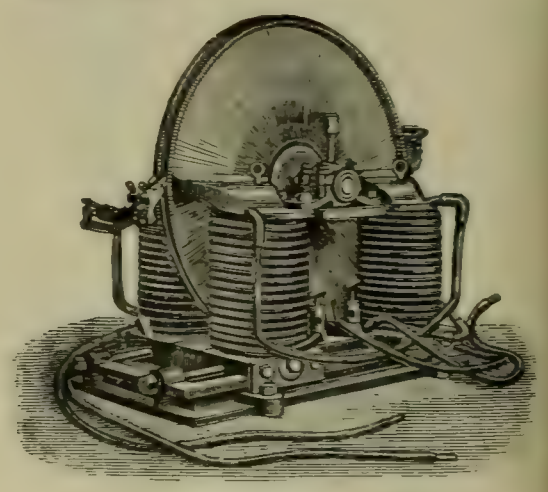
$$l = a_1 - a.$$

Let n = the number of revolutions per second. Then v, the mean linear velocity of each radial portion of the disc, is

$$v = 2\pi \frac{a_1 + a}{2} n.$$

Calling H the intensity of the magnetic field in C.-G.-S. units, the E.M.F. in volts induced in each radial segment is as follows:

$$e = \frac{n\,H\,v\,l}{10^8} = \frac{n\,H}{10^8} \pi (a_1 + a)(a_1 - a) = \frac{n\,H}{10^8} \pi (a_1^2 - a^2).$$



THE POLECHKO DYNAMO.

The total E.M.F. induced in two opposite segments is—

$$E = \frac{2\,n\,H\,v\,l}{10^8} = \frac{2\,n\,H}{10^8} \pi (a_1^2 - a^2) = \frac{2\,n\,H}{10^8} S,$$

S being equal to $\pi (a_1^2 - a^2)$—that is to say, the active surface of the disc.

According to this formula, and with the dimensions of the first machine constructed by M. Polechko, we find that at a speed of 1,600 per minute the dynamo could develop 50 volts when H = 12,600. As a matter of fact, in the first machine, H was only equal to 6,500, and the machine gave 25 volts and 2,000 ampères at 1,500 revolutions per minute, its weight being 1,140 kilogrammes (about 22 cwt.). At the present moment M. Polechko is constructing a modified machine, having almost the same dimensions as the first, and it is possible that these dynamos, of solid construction, small weight, and extreme simplicity, may prove useful in electrolysis, electro-metallurgy, and even electric lighting.—*La Lumière Electrique.*

The Edison Company in Boston.—The work of laying the underground wires of the Edison Illuminating Company in Boston is being carried forward with great vigor, and on a large scale. It is reported that there is a very large demand for light and power on this company.

ELECTRIC LIGHTING AND INSURANCE.

Mr. Thomas F. Clohesey, the well-known electrical engineer, of Kansas City, Mo., at a recent convention of Underwriters at Excelsior Springs, Mo., read a paper on the relations between insurance and electric light companies.

One of the most important and interesting subjects brought before the National Electric Light Convention recently held in Kansas City, said Mr. Clohesey, and the one eliciting most discussion, was the report of the committee on harmonizing insurance and electric lighting interests. If differences exist between these interests, it may be news to the public, who, I imagine, have some curiosity to know the cause.

As I understand it, the insurance companies classify the fire risk on electric lighting central stations as extra hazardous, and demand a premium determined by such classification.

The claim of the Electric Lighting Company is that this high premium is a hardship, forced upon them more through prejudice, and possibly ignorance in many cases, than the hazardous business in which they are engaged ; that the fires originating from electric wires are comparatively less than from many other of the frequent causes.

Those who are qualified to judge will agree on one point, viz., that electricity for illumination and power is the most economical, the most healthful and, above all, the safest element that enters our place of business, or our homes. Simple precautionary measures are only necessary.

The report of the committee on harmonizing insurance and electric light interests, while it did not recommend in so many words, the adoption of the New England plan, yet practically did so. They also recommended that the electric lighting companies contribute toward the remuneration of several expert electrical engineers in different parts of the United States, who should instruct special agents, or inspectors of insurance companies, in the necessary knowledge to discern between good and bad electrical insulation. This committee thought that the special agents and inspectors of insurance companies ought to qualify themselves in inspecting electrical installation, as far as fire is concerned, the same as they qualify themselves in inspecting other appliances put up in buildings, and judge of their relation to fire hazards.

The report was unanimously adopted by the convention, showing at once a disposition on the part of the electric lighting companies to furnish money for the education in electrical knowledge of special agents and inspectors of insurance companies. Rather a generous offer. It would reflect discredit upon them to accept it. They should select the electricians themselves and educate their own agents and inspectors.

I am willing to go on record with the prediction that if the insurance companies will mature and put in operation some uniform and systematic plan of electrical inspection throughout the United States, a greater impetus will be given to the application of electricity to light, power, and heat, for three years after its adoption than existed for fifteen years previous. It would inspire confidence in the use of electricity and be universally used, where to-day it is regarded as a very dangerous element. except by a few who keep abreast of modern appliances, despite the "howl" from sensational critics.

Recently, in Kansas City, a party was about to close a contract for the installation of a two horse-power electric motor. The purchaser learned on inquiry that his insurance would be increased $1.25 per hundred if he put the motor in the building. In my judgment this is a great wrong. Can the danger from an electric motor be compared to that of a kerosene lamp, a tallow candle or a gaslight, if properly installed?

Mr. Clohesey then quoted some facts from Mr. A. R. Foote's work on the "Economic Value of Electric Light and Power," touching the danger of kerosene alone, and after showing how many fires were due to coal oil in various cities, continued :

Why then should anything electrical be considered hazardous, when, as a matter of fact, it is just the reverse, properly handled.

Of course electricity in some forms would be dangerous to life and property, but it is not supposed that every element of safety shall be overlooked. The great hue and cry of the hour is, down with the dangerous wires. If they are dangerous, whose fault is it? The municipal authorities and insurance people should see to it that these wires be made harmless if they are dangerous. The former should appoint an electrical inspector competent to judge of the external overhead wiring of all kinds, whether electric light, telegraph, telephone or district, and determine its safety.

Inspectors acting under the municipal authority must be appointed whose duty it will be to straighten out overhead wires, and see that they are put up according to approved methods.

It is equally important that the insurance companies employ thoroughly competent men to pass upon the safety of electrical installation of isolated plants and the wiring in all buildings connected with the central station system.

The great cry of the hour should be inspection, inspection ! We make laws for the inspection of grain, inspectors of weights and measures, license inspectors, elevator inspectors, plumbing inspectors, sidewalk inspectors, coal oil inspectors, boiler inspectors, milk and bread inspectors, and other inspectors too numerous to mention, yet there can be found no one in this section of the country acting in the capacity of electricial inspector. Still electricity is considered "extremely dangerous," and the people are kept in constant fear. "O, consistency, though art a jewel !"

If I were called upon for an opinion as to the best methods of inspection, I could offer none better than the admirable plan so long in operation in New England under the authority of the New England Insurance Exchange. The requirements of this exchange are reasonable, simple and easily understood by a workman of average intelligence.

Next to perfect insulation and conductivity, comes the importance of safety cut outs and switches.

Mr. Clohesey then quoted from Prof. Elihu Thomson's paper, read at the Kansas City Convention on "Safety and Safety Devices in Electric Installation," and continued :

It is manifestly the duty of the electric lighting companies, as a matter of economy, if for no other reason, to use modern safety appliances ; and the rights of the insurer, as well as the insured, demand that they do so. In addition to this, the municipal authorities have a right to demand the use of such modern appliances by the electric light companies as will protect her citizens from danger to life and property and have the authority to pass laws for thoroughly inspecting the various systems of electric distribution by competent persons, and should set the example by appointing her own electrician, whose duty should be to inspect outside wiring and keep them in a condition of safety.

Professor Thomson recognized the element of danger, but intimates "that electricity as an agent in itself is not to be charged with bringing about the results for which recklessness in its use is sufficient to account." He evidently means by this that it is unsafe to permit high or low tension currents to pass out upon a system improperly constructed. Of course it is. No one would think of carrying 100 pounds of steam through a pipe that would carry but fifty pounds safely. The same applies to water mains. Ignorant workmen are permitted to undertake all manner of electrical work, men who do not know the difference between a volt and a pumpkin, who could not explain the simplest form of Ohm's law, are daily wiring buildings for incandescent lighting and jeopardizing the property employed on by a complexity of wiring more intricate than Ohm or Kirchoff ever dreamed of.

This condition of affairs should not be permitted to exist for a moment. There is no excuse for poor wiring. The municipal authorities can stop it ; the electric lighting companies can stop it, and the insurance companies can stop it easier than any one else, by positively refusing to insure the premises until inspected by experts. Wiring should be done only by men licensed to work at the business.

They must pass an examination on simple elemental principles touching the more important requirments of the business ; failing to pass they must give way to others. Engineers are licensed, plumbers are licensed, and why not men who wire for electric lighting?

Men who do wiring for electric lighting ; that is, men who plan the work, should be electricians. An inspector should, by all means, be one. You would not think of employing a carpenter to inspect the work of a steam-fitter, and *vice versa*. It is not exactly the case of "thief catch thief," but it requires an electrician to inspect the plan and work of an electrician.

I have some curiosity, Mr. Chairman, to know how your inspectors who make no pretension to knowledge on electric wiring render an intelligent report on a building wired for several hundred lights. They must pass that feature, and leave it to the lighting companies : but these companies can tell nothing about the safety or danger of wire hidden between the walls. The inspector, loyal to his master, may consider the risk as extra hazardous, no matter whether the wiring be good, bad or indifferent, and up goes the rate. Now, I do not say this is true. It is only what might possibly occur.

Recently I had occasion to take out about $25,000 insurance on a company in which I am interested. This amount was divided among some twenty companies. Shortly after the policies were delivered, the agent began a series of visits to my office for the purpose of exchanging some of those policies, alleging as a reason that the company would not carry insurance on electric light plants. If these companies belonged to the New England Insurance Exchange they would accept suchr isks if passed upon by their inspector. In this particular case no reason was given by the agent for returning the policies, except that the companies considered such risks so hazardous they could not accept them. It is true the wiring was not in accord with any particular rule, but was done by experienced men and perfectly safe. This is unjust to the lighting companies where wiring is safely done, whether it is in accord with any particular rule or not the element of danger from fire is less than from any other source. This is a recognized fact among those competent to judge, as statistics sustain the statement. The premium on these policies amounted to 2¼ per cent , a rate out of all proportion to other risks. One of the gentlemen connected with the insurance companies called one day and, finding me in the dynamo room, asked the question, "What makes these dynamos so dangerous and are they easily destroyed?" When I placed my two hands on opposite poles of the machine that furnished light for the premises, and, noticing that I was still alive and feeling absolutely no shock, he was perfectly bewildered. He "could not understand why those machines set buildings on fire and caused me not the slightest sensation of pain." That is the trouble, gentlemen, too many insurance

people feel the same way. They imagine that death lurks in every part of the dynamo and every inch of wire.

It might surprise those present to know that the machine in the Midland hotel, Board of Trade, Keith & Perry building, New York Life building and those immense Edison dynamos in the Edison station, all at Kansas City, which furnish over 10,000 lights, can be handled with perfect impunity. They cannot produce a current strong enough to shock one in a painful degree. This is the low potential system which the insurance companies deal with most.

Now, this is the element that creates at times consternation in the minds of so many people. It is true, as Professor Thompson says, that "electric currents of comparatively high pressure may injure or kill," but the insurance companies do not raise the rate when arc or alternating currents enter buildings. Yet these are the currents that are supposed to kill, as well as destroy property.

Now, said Mr. Clohesey, in conclusion, where are you going to draw the line in the use of any system of electric illumination, no matter whether it be high or low potential, direct or alternating? In the present stage of the science there can be no manifestations of electricity without heat. You cannot produce the arc, or raise a carbonized filament to incandescence without heat. Heat is everywhere present in the electric system in varying degrees, depending upon the size of the conductor, and quantity of current forced through it. You cannot draw the line and bar the door against the introduction of any economic system of illumination, heat or power, simply because under certain conditions it is dangerous.

THE ELECTRICAL SECTION OF THE CENSUS.

Mr. Allen R. Foote, special agent of the Electrical Section of the Census, sends us a report on progress of the work in that department. The following schedules have been completed.

1. Manufacturers of electrical apparatus, instruments and supplies; 2. Electric light and power central stations; 3. Fires caused by electric currents, information to be obtained from electric central station companies; 4. Fatal casualties occurring on electric circuits. Information to be obtained from electric central station companies; 5. Fires caused by electric currents. Special investigation in cities of 10,000 population and over; 6. Fatal casualties occurring on electric circuits. Special investigation in cities of 10,000 population and over; 7. Isolated electric lighting and power plants; 8. Educational institutions. Electrical engineering courses.

The schedule for central station companies required infinitely more work for its preparation than any other. While in preparation it was shown to a large number of managers of central station companies and others, and full benefit has been taken of every suggestion offered. Every possible effort has been made to render it full, plain, complete and practical. The range of inquiries in the complete schedule necessarily covers all apparatus and service that a central station company may have in use or render.

THE ELECTRICAL SUB-DIVISIONS OF THE SCHEDULE.

1. Underground conduits; 2. Underground conductors; 3. Aerial conductors; 4. Incandescent lamps; 5. Arc lamps; 6. Converters; 7. Accumulators; 8. Motors; 9. Stationary motors; 10. Current supplied to motor cars.

To avoid sending a company inquiries that do not pertain to its business, the schedule will be printed in sections.

To ascertain what section to send to each company, the following inquiries are being sent out to be answered at once.

1. Do you own or operate underground conduits? 2. Do you operate incandescent lamps? 3. Do you operate arc lamps? 4. Do you operate a converter system? 5. Do you operate an accumulator system? 6. Do you operate stationary electric motors? 7. Do you operate or supply current to electric motor cars? 8 Are you making, or do you contemplate making additions to your plant during the year 1890? If so, please state of what the additions will consist, and give the total amount of estimated cost.

The returns from the preliminary schedules sent out in February and March are quite satisfactory. An official directory of electric central station companies is now being compiled from these schedules and all other sources of information at command. If any company has failed to return the preliminary schedule, it will oblige the office greatly by doing so at once. In case a company has failed to receive this schedule, one will be forwarded at once if it will kindly give notice of the fact. All companies are earnestly requested to notice carefully the way their names are written on all papers addressed to them, and to make needed corrections in their replies. With such assistance, and due diligence in the office, a creditable degree of correctness may be obtained.

The schedules that have been prepared outline only a portion of the work. To subdivide the inquiries for manufacturers, directories are being compiled, classified as follows:

DIRECTORIES OF MANUFACTURERS.

1. Dynamos; 2. Motors; 3. Incandescent lamps; 4. Arc lamps; 5. Carbons; 6. Insulated conductors for electric currents; 7. Conduits; 8. Primary cells; 9. Accumulator cells; 10. Electric meters; 11. Electric clocks; 12. Electric welding apparatus; 13. Electro-Plating machines; 14. Electric fire alarm; 15. Electric burglar alarms; 16. Electrical apparatus for use in medicine and surgery; 17. Electrical instruments.

Extended as this list is, it requires many addresses to make it complete.

A letter has been addressed to each manufacturer, requesting him to assist in furnishing information for a chapter in the census report, on the "Manufacture and Uses" of the special apparatus named. This letter solicits:

1st. A list of all manufacturers of the apparatus.

2d. A list of the addresses of all users of the apparatus when this is practicable, together with a statement of the purposes for which it is being used.

3d. A full description of any novel or special use being made of the apparatus.

4. Suggestions of pertinent inquiries for a schedule to be sent to manufacturers and also for a schedule to be sent to users of the apparatus when desirable, for the purpose of obtaining information considered to be important.

It is very clear that this invitation affords manufacturers an opportunity to furnish information, the publication of which will be a revelation, not to laymen alone, but to those most familiar with the progress being made in adapting electrical energy to the services of civilized life.

VELOCITY OF ELECTRICITY.—The velocity of electricity is, according to Wheatstone, 454,133 kilometers per second through copper wire. The method employed to ascertain this speed is very ingenious, consisting of insulated conductors arranged in a certain way and in connection with a Leyden jar. A rotating mirror is placed behind the apparatus, and when the current is passing sparks are emitted at certain points and are reflected in the glass. When stationary these reflections showed only as points of light. When rotating the sparks appeared in circular lines parallel to each other. This, Mr. Wheatstone says, shows that it takes electricity an appreciable time to move along its conductor. This time is plainly calculable when the rate of rotation of the mirror and the duration of the spark are known.

PROTECTION OF SUBMARINE CABLES.—The text of the convention for the protection of submarine cables held in Paris has just been published as a Parliamentary paper. It is a punishable offence to wilfully damage a cable to the interruption of telegraphic communications; but this clause (No. 2) does not apply to those who injure it with the object of saving life or their ship. If the owner of a cable damages another one he must repair it, and that without prejudicing a penal action which may be instituted It is compulsory for all vessels and fishing boats to keep a mile away from any ship engaged in laying a cable. Owners of vessels who can prove that they have sacrificed gearing or anchors in order not to injure cables can recover the amount from the owner of the cable if made at once. The treaty, which is an international one, and applies to the English colonies, remains in force for five years, and is to be renewed yearly.

REVERSING POLE PIECES.—In the device patented by Mr. James Swinburne, of reversing pole-pieces for obviating the necessity of changing the lead of a dynamo as the load alters, a subsidiary armature is used. The core of this armature consists of a ring of wire or discs. Each commutator connection passes only once over the outside of the core, and is either made thin where it passes through the reversing field, or is embedded within a groove milled in the core, so that the reversing pole-pieces may be brought very close to the armature core. The reversing magnets are adjustable in position like the brushes, and are excited by the main current, and their influence consequently increases with the load.

FRANKFORT ELECTRICAL EXHIBITION.—This exhibition was to have been held this year, but has been postponed until 1891. A new prospectus has now been issued, giving the classification, which is as follows: (1) Motors (steam, water, air or gas) for electrical purposes; (2) Generation of electricity; (3) Conductors; (4) Accumulators; (5) Electric transmission of power; (6) Electric lighting; (7) Telegraphy and telephony; (8) Electric signals; (9) Electrometallurgy and electrolysis; (10) Instruments; (11) Medical electricity; and (12) Literature.

ELECTRIC TRAM-CARS IN BERLIN.—Negotiations are proceeding between the General Electric Company of Berlin and the principal local tramway company, with a view to the introduction of electric traction on the latter's system. The first line to be worked is the portion called Friedrichstrasse-Kreuberg, and operations will be commenced as soon as the Berlin Municipality has given its consent to the employment of electric tram-cars. Only half the number of cars on the line in question will be fitted electrically. The reason for this is because the cars are small, and two cars will be coupled together.

A LIGHT STATION ENJOINED.—A temporary injunction has been obtained restraining the Edison Electric Illuminating Company from operating its station on 36th street, between Broadway and 6th avenue. The complaint was made by certain of the occupants of the "Mystic" flats, which building adjoins the station, on the ground that the machinery makes a noise day and night; that soot, cinders, gases and steam are discharged from the building, falling upon and ruining furniture in the "Mystic;" that disagreeable odors from the place permeate the apartments, and that the continuous noises disturb the health, sleep and quiet of the occupants.

L'ELETTRICITA.—The editor of *l'Elettricita*, which is published at Milan, would be glad to receive answers to the two following questons from all competent electricians; these answers will be published in an early issue of our contemporary. 1. What has been the most important electrical invention, discovery or investigation of the past year? 2. What application of electricity, already known, will make the greatest progress during the present year?

DIED.

The sudden death of Mr. Harry A. Glasier, at his residence, 3,024 Prairie avenue, Chicago, on Tuesday morning, April 15th, has caused a deep feeling of regret in electrical circles. He had complained of feeling unwell Monday, but his associate, Mr. Wilson, did not suspect his illness to be of a serious nature. Mr. Glasier left his office at 2.30 Monday saying he would not return that night. He appeared to feel better when he retired that night, but early in the morning awakened his wife to tell her he was choking and appealed in touching terms for assistance. Medical aid was at once summoned but came too late, and in a short time he passed away surrounded by his wife and two or three friends.

Mr. Glasier was born at Johnsburg, N. Y., June 7th, 1840. He received his education at the public schools of that place, but being fond of reading continued his studies throughout his life

Mr. Glasier served in the Union army during the late war, at first as a private but afterward returning he formed a company in which he was Second Lieutenant and later, Captain. His regiment was the 64th Massachusetts Volunteers. He was proud of his war record, and bore the marks of three wounds received on the field of battle, two of bullets, and one a sabre cut in his right wrist. He was a friend of the late General Crook, with whom he served during the war, and spoke very feelingly of the General's death.

At the close of the war Mr. Glasier engaged for some years in the wool business in California. Returning east he was made Vice-President of the Jarvis Engineering Company and remained in that capacity for fifteen years.

A few months since he removed with his family to Chicago and established the western agency of J. A. Grant & Co., at 103 Adams street.

Having been for many years engaged in work which brought him into connection with the electrical fraternity, Mr. Glasier was known and respected by members of the fraternity throughout the country. He was kind toward all and especially took a fatherly interest in the young men whom he met that won them to him, and his death causes many a pang of sorrow to those who have thus felt his kindly interest. He leaves a wife and two children.

Mr. Glasier was a charter member of the Chicago Electric Club, whose meetings he attended whenever in the city.

As soon as the sad news of his death became known President Beach called a meeting of the Board of Managers of the Club, and a committee was appointed to tender the sympathies and services of the club to the sorrowing family. At the request of Mrs. Glasier the committee selected as pall bearers, Messrs Beach, Haskins, Kreidler, Kempt, Martin, Walker, Cutter and DeLand. The funeral was held at the residence on Friday, April 18th, and the remains laid to rest in Oakwoods Cemetery.

NEW AUTOMATIC LIGHTNING ARRESTER.

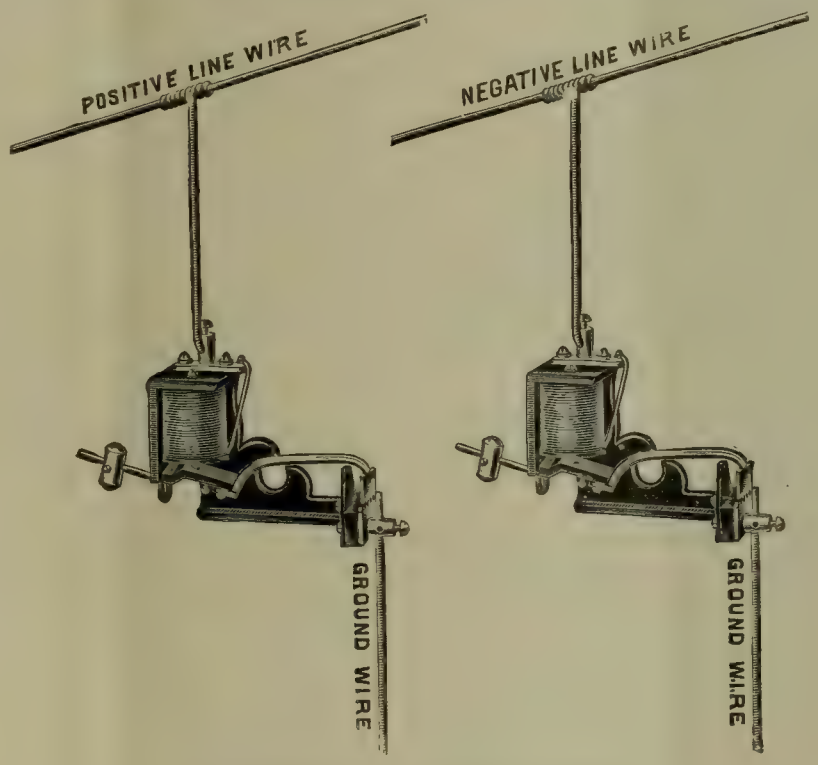
The accompanying cut shows the latest form of the Sperry Electric Company's lightning arrester. These arresters may be used on either arc or incandescent circuits and are made in suitable sizes for currents of from five ampères up. They are connected, one to the positive line wire and one to the negative line wire, as indicated in the cut, while from the lower binding post of each a wire leads to ground. As will be seen, the arrester is automatic in operation. The armature lever carrying at its outer extremity the upper serrated discharge plate is lifted upon the passage of the current through the arrester to break any arc which may form between the plates, and, upon thus breaking the current, is released and returned to its normal position by gravity. An adjustable weight is provided on the rear end of the armature lever for varying the current required to separate the serrated plates. This arrester is manufactured by the Sperry Electric Company, 195-207 Canal street, Chicago, and is guaranteed by them to protect any armature when used.

A NEW VACUUM PUMP.

An exhibition of the Berrenberg vacuum pump, the invention of Mr. Adolph Berrenberg, of Somerville, Mass., was given in Boston, on the 9th inst., to a party of newspaper men and others for the purpose of showing some of the results accomplished by what may well be termed a wonderful piece of mechanism. The pump is intended specially for use in producing the vacuum in the globes of incandescent electric lamps, and the exhibition was devoted entirely to this end, but the pump's usefulness does not stop here, since it may be applied wherever a perfect, or as nearly perfect, vacuum as it is possible to get may be required. Hitherto it has been impossible to get the required vacuum in the electric lamps without using the glass mercurial pumps, in which the falling of a column of mercury draws out the air with it. The Berrenberg pump, however, accomplishes better results without the use of mercury and at the same time does the work very much more quickly than the best of the mercurial pumps. The principles of this operation are practically the same as with any piston vacuum pump, but the manner in which these principles are applied constitutes the secret of the invention and is of course not made public. Suffice it to say, then, in description of the pump that it may be run by any convenient power, that its three exhausting cylinders are made air tight by means of liquid under heavy pressure, and that glass and mercury do not appear to enter into its composition or operation, a refined oil being the liquid used.

Exhibition of the power of the pump was first made in exhausting about 20 globes. The globes were mounted on glass tubes so that they could be easily sealed and taken from the pump. After starting the pump Mr. Nickerson, the electrician, explained that by far the greater portion of the air in the globes was taken out almost immediately, probably in two or three strokes of the pump, and that the time taken subsequently was in producing the almost perfect vacuum needed in electric lighting. At the end of five minutes a couple of globes were sealed and taken from the pump and the bit of glass tube attached carefully broken off in a vessel of mercury, the result being a rush of the mercury to fill the vacuum in the globe and the consequent indication of the vacuum obtained. It was found that the air bubble left in these globes was only about twice as large as the head of a pin, a very much better result than shown in the lamps of the companies now making them, and in which the vacuum had been obtained by mercurial pumps only after three or four hours' time. Globes taken off in ten minutes showed a bubble hardly larger than a pin head, and consequently a more perfect vacuum than had been obtained by any other process The bubbles were also uniform in size in different globes, showing the steadiness of the operation.

The next experiment was to show how quickly the current could be let on to a lamp after exhaustion had begun without burning the carbon, it being explained that in the ordinary manufacture at least one hour was allowed to elapse. In less than thirty seconds after starting the pump the half-dozen lamps used in the experiment were lighted and burned steadily and brightly, showing that in that short time a vacuum sufficient to prevent the burning of the carbon had been formed. Lamps were also shown, still burning steadily, which had been burning for over 500 hours, this being to show the superior durability of the lamps exhausted by the pump.



NEW AUTOMATIC LIGHTNING ARRESTER.

The claims made for the pump and which appear to be well borne out by the experiments may be briefly summed up as follows: It does in minutes what now takes hours for a mercurial pump and the work is better and more uniform; it does alone what would require hundreds of mercurial pumps; it takes up very little room and will not poison those who work it; the lamps made by it are better than others and will burn longer on account of the uniformly good vacuum it produces. The pump has a strong syndicate interested in its development and will soon be put to practical use.

PERSONAL.—Mr. J. L. Barclay, formerly special railway agent for the Sprague Electric Railway & Motor Company in Chicago, Ill., has severed his connection with the Sprague Company.

Mr. H. McL. Harding, of Chicago, Ill., formerly general agent and recently manager of the mining department of the Sprague Electric Railway & Motor Company, has severed his connection with the Sprague Company.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE.

BOSTON, April 18, '90

Sixteen members of the Massachusetts Street Railway Association met in monthly meeting at Young's Hotel, last Wednesday evening, and discussed the subject of "Accidents." Mr. E. P. Shaw presided, and among the speakers were President Shaw, Hon. Henry D. Hyde and President Henry M. Whitney, of the West End Railway Company.

New Hampshire.—A survey has been completed for an electric railway from Milford, through Amhurst, to Mount Vernon, and it is stated that this scheme has ample financial backing. Other electric lines that are being agitated are those from the city proper, of Manchester, to Lake Massabesic and from Dover to Great Falls.

At a meeting of the Society of Arts at the Institute of Technology, last Thursday evening, Professor Elihu Thomson, of Lynn, read an illustrated paper on "Experiments with Alternating Currents."

The Lebanon, N. H., Business Men's Association has appointed a committee to investigate the subject of electric lights.

Judge Co't, of the U. S. Circuit Court, has rendered a decision in the case of the attorney-general of Massachusetts *vs.* the Western Union Telegraph Co., holding that the payment into the Court under the order of the Court, by the defendant, of the sum of $10,956.49 on June 8, 1888, should be treated as a settlement *pro tanto* of the plaintiff's claim, and that the interest upon this amount ceases from this date.

Arrangements have been completed for supplying Hartford, Conn., with electric power from the Farmington river, using the water-power below Tariffville. It will light the streets and supply motors.

A special meeting of the Telegraphers Mutual Aid and Literary Association was held at Little Hall, Eliott street, last Friday evening; H. E. Tobin presided.

The Turner Electrical Manufacturing Co., of New Bedford, has been formed with a capital of $5,000. J. M. Turner, President, and H. W. Parker, Treasurer.

The River and Rail Electric Co. will locate in the shops of the old Taylor Manufacturing Co., on Stanley street, in New Britain, Conn. in a short time. The company will embark at once in the manufacture of electrical devices under patents controlled by them. The company, it is said, will make a specialty of manufacturing Professor Main's new storage battery, as well as improved motors which are particularly adapted to the use of boats and tramway cars.

The New Bedford Gas Co. has placed poles over the north part of the city, where they will put electric lights.

The Waltham aldermen at their meeting last Wednesday evening received a protest from the New England Telephone and Telegraph Co. against the location of electric light wires on its poles.

H. H. Walter, general manager of the Card Electric Motor and Dynamo Co. was in town Tuesday and Wednesday of last week. He expressed himself as much pleased with the prospects for business in this section, but thinks he prefers Cincinnati as a place of residence.

The Edison Illuminating Co. are rapidly increasing their underground system throughout the city.

The governor and council at Augusta, Me., last Wednesday assessed the following taxes against telegraph and telephone companies of the State, the rate being 2½ per cent.: New England Telephone and Telegraph Co., $1,650; Western Union Telegraph Co., $3,125; Maine Telegraph Co., $1,250; Great Northwestern, $125; Eastern Telegraph Co., $450; International Telegraph Co., $1,250.

The stockholders of the New Bedford Gas Light and Edison Electric Illuminating Companies last Wednesday voted unanimously to consolidate, increasing the capital stock of the gas company $150,000.

The city government of Dover, N. H., last Wednesday granted an exclusive franchise to the Consolidated Light and Power Co, to erect poles and wires for a term of ten years, and the Union street railroad, between Great Falls and Dover, will be begun at once. It is to be completed before July 1.

An electric railway franchise has been granted for a road from Greenfield to Turner's Falls. The double trolley system will be used.

The Worcester board of aldermen has granted the petition of the street railway company for the use of electricity as a motive power in operating its cars.

The new Merchants' Electric Company, of Rockville, Conn., has obtained a charter, having been incorporated under the laws of Maine, to furnish electricity for various purposes. The capital of the company is $25,000, and considerable stock has already been taken.

Colonel Burnham, of the Electric Gas Lighting Company, has returned from his southern trip, looking and feeling greatly improved. While away he combined business with pleasure and is much pleased with his success.

An electric welding machine is to be placed in the machine shop at the Charlestown navy yard, at a cost of $12,000.

In the Board of Aldermen, last Monday, the order that permission be granted to the Suburban Light and Power Co., to erect 861 poles for the support of electric wires in streets in Roxbury, Dorchester, West Roxbury, and South Boston, was laid over until the next meeting.

In the House of Representatives, last Friday, an order was adopted requiring the Attorney-General to transmit to the House his opinion, with reasons therefor, as to whether, under the existing statutes, cities and towns have authority, first, to construct and maintain within their own limits and for their own use systems of lighting by gas or electricity; and, second, whether, in connection with such systems, they may sell gas or electricity for private use in such towns or cities.

Judge Ely, of the Municipal Court, has sent to the Superior Court the results of the inquest held by him on the death of Mr. George H. Bradford, who was killed by an electric car of the West End Railway Company, on Beacon street February 17th, and finds that the death of said Bradford resulted from the unlawful act of Daniel W. Lizer, the driver of the car.

The Massachusetts Electric Engineers and Mechanics Association held their third regular meeting at the Brunswick Hall, 241 Tremont street, last Thursday night. About fifty new names were added to the list of members, bringing the total membership up to about 100. Good fellowship prevailed and great expectations are anticipated if the feeling manifested is any criterion. This club is organized solely for the exchange of ideas in an educational manner and to elevate the standard of electrical workmanship, and the members wish it understood that it is not a labor organization. The next meeting will take place on the evening of May 2d, at the above-mentioned hall.

The Gas Commissioners gave a hearing last week in the matter of the electric light muddle in Wakefield, where three different companies are seeking the contract to provide lights for the town. The Citizens' Gas Light Co., which had been given leave to withdraw by the Selectmen of Wakefield, brought the matter before the Commissioners, who have now taken the matter under advisement.

The annual meeting of the New England Electric Exchange was held on Monday of last week, at the rooms, No. 7 Park street, President P. H. Alexander in the chair. The officers who had served the Exchange since its foundation, declined to be candidates for re-election. The following board of officers were chosen: President, A. P. Wright; Secretary and Treasurer, H. H. Fairbanks. These, together with Messrs. E. H. Hewins, H. C. Spaulding and W. S. Hill constitute the Board of Directors.

W. J. P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE.

35 COMMERCIAL BANK BUILDING,
CHICAGO, April 17th, 1890.

W. H. WRIGHT, president of the Council Bluffs Gas & Electric Light Company, Council Bluffs, Iowa, was in the city the early part of the week, with a view to purchasing apparatus to add to their electric plant.

F. H. WHIPPLE, of Detroit, was at the Electric Club this week.

HARRIMAN, TENN., is to have a 400 room hotel, which will be lighted by electricity.

COLLINSVILLE ELECTRIC LIGHT, HEAT & POWER COMPANY has been formed at Collinsville, Ill., with a capital stock of $25,000. Incorporators: Louis Lumaghi, Geo. Hadfield, T. J. Thomas.

THE AUTOMATIC ELECTRIC EXCHANGE has been formed at East St. Louis. Capital stock, $100,000. Incorporators: W. H. Ford, A. Leslie, H. Overstolz.

ELECTRIC FIXTURES.—The general use of electricity as an illuminant has resulted in such a demand for electric fixtures as to have created a special industry of their manufacture. Among the houses which have come to the response to this demand is that of Noyes Bros, of Chicago, whose recent catalogue presents in a very neat form some of the electric and combination fixtures, of which they make a specialty. Their electric brackets, especially, seem to be meeting with favor among buyers of that class of apparatus.

AN ELECTRIC PICNIC.—The city officials of Milwaukee were treated to an "Electrical Picnic" on the 14th inst., by the street railway company of that city, operating the Sprague system. With a special train of two cars the party made a tour of the lines of the railroad company, after which a banquet was served at the Plankinton House.

THE DULUTH CITY COUNCIL passed a resolution on the 14th, allowing the street railroad company to erect poles and wires for an electric line, and making the number of years to run 15 instead of 40 as at first proposed. The council and the railroad company have had some difficulty in coming to terms, and the decision of the railroad company in this latest offer is looked for with interest.

THE LEAVENWORTH ELECTRIC RAILWAY COMPANY has been formed at Leavenworth, Kan.; capital stock, $100,000. Directors: J. A. Borard and John H. Borard, of Kansas City; S. S. Nelley, J. B. Braidwood, Robert Garrett, of Leavenworth.

THE ELECTRICAL SUPPLY COMPANY, Chicago, have just passed through their annual "house cleaning," and with all departments newly restocked have a very attractive place of business. Their warehouse is well filled, especially in their wire department, where they have a supply of the well-known Shield brand of moisture proof wire, sufficient to meet the largest orders in all sizes. One of their greatest demands has been for No. 6 B. & S. gauge, the sale of which they are pushing vigorously. They have 60,000 pounds of this size alone in stock, and report a large number of orders recently.

LONG DISTANCE POWER TRANSMISSION.—A syndicate has been formed in the southwest to transmit power a distance of thirty miles, which they expect to do satisfactorily electrically. The amount of power required is 1,500 horse-power, which will be used mainly for heating purposes, and will have to compete with gas at 50 cents a thousand. The electric heating system, designed by C. E. Carpenter, of Minneapolis, will probably be used. Chicago parties are figuring upon the engineering problems involved, and it is believed that the scheme is practicable. With $1,000,000 of capital backing the enterprise, and Chicago brains and push engineering it, nothing but success can be expected.

BANQUET TO MR. VILLARD.—The Twin City Commercial Club, of St. Paul, surpassed all their previous efforts in the grand banquet given on the 14th to Mr. Henry Villard, who is in that city, accompanied by his friend Herr E. Rothenall, of Berlin. Two hundred and fifty members and guests of the club partook of the banquet which consisted of ten courses. Prof. Siebert's orchestra furnished music for the occasion. Following the banquet, President D. A. Monfort, in a happy speech, introduced Mr. Villard, who was received with great applause. Mr. Villard spoke of the railroad and electrical interests of St. Paul and Minneapolis, in which he is largely interested, and referred to the proposed scheme of utilizing water power to light and furnish power for all purposes to both cities. Mr. Villard has been associated with Mr. Edison since 1879, and is president of the Edison Consolidated Company, with a capital of $12,000,000, and also has a controlling interest in the electric and gas companies of the twin cities. Other speakers were Governor William R. Merriam, Fred Driscoll, Thomas Lowry, President Northrop, of the State University, Archbishop Ireland, and President Oakes, of the Northern Pacific. The occasion was an enjoyable one, and not soon to be forgotten by those present.

J. A. GRANT & COMPANY, through their Chicago office. have closed a contract to install three McIntosh-Seymour engines, aggregating 600 horse-power in the new Wisconsin depot in this city.

E. RATHEMAN, Berlin, Germany, and George P. Wilson, Philadelphia, were among the visitors at the Electric Club recently.

CHICAGO ELECTRIC CLUB.—The annual meeting for the election of officers and receiving the annual reports was held at the club rooms on the 17th. The officers elected for the ensuing year are as follows: President, F. G. Beach. Vice-Presidents: 1st, F. B. Badt; 2d, Alex. Kempt; 3d, D. P. Perry; 4th, W. H. McKinlock. Secretary, W. A. Kreidler; Treasurer, F. S. Terry. Managers: B. E. Sunny, M. A. Knapp, F. W Cushing, Geo. O. Fairbanks, William Taylor, F. E. Degenhardt, E. Baggot, F. W. Parker, Geo. C. Bailey, C. H. Wilmerding. Membership Committee: C. C. Haskins, George Cutter, W. B. Pearson. The treasurer's report showed:

Balance on hand March 31st, 1889.....	$ 251 93
Entrance fees.....	1,070 00
Dues	3,107 47
Special assessments and other sources ..	6,278 08
Total.....	$10,707 48
Disbursements, including fitting up of rooms, $3,500.00 and dedication expenses, $1,600 00, etc.....	10,553 78
Balance on hand, March 31st, 1890....	$ 153 70

The report of President Beach, which was well received, made an excellent showing of the progress of the club during the past year. April 1st, 1889, the number of members were 101 resident and 34 non-resident. April 1st, 1890, the number had increased to 173 resident and 57 non-resident—a gain of 72 resident and 23 non-resident members, or about 70 per cent. The list of papers read during the year is a most excellent one. The Chicago Electric Club is the only electrical literary society giving its members two papers each month with the resulting discussions which are in themselves of great value. High class journals here and abroad make liberal abstracts of, or publish in full, the proceedings of this club. A nucleus of a library has been formed during the year by the receipt from the old American Electrical Society of a very valuable collection of books containing many rare volumes. This will be added to as fast as practicable.

With regret the President announced the death of two of the club's most esteemed members during the past year—Mr. King, of Jacksonville, Ill., and Mr. Glasier, of Chicago, whose so recent death casts a gloom over our present meeting. From present indications it is evident that the club will receive during the coming year a strong representation from some departments of the electrical industry which are at present but lightly represented on its membership list. Several pleasant entertainments have been given during the year. On two occasions it has been the good fortune of the club to be able to extend to representatives of the electrical industry from other sections of the country courtesies which have been highly appreciated. President Beach spoke of the social advantages of the club, and also referred to the restaurant service, which, though the club maintains no cuisine of its own is equal, if not superior, to that of any other club in the city of Chicago. The report was ordered spread upon the record and printed copies to be distributed among the members. At the close of the meeting the clerks of election presented a proxy which had been executed by Mr. H. A. Glasier a day previous to his death to be used at this meeting. As a mark of respect to the departed member the proxy was ordered made a part of the records of the club and filed with the resolutions of respect to be adopted.

THE STILLWATER (MINN.) ELECTRIC PLANT has been sold for $25,000 to the Stillwater Gas & Electric Light Company. The latter is an old company, and is controlled by Isaac Staples, E. W. Durant, David Tozer, and others.

THE T. W. WILMARTH COMPANY has been formed at Chicago to furnish gas and electric light; capital stock, $75,000. Incorporators: T. W. Wilmarth, J. O. Claghorn, H. H. Johnson.

THE ELMER A. SPERRY COMPANY, Chicago, has closed a contract with the Martin Anti-fire Car Heater Company, of Dunkirk, N. Y., to equip trains with the system of automatic temperature regulation recently devised by Mr. Elmer A. Sperry. F. M. I.

THE ESSICK SYSTEM OF TELEGRAPHY.

The demand on the part of the public, especially those engaged in active business operations, for a simple, rapid, secret and accurate means of inter-communication has led to many inventions with this end in view. One of the most ingenious and efficient systems yet developed is that of the Essick Printing Telegraph Company. This system, the transmitting and receiving instruments of which are shown in the accompanying illustration, is the invention of Mr. Samuel V. Essick, and the company above-named own and operate the same.

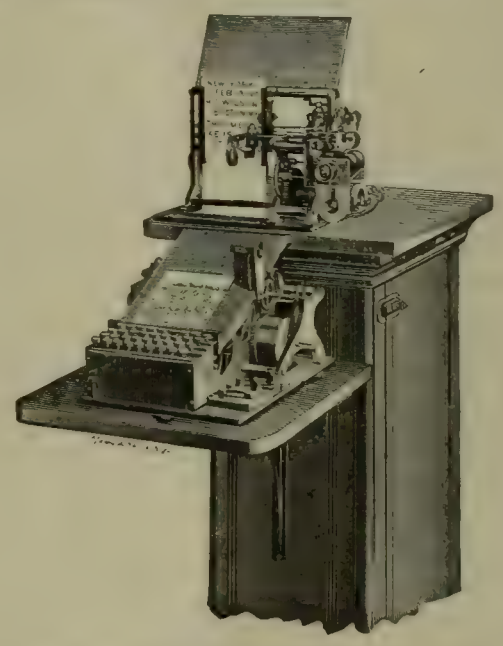
The Essick system differs very materially from any other means of telegraphy in that the electrical impulses move the instrument, whereas in other printing systems, the instruments move the impulses. The Essick system differs radically from others, too, in another respect. The receiving instrument operates only by the impulses leaving the transmitting instrument; consequently, in case of wire trouble, or other interference with the impulses it does not work.

In the Essick Printing Telegraph System no combination of electrical impulses or currents is employed. An even succession of dots or impulses which operates a polarized relay armature at the receiving stations, places the revolving type wheel in the required position, when the local mechanism causes the letter to be printed. Thus it will be understood that inasmuch as these even impulses have no work to do, other than simply to vibrate a delicate armature, the impulses will perform their work if much enfeebled by leakages and resistances that may be added to a wire while in operation.

This system being polarized insures the relays adjusting themselves to the changing conditions of the line, so long as the impulses from one pole of the battery reach the receiving stations with the same strength as the opposite pole; and this would invariably be the case unless the line was wholly interrupted by breakage, in which event the instruments would stop running; or, should the battery open at the transmitting station the instruments would immediately stop.

Fourteen electrical impulses represent the entire alphabet making a complete revolution of type wheel, which may be turned at a speed of 200 revolutions per minute.

In the receiving instrument the shifting from letter to letter and line to line is wholly automatic, and the instrument requires no attention whatever.



THE ESSICK RECEIVER AND TRANSMITTER.

By turning a small switch the transmitter is connected with the line, enabling the subscriber to immediately reply to a message.

The advantages of the Essick Printing Telegraph system may be briefly stated as follows:

1st. It is an electrical type-writer by means of which the message is printed in the presence of the transmitting operator in page form, and a duplicate of the same is printed at all receiving stations on the line, whether it be a long or short circuit.

2d. It is a news printer, by the use of which the current news may be distributed for the benefit of the press in the various newspaper offices. A single transmission prints the same simultaneously in page form, ready for compositor's case, in all the newspaper offices of many cities.

3d. It is a new stock and news ticker for the distribution of the current commercial and financial news to public places.

4th. It is a practical telegraph system, and enables telegraph corporations to reduce working expenses fully one-half.

5th. It is highly commendable for railroad service.

Messages can be received day or night without the presence of the person for whom the messages are intended.

The practical value of the system has been thoroughly tested on lines between New York and Pittsburg, Philadelphia and Boston, and excellent results were obtained.

The offices of the company are at 169 and 171 Broadway, where the system can be seen in daily operation.

ELECTRO-MAGNETIC RADIATION.*

BY PROF. G. F. FITZGERALD, M. A., F. R. S.

The Professor began by explaining how small forces, if repeated at regular intervals so as to give rise to a series of rhythmic impulses, might be made to produce great and destructive effects. By suitably selecting the period of vibration, so as to agree with one of the periods of vibration of any body, these rhythmic impulses might be made to exert destructive effects on that body; and, on the other hand, damage to any given structure might be avoided by selecting periods to which it was incapable of responding. This principle, that certain bodies or structures were capable of absorbing periodic impulses of certain definite periods, being thrown by them into very intense vibration, was known as the principle of resonance. Prof. Lodge, in a lecture on "The Leyden Jar," delivered at the Institution last year, had arranged his apparatus so as to make the period of the alternating discharge as great as possible, in order that each wave might be separately distinguishable. The lecturer then proceeded to explain that for waves in any given medium, which in the case of Prof. Lodge's and his own experiments was the ether, the wave-length was inversely proportional to the vibration period. The length of the waves in Prof. Lodge's experiments was about 600 miles.

Ether waves which would produce the highest audible note would have a length of five or six miles, but what he required for making the presence of electro-magnetic vibration visible was a wave length of from two or three, up to ten or twelve feet. The period corresponding to this would be about the hundred-millionth of a second. Waves giving the highest audible note would take about three hours to make as many vibrations as these would in a second, and the waves in Prof. Lodge's experiments would take about a fortnight.

The lecturer then exhibited a large Hertz oscillator which was to be employed in setting up the electro magnetic vibrations.

This consisted of a pair of large metallic plates suspended from the ends of a long glass rod. From the near sides of the plates projected wires terminating in brass balls, the distance between which was capable of being varied by sliding the plates along the rods. The two plates were then connected with the terminals of a Ruhmkorff induction coil, and sparking set up between them. The indicator employed to detect the presence of electrical oscillations consisted of a long conductor of copper wire, having its ends furnished with brass knobs, brought sufficiently close together to allow sparking to take place between them when electrical oscillations were set up in the wire by the ether waves radiating from the oscillator.

The lecturer then explained the nature of the circumstances which determined the period of the electrical oscillation by comparison with the vibrations of a tuning-fork. The vibration period of a tuning fork could be diminished eithed by increasing the stiffness of the prongs, or by diminishing their mass, and, similarly, the period of an electrical oscillation could be diminished by diminishing the capacity of the conductor in which the oscillations took place, or by diminishing the air-space across which sparking occured; a small electrical capacity in the conductor corresponding to stiff prongs in the fork, and a small air-space corresponding to small mass in the prongs. The sparks in the secondary circuit or detector were too minute to be seen at a distance; but the lecturer was able to indicate their existence to the audience by means of the discovery which he had recently made, that if the air-space terminals were connected through a delicate galvanometer, the galvanometer was deflected whenever sparking occured across the air-space. He had not at present succeeded in arriving at any satisfactory explanation of this phenomenon, but it afforded a convenient means of demonstrating the existence of the sparks to an audience. The lecturer explained that it would not do to connect the terminals of the secondary circuit, or resonator, as he called it, through the galvanometer, as if that were done no sparking would take place. He therefore had to adopt an arrangement in which a small subsidiary spark was given across an air space with its terminals connected in this manner.

It was then shown that when the length of the secondary circuit was doubled the sparks became smaller, which was indicated by the diminution in the disturbance of the galvanometer. This result was in contradiction to all the theories of electro-magnetism, with the exception of the Faraday-Maxwell theory that electro magnetic disturbances were propogated by ether waves. According to this theory it was to be explained as due to diminished resonance, the resonator in the first case having, so to speak, been tuned into synchronism with the oscillator, and the addition of a greater length of wire to the resonator throwing it out of synchronism. The lecturer then illustrated the principle of interference of vibrations by communicating vibrations of large amplitude to the free end of a cord suspended from the roof, and showing, in the first place, that the wave, after traveling up the cord, was reflected on reaching the fixed end, and traveled down again. He then agitated the lower end of the cord rapidly and regularly upon which it separated into segments separated by points of rest, or nodes, and the centres of which were points of maximum amplitude of vibration, or loops. This was explained to be due to the interference of the direct and reflected waves. The fixed end of the cord, or point of reflection, was a node, and the lecturer showed that similarly the point of reflection of an electro-magnetic wave was a node, or point of no vibration. This was effected by placing a sheet of metal immediately behind the resonator, which had previously been sparking under the influence of the oscillator. This reflected the waves, so that the resonator was close to the point of reflection of each wave, and this position was shown to be a nodal one by the fact that sparking at once ceased in the resonator.

The lecturer then referred to Hertz's fundamental experiment demonstrating the existence of a series of points of maximum sparking, or loops, separated by equal distances, each double the distance of the first loop from the reflecting surface. This proved conclusively that electro-magnetic radiation took time for its propagation, as was required by Maxwell's theory.

The lecturer then again threw the suspended cord into vibration, but this time by moving its free end rapidly in a horizontal circle instead of backwards and forwards in a horizontal straight line. This gave to each point of the cord a combined motion of oscillation and rotation which he compared to the electric and magnetic forces respectively in an electro-magnetic vibration, observing that the magnetic and electric forces, like the rotary and oscillatory motions of the points of the cord, were invariably at right angles to each other. It was then pointed out that in the case of a single wave traveling along the cord, the crest of the wave, or point of maximum displacement, was also the point of maximum rotation, while in the case of a series of direct and reflected waves, following each other in rapid succession, the nodes, or points of no displacement, became the points of greatest rotation. It was exactly the same in the case of the electric and magnetic forces, the two attaining their maximum and minimum values together at a distance from the oscillator—that is to say, in the case of a single wave; while near the oscillator—that is, in the case of a series of waves surging backwards and forwards, the magnetic force is a maximum when the electric force is a minimum, and *vice versa*.

The lecturer then observed that Maxwell had deduced from his theory that light is an electro-magnetic disturbance propagated through the ether, the conclusion that sunlight ought to repel any body which either absorbed or reflected it. The effect, if it existed, would be exceedingly small, which was probably the reason that it had not as yet been possible to detect it; but a similar effect could be observed by suspending a metallic conductor in front of a powerful electro-magnet excited by an alternating current. The conductor absorbed part of the electro-magnetic radiation falling upon it, and also reflected a portion, so that it ought to be repelled by the magnet. This was shown to be the case by suspending a half-crown, with a mirror attached to indicate its motions, in front of an electro-magnet excited by an alternating current from a dynamo in the basement of the Institution. The coin was seen to be repelled as soon as the current was turned on.

Referring to the nature of the ether, or medium by which electro-magnetic waves are transmitted, the lecturer pointed out that it could not be of the nature of a solid, because rotation could not possibly continue for any long time in the same direction in a solid body; and in case of the transmission of electro-magnetic waves, continuous rotation of the transmitting medium could go on for hours at a time.

The fact that electro magnetic radiation obeys the same laws of reflection as the other forms of radiation known to us, viz.: light, heat and sound, was demonstrated by placing a small oscillator with its air-space on the focal line of a vertical metallic parabolic cylinder, and a resonator, in the same horizontal plane, on the focal line of a second metallic parabolic cylinder, having a common axial plane with the former one. The resonator was then seen to respond to the sparking of the oscillator, although the distance was too great for it to have done so without the intervention of the mirrors, and merely by the action of the waves transmitted directly. A wooden frame with a number of parallel wires stretched upon it was then interposed between the two mirrors perpendicular to their common axial plane. It was then found that as the frame was rotated, a position could be found in which the resonator would not respond to the oscillator, but when turned through a right angle it produced no effect, the waves traversing it without hindrance. Now this framework would absorb electro-magnetic vibrations parallel to the wires, but not those at right angles, so that the experiment showed that the electro magnetic vibrations were polarized—that is to say, were all parallel to one plane.

The growth of the electric and magnetic forces was then illustrated by a series of diagrams, which were first thrown upon the screen in slow succession, and then made to follow one another with great rapidity by means of a kind of zoetrobic apparatus, designed by the lecturer, thus illustrating in a very striking manner the nature of a series of electro-magnetic waves.

Returning to the consideration of the nature of the medium by which electro-magnetic waves are propagated, the lecturer exhibited a beautiful experiment to show that a vortex in a liquid could be thrown into vibration exactly as if it were a solid. A large glass jar, full of water, was provided, with a small aperture at the bottom. The lecturer then opened the tap at the bottom, and threw the liquid into rotation about a vertical axis, by stirring it. A columnar vortex was then formed, extending from the top to the bottom of the water, and was made visible by throwing some quinine into the liquid, and illuminating it by a beam from an electric lantern. The jar was then shaken, and the beautiful fluorescent vortex was seen to pulsate just like an elastic solid, the waves traveling up and down between the two surfaces of the liquid from each of which they were reflected. The

*Abstract of a lecture delivered at the Royal Institution, March 21.

lecturer then suggested that the ether might be supposed to be a liquid containing a number of vortices of this kind, for Sir William Thomson had shown the possibility of the existence in a liquid of stable columnar vortices with their axes inclined at all possible angles. Vortex rings threading between these stable vortices would represent material atoms. This theory would explain all the phenomena of nature as being due to different movements of space.

THE DEPTFORD ELECTRIC LIGHT STATION.

In the annual report of the London Electric Supply Corporation, Limited, Mr. Ferranti, the engineer, states that during the past year the buildings at the Deptford station were completed and a large amount of machinery for supplying electric light has been erected. There is now in complete working order a plant consisting of two 30,000-light dynamos, with necessary power.

Some of the mains bought and laid during the year proved to be very great failures, in consequence of which only one-quarter of the capacity of the plant could be utilized. The Grosvenor Central Lighting Station continues to supply a large number of consumers. The plant is to be removed to the Deptford Station in the autumn. The combined plants will then be capable of generating power for 90,000 lights. In addition to the above, two large dynamos of the capacity of 200,000 lights each are being built.

"The laying of distributing mains has been commenced," says Mr. Ferranti, "and fair progress made in a portion of the corporation's area. The manufacture of permanent trunk mains by the corporation's own staff has been vigorously pushed forward, but partly on account of the time occupied in getting a new system into working order, and partly owing to the great difficulties experienced in meeting the varying requirements of the several local and other authorities, none have yet been laid. These mains have been tested on the corporation's own premises, and the results show that they are capable of withstanding greatly more electrical pressure than will be required in ordinary working, and also that they are in every sense a practical and commercial success. The defective mains now in use between Deptford and London will shortly be replaced by these permanent trunk mains, when a supply of current to the full capacity of the machinery now erected at Deptford may be utilized."

Mr. Ferranti states that great difficulty was experienced in getting a satisfactory current meter for use of consumers, but that a satisfactory one has been found and put into use. The old ones caused a loss to the corporation.

In closing his report, Mr. Ferranti predicts a successful career for the great station.

DEATH BY ELECTRICITY. — An electrician, writing recently on the action of electricity on the human body, says that just what takes place in the human organism to produce death from an electric current seems to be an unsolved problem. One of the theories sometimes advanced concerning it is that when a being suffers death from electric shock it is a pure case of internal rupture or explosion from the generation of gas or vapor.

TELEPHONE.—A novel telephone, invented by an American, has for its primary feature the transmission of sound by the vibration of glass. From a glass diaphragm extend a number of glass tubes of various sizes communicating with an ordinary wire. Very clear and distinct utterance has been found to result on trials over a line three miles long.

MINES.—When mines are lighted by incandescent light it is claimed that dangers from fire damp and explosive gases will be minimized.

A NEW SYSTEM OF ELECTRIC ACCUMULATORS AND ITS ACCESSORY APPARATUS.*

In a note by M. Charles Pollak (*Comptes Rendus*) he says: My experiments with accumulators of the Planté type were chiefly with a view to securing great capacity in the shortest possible space of time. To this end I covered the plates with spongy lead obtained by electrolysis. To secure the perfect cohesion of the lead and the plated surface the latter was treated in such a way as to present the appearance of a smooth-haired brush, this being obtained by means of a special laminating roller. The points were 2 mm. in height and 1 mm. at the base, the interstices between the points being 1 mm. The plate having been washed in order to be free from grease was coated over with a paste composed of sulphate of lead tempered in brine, and was then immersed in brine between two sheets of zinc.

The appearance of the reduced plates was uniformly grey, the adhesion of the spongy lead to the plated surface and to the points was perfect.

These having been properly soldered, next we proceed to the formation of accumulators, this being done by causing the current to pass in one direction during a space of fifty hours. The negatives assume a greyish aspect, and the positive ones are a decided brown. After the formation the adhesion of the active material (spongy lead and bioxide of lead) is so perfect that it is impossible to distinguish the place where the overlaying stratum commences.

An accumulator composed of nine plates, four positive and nine negative, having a total weight, including the connecting rods, of 11.206 kg., gave, after twenty-four hours formation with a current of 16 ampères, during the discharge:

HOURS.	AMPERES.	VOLTS.
Mid-day.	18	2.12
1	"	2.08
2	"	2
3	"	2
4	"	2
5	"	1.9
5.18	"	1.8

Total: 95.4 effective ampère-hours.

The resistances over which the discharge was made were regulated so that the discharge should be of equal intensity throughout. The same accumulator, being recharged with a current of 16 ampères for a space of seven hours, gave during the discharge the following:

HOURS.	AMPERES.	VOLTS.
Mid-day.	17	2.2
1	17	2
2	17	2
3	17	2
4	17	2
5	17	1.95
5.30	16.5	1.92
5.45	16.4	1.87
6.4	16	1.8

Total: 102.35 effective ampère-hours.

A yield, therefore, of 91.384 ampères per cent.

The capacity is 9.133 effective ampère-hours per 1 kg. of lead.

Further, it will be seen by the two tables above that the accumulator's E.M.F. altered but very slightly during the discharge, but fell suddenly at the close.

I endeavored to get with a small volume and slight weight a high tension current for adaptation in particular to the requirements of portable lighting. For this purpose I have constructed a small battery of accumulators, which I have called *accumulateur multiple.* It is composed of plates, each having a positive and a negative side, and rubber envelopes separated by frames in ebonite. The whole is perfectly staunch.

*London *Electrical Review.*

THE WOMAN'S EXCHANGE EXHIBITION. — The most interesting exhibit at the Lyceum is the exhibition of the Long-Distance Telephone Company. Their part of the building on the floor below is crowded to such an extent that the management finds great trouble in making the people move on after having once heard the transmissions of songs and speeches from a distance. Such songs as "Oh, willow, tit willow," were rendered so distinctly the other evening that every syllable could be distinguished. A long line of visitors continually had hold of the ten or twelve "phones," listening with astonishment and pleasure to Lillian Russell singing "Saber of My Sire," from "The Grand Duchess," at the Casino. When the piece was finished there was a little round of applause.

Mr. Pickering, the manager of the Telephone Exhibit, called up Boston, 254 miles away, and had some one in the office there to recite "Barefoot Boy," which was distinctly heard two or three feet from the telephone. A cornetist also performed in Boston and the notes rang out as plainly as if the playing had been done in the hall. While the singing of the "Mikado" and "The Grand Duchess" was being heard at the Lenox Lyceum, it was also heard by newspaper men in Rochester, N. Y., and Boston, so that the telephone at each of the theatres was connected with three places at the same time, and all heard with the same amount of clearness. During the coming week, the "Pirates of Penzance" at the Broadway Theatre, and "The Grand Duchess" at the Casino, will be heard nightly at the Lyceum over the telephone.

The Edison Phonographs are also attracting large crowds which keep the machines in constant operation.

ELECTRIC BELTING.—Messrs. Chas. A. Schieren & Co., of this city, report the receipt of an order from the Citizens' Electric Illuminating Company, of Brooklyn, for ninety-eight feet of 42-inch, three-ply electric leather belting. The latter company has already in use 727 feet of double electric belting for main drive, and all the necessary dynamo belts in addition. The firm has also furnished the Municipal Electric Light Co., of Brooklyn, with over 300 feet of double electric belting, of two widths, for main driving belts, and about 325 feet of 8-inch double belting to run their dynamos.

SOMETHING WRONG IN THE MANAGEMENT.— Bismarck, North Dakota, stands unique in its experience with electric light. The electric light plant in that thriving city was closed recently owing to not paying expenses. The Bismarck plant is one of the finest in the Northwest, and cost $40,000. Oil lamps and candles are now used in illuminating the streets. A local paper intimates that the plant can be had at a bargain, and that to do without electric light in this age is taking a long leap backward into darkness.

CENTRAL STATION IN BRESLAU. — The Town Council of Breslau has just commissioned Messrs. Siemens and Halske, of Berlin, to erect a central station in the former town. The initial capacity will be 10,000 16-C. P. lamps and the station is to be completed by the autumn. It is proposed to employ steam engines coupled direct to dynamos of 250 H. P., and probably accumulators will also be used.

NEW PLANT.—It is rumored that an electric light plant is to be put up at Cherokee, Iowa, at a cost of $10,000.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED APRIL 15TH.

425,269. Electric Meter. Milton E. Thompson, Boston, Mass. Filed June 4, 1889. The action of this meter is based upon the heating effects of a current, two heating effects in coils being compared and the difference being measured.

425,270. Electric Meter. Milton E. Thompson, Boston, Mass. Filed October 28, 1889. This invention is similar to the preceding one, the difference being in the method of taking the records. In this a recording differential thermometer is used for recording the amount of heating effect.

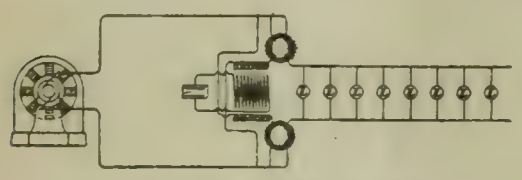
425,335. Process of Manufacturing Metallic Electrodes for Batteries. Friedrich Marx, Berlin, Germany. Filed Dec. 30, 1889.

425,388. Electric Railway Apparatus. John B. Odell, Chicago, Ill., assignor of one-half to Horatio N. May, same place. Filed November 30, 1889. This invention relates to underground conduits for electric railways and provides improvement in method of construction, etc.

425,413. Balanced Pen for Autographic Telegraphs. Harry Etheridge, Pittsburg, Pa., assignor to the Writing Telegraph Company, New York, N. Y. Filed Nov. 14, 1888.

425,435. Brush Holder for Dynamo Electric Machines or Motors. Frederic A. LaRoche, Philadelphia, Pa. Filed Dec. 7, 1889.

425,466. Car Telegraph. Wm. F. Stevens, Joppa, Md. Filed June 26, 1889. This system is of direct contact with the conductors, of which there are three.



NO. 425,269.—ELECTRIC METER.

425,470. Distribution of Electric Currents. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Jan. 29, 1890. This is a method of maintaining or regulating the potential at any point of a system of electrical distribution, consisting in supplying energy thereto from two sources, one connected therewith over one set of mains or conductors, and the other indirectly connected therewith through another set of mains or conductors of high potential, from which the energy is transformed to low potential for application to such points.

425,488. Contact Device for Electric Railways. Francis O. Blackwell, New York, N. Y., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed July 5, 1889. This invention provides, by means of springs, method of holding the trolley firmly against the supply wire.

425,489. Electric Railway Contact. Francis O. Blackwell, New York, N. Y., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Aug. 31, 1889. In this invention the trolley is supported by frame-work fixed on the top of the car.

425,493. Method of Transferring Batteries. Wm. B. Cleveland, Cleveland, Ohio. Filed Feb. 1, 1890.

425,507. Electric Snap Switch. Cornelius J. Hamilton, Philadelphia, Pa., assignor to the Novelty Electric Company, same place. Filed Jan. 20, 1890.

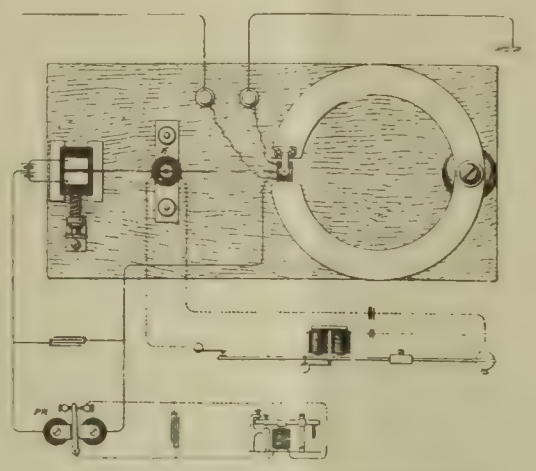
425,511. Telegraph Transmitter. Francis W. Jones, New York, N. Y. Filed June 11, 1889. This invention is a new means of changing the polarity of a battery with reference to the line, as in quadruplex telegraphy.

425,568. Thermo Electric Battery. John Edelkamp, New York, N. Y. Filed January 23, 1890.

425,579. Electric Meter. Victor Popp, Paris, France, assignor to the Popp Compressed Air and Electric Power Company, (Limited.) Filed July 6, 1888. Renewed March 12, 1890.

425,597. Receiving Apparatus for Cable Telegraphy. Patrick B. Delany, New York, N. Y. Filed July 15, 1889.

425,615. Insulating Compound. Adolphus A. Knudson, Brooklyn, N. Y. Filed Feb. 15,



NO. 425,597.—CABLE TELEGRAPHY.

1890. Claim 1 reads—A plastic insulating compound consisting of substantially equal proportions of carbolic acid and an insulating substance capable of being brought to a viscous condition.

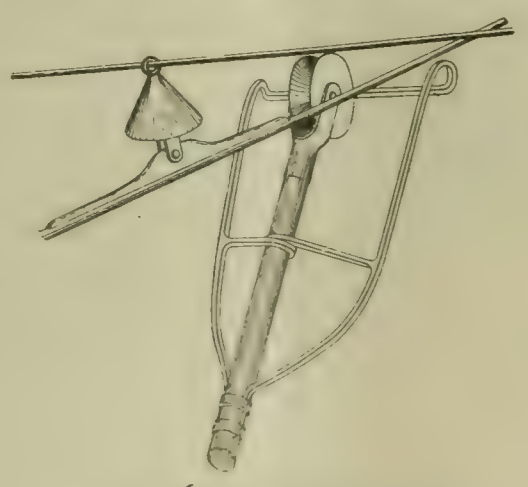
425,625. Electric Temperature Controller. Emer H. Parker, Evanston, Ill. Filed May 21, 1889.

425,627. Electric Car Motor. Edgar Peckham, New York, N. Y. Filed December 2, 1889.

425,630. Electric Call. David H. Rice, Lowell, Mass., assignor to the Currier Telephone Bell Company of Massachusetts. Filed Feb. 13, 1882.

425,631. Telephone Bell and Connection. David H. Rice, Lowell, Mass., assignor to the Currier Telephone Bell Company, of Massachusetts. Filed Nov. 16, 1881.

425,640. Guard for Electric Railway Trolleys. Elihu Thomson, Lynn, Mass., assignor



NO. 425,640.—TROLLEY GUARD.

to the Thomson-Houston Electric Company of Connecticut. Filed Feb. 10, 1890. This invention consists of a guard which aids in the re-establishment of the connection with the conductor in case of displacement of the trolley.

425,694. Trolley. Wallace Porter and Henry George, Wilkes-Barre, Pa. Filed March 8, 1890. This is a method of setting the trolley wheel on its bearings.

425,720. Safety Attachment for Electric Railway Trolleys. Francis C. Wheeler, St. Joseph, Mo., assignor of one-half to Henry Corbet, same place. Filed Oct. 9, 1889. This invention provides means for drawing the trolley arm down by the action of weights.

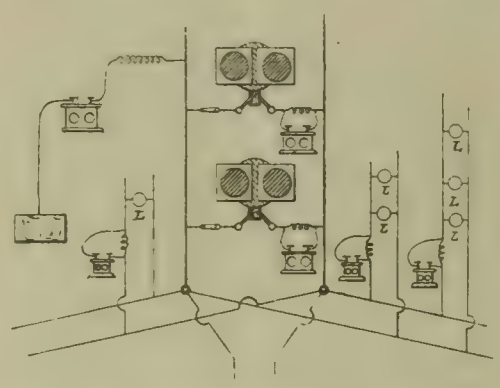
425,726. Cut-Out. Charles Batchelor, New York, N. Y. Filed May 14, 1885.

425,741. Incandescent Lamp Socket. Jas. J. Bradley, Harrison, N. J., assignor to the Edison Lamp Company, same place. Filed Oct. 18, 1889.

425,757. Electric Heating Apparatus for Electric Railway Systems. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed January 27, 1890. In this invention the current for heating is taken from the conductors supplying the motive power to the vehicle.

425,760. Measurement of Electricity in Distribution Systems. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed June 22, 1881. Patented in England and France. Claim 3 reads: The combination, in a system of electrical distribution employing a complete metallic circuit, of a meter or meters in the circuit of the system at the point of generation, meters at the points of consumption, and a meter located in circuit between one side of the system and the earth at the point of generation.

425,761. Incandescent Lamp. Thomas A. Edison, Menlo Park, N. J. Filed Nov. 22, 1883. The lamp is charged statically with electricity of such a character as to neutralize the static



NO. 425,760. MEASUREMENT OF ELECTRICITY.

charge imparted by the current when the lamp is in use.

425,762. Cut-Out for Incandescent Electric Lamps. Thomas A. Edison, Llewellyn Park, N. J. Filed Mar. 8, 1888.

425,763. Commutator for Dynamo-Electric Machines. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Nov. 15, 1881. The contact surfaces of the brushes are amalgamated.

425,767. Electric Railway. Thomas A. Evans, San Francisco, Cal. Filed July 25, 1889. The invention relates to the underground conduit class of electric railways.

425,777. Electric Door-Opener. William L. Godfrey, Brooklyn, N. Y., assignor of one-half to H. F. Hollsberg, same place. Filed Sept. 12, 1889.

425,801. Electric Lighting System. Frederick Johnson, Brooklyn, assignor to the Edison Machine Works, Schenectady, N. Y. Filed Nov. 2, 1889.

425,818. Secondary Battery. James F. McLaughlin, Philadelphia, Pa. Filed Jan. 8, 1890.

425,819. Secondary Battery Electrode. James F. McLaughlin, Philadelphia, Pa. Filed Jan. 8, 1890.

425,840. Phonograph Recorder. John H. White, Washington, D. C. Filed June 19, 1889.

425,853. Electric Circuit for Telephone Purposes. Arthur W. Berne, New Orleans, La., assignor to Brownlee W. Taylor and Samuel B. McConnico, same place. Filed Sept. 24, 1889.

ANSWERS TO INQUIRIES.

Editor ELECTRIC AGE.—Will you kindly give the meaning of the word "hysteresis?" I notice that it is frequently used in dynamo discussion, and I can not find anywhere the meaning of the word.

Easton, Pa.

ANSWER.—In alternating current dynamos the rapid reversals of polarity cause the iron part to become heated, and this effect is called hysterisis.—Ed. ELECTRIC AGE.

"ANOTHER BEGINNER."—The author of the article himself is in error in the use of the terms, and the article was printed as it came to us. The careless manner in which the terms are used naturally carries confusion in the minds of those who are in training. The volt is the measure of difference of potential, and the ampère is the current unit. The author meant, of course, current measure in using the "i."

A YANKEE TRICK IN LONDON.—During the recent test of the value of the conduits of the Interior Conduit and Insulation Company, Mr. E. H. Johnson, the President, who was personally conducting the tests, told a story which brought a smile to the faces of those present. A slight delay in making a connection reminded him of his experience in exhibiting the Edison light in London some years ago. "The exhibition was to take place at the Crystal Palace," said Mr. Johnson, "and I had made great preparations for the event. A large party of prominent people were invited, and had begun to arrive. I was going to turn on 1,200 lamps and astonish the Britishers. Finally everything was all ready and the switch was turned, but no light came. I hurried down to the engine room to see what the trouble was, and found that a plug had blown out of the boiler, which, of course, stopped everything.

"They don't do things in as great a hurry as we do over here," continued Mr. Johnson, "and the English engineer said repairs could not be made before next morning. But I insisted on repairs at once, and the result was in a short time, after a little delay, my efforts were successful, and the lights gave forth their brilliancy.

"But there isn't a man in all England to-day," concluded Mr. Johnson, "that doesn't believe that that was not a Yankee trick."

JAPANESE ENTERPRISE.—It has been said that the Japanese possess more imitative ability than originality, but it must be admitted that they exercise wonderful discretion in the choice of many of the points which they strive to imitate. The Government of Japan is about to establish a meteorological observatory in the Lin-Chin Islands, a position of considerable importance, more especially with regard to observations in the course of the typhoons which are encountered in the China seas. Systematic observations in these regions may be made most valuable to shipping, particularly in conjunction with a complete system of telegraphic communication. That the Japanese thoroughly grasp the situation is shown by the fact that the Government is considering the connecting of the Lin Chin group with Japan by means of a submarine cable.

CLASSIFICATION OF ELECTRICAL PATENTS.—Of the electrical patents issued during the week ending April 15th, 17 were pertaining to electric railways, 11 to electric lighting (dynamos, lamps, etc.), 6 telephone, 6 telegraph, and 4 on storage batteries.

ELECTRIC LIGHTING.—Roddey & Whitner, of Anderson, S. C., have been awarded the contract for lighting the city for a term of ten years.

HIGH CHARGES.—Dissatisfaction with the charges of the electric light company in Middletown, Del., has led the citizens to take steps towards establishing another electric light plant.

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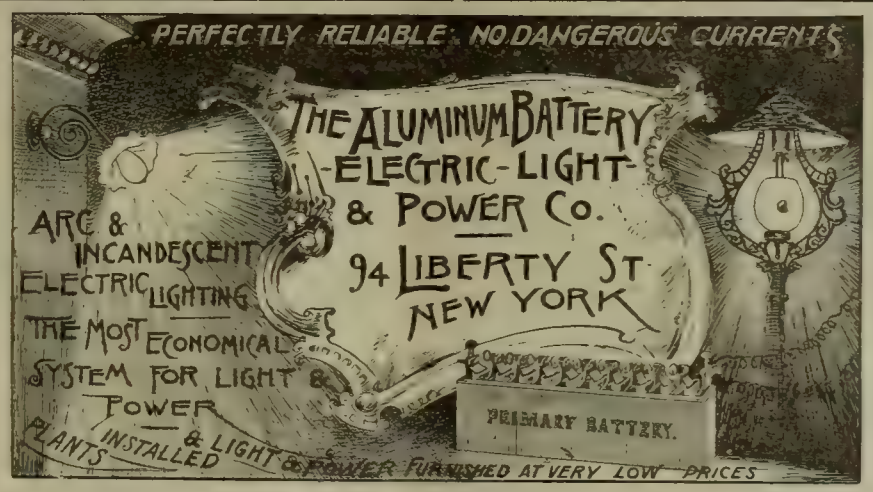
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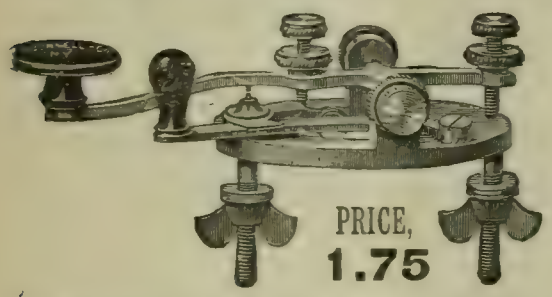
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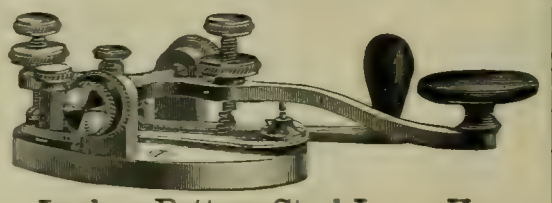


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It will also be noticed by Telegraphers, that since the STEEL LEVER KEY was introduced, a brood of "improved" keys has been hatched and put forward from various sources from time to time each one made to look as much like the STEEL LEVER KEY as possible, or made with some kind of a "steel lever," or "patent lever," and in every case *claiming* all the merits possible and impossible that language could describe. Most of these "improved keys" have become exterminated by the force of their own worthlessness. Years of practical test in the use of THOUSANDS of BUNNELL STEEL LEVER KEYS throughout America demonstrates their perfection and popularity. BE NOT DECEIVED BY THE ABSURD IMITATIONS.

THE BUNNELL STEEL LEVER KEY is *more durable*, and in every respect *better* than any other for rapid and perfect sending for the following reasons:

The Lever is *only one-half the weight* of the ordinary brass lever as generally made.

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NEW YORK, MAY 3, 1890.

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ELECTRICITY ON THE BRIDGE.

While the Trustees of the Brooklyn Bridge are considering plans for the enlargment of railway facilities they should not lose sight of electricity. One of the leading electric railway experts in the United States, Mr. Frank J. Sprague, has given it as his opinion that electricity would solve the problems with which the trustees are now confronted.

To enlarge the facilities for handling trains under the present system of operation will require the acquisition of more land and an enormous outlay of money. Even with more room the element of uncertainty in the operation of the cable would still be present. The people want some reliable power to transport them across the river. The cables break during the hours when travel is heaviest simply because of the enormous additional strain put upon them. With electric power nothing of this sort would or could happen. As we have already pointed out, each car could be run independent of every other car. The conductor from which the electrical current is taken would be stationary and fixed. There would be no strain upon it, hence it could not break In short, electric power would overcome every single difficulty experienced now. Besides, it probably would not be necessary to increase the present amount of room. With slight alterations the existing station facilities would answer the purpose, and the service would be greatly improved. Electricity is the thing. and the sooner the trustees recognize the fact the better it will be for the thousands of people who depend on the bridge for communication between the two cities. The people ought to look into the subject themselves, individually, and after they are convinced that what we have said on the subject is correct it would be an easy matter to let the Trustees know that electricity is preferred to to the unreliable cable.

THE END OF THE PAN-ELECTRIC CASE.

On April 21st the Court in General Term in Washington, dismissed the celebrated Pan-Electric case. The case was known in the Courts as that of J. Harris Rogers, against Ex-Attorney-General Garland, Gen. Joseph E. Johnston, Isham G. Harris, John D. C. Atkins, and Casey Young. Judge Cox delivered the opinion of the court. The case has been in the courts since the summer of 1886, and was brought for dissolution of partnership, an accounting, etc.

The complainant claimed to be the owner of a number of patents, to operate which a joint stock company was formed, and after interviews with him a new company was formed by the defendants on a basis of a capital of $5,000,000. He charges that the defendants had not kept their agreement with him to push the project, and to secure a comprehensive charter, and that they had deprived him of his rights in various ways.

Ex-Attorney-General Garland in his answer denied that any injury had been done the complainant, but asserted that the complainant had violated his contract by selling a large part, if not the whole, of his interest for $40,000 or $50,000, thereby injuring the company and bringing it and the stock into disrepute. Mr. Garland and the other defendants denied in detail all the material allegations made by the complainant.

The Court held that the charge of violation of agreement had not been sustained, that the allegation of a new and amended contract being made was not sustained; that complainant was not entitled to an account nor for money to be paid back, for the reason that an account had been taken, and the complainant received his dividends when paid, and if he had not been paid enough his remedy was by an action at law. All that he was entitled to was a reconveyance of patents not conveyed to the Pan-Electric Telephone Company and Pan-Electric Telegraph Company. The bill would be dismissed, each party to pay his own costs.

WHAT IS A PATENT?—Is a question very few persons can answer. Patents are issued to a great many people who have not the slightest idea what the nature of a patent is. In a general way they know that the government of the United States, in a legal instrument, guarantees them protection in the exclusive right to the benefits of their inventions for a certain length of time, and that is about the extent of their knowledge of the nature of a patent. Mr. Chas. J. Kintner, the well-known electrical and patent expert, who was for many years the chief examiner in the patent office at Washington, in an article which will be found elsewhere in this issue, tells in a very clear and able manner what a patent is. The article is well worth very careful thought. To many, no doubt, the facts contained therein will be a revelation, and it would be well for every one who owns a patent, or who may own one at some future time, to know what his relations are to the people, or government, who give him the exclusive privilege of controlling and reaping the benefits of his invention.

Mr. Kintner makes prominent many points in patent law about which there is a general and profound ignorance, and he shows plainly the importance of employing an expert patent solicitor in making application for a patent. An unskilled patent lawyer can as effectually ruin patent property as an unskilled workman can ruin a piece of mechanism, and many valuable inventions, in such hands, have been ruined and lost to the inventors.

ELECTROMOTIVE FORCE OF A DYNAMO.—The electromotive force of a dynamo is proportional to the number of turns of wire in the rotating armature, and, within certain limits, to the speed of revolution.

THE JERSEY CITY ELECTRIC LIGHT COMPANY.

On the afternoon and evening of April 22d, invited guests inspected the new lighting station of the Jersey City Electric Light Company, Wayne and Fremont streets, Jersey City.

This is the original and only company in Jersey City supplying arc and incandescent electric lights for city, commercial and domestic purposes. The officers of the company are I. J. Struble, President; G. B. Wilson, Secretary, and Frederick L. Perine, Treasurer. W. W. Titzell is Superintendent. The capital stock is $250,000. The company have had their plant in operation about seven years. Recently the old quarters in Bay street were abandoned for the new building, situated on ground comprising twenty-two lots.

The main building, which is of brick, is 60x140 feet, and the dynamo room is 60x120. A wing of the building contains the boilers.

The light plant consists of three Ball 20-light arc dynamos; nine Ball 35-light arc dynamos; one American 50-light arc dynamo; three American 30-light arc dynamos; three Fort Wayne Jenney Slattery Inductor System for Incandescent lighting, 1,000 lighters; one Edison Muncipal 1,000-light dynamo; one hundred storage batteries; three Buckeye engines, of 450, 225 and 100 horse power respectively. The shaft is 140 feet long, with 28 pulleys, operated by the Hill clutch.

There are 6 Abendroth & Root boilers, two each of 175, 150 and 100 horse power. The station has 3,100 incandescent lightings; a switch-board capacity of 9,600; a machine capacity of 4,800; 313 arc lightings, a capacity of 430. There are 40 miles of arc wires and 12 of incandescent wires.

The switch board is 12 ft. by 20 ft. high. There are two ten-circuit Wood Switch boards for arc lights and instruments and switches for six incandescent circuits.

There is ample room for future enlargement, and the plant entire creates a very favorable impression. Everything has been used and done to make it first-class in every respect.

An 80 horse power Thomson-Houston generator is to be installed at once to supply the power for the Montgomery street car line. This line is going to adopt electricity as the motive power and will begin operation by electricity on May 15th.

MICA.—The proposition to put a duty of 35 per cent. on mica imported into this country is, when it is analyzed, a curious one. Mica is produced to a very slight extent in this country, the mines being in New Hampshire and North Carolina. But for electrical purposes this domestic mica does not answer. The foreign article, therefore, is necessarily used. The electrical industry is a large and rapidly-growing one, and to tax this article of necessity, under the circumstances, would be a rather strange proceeding. The mica miners in this country are but a handful in number, and to lay a tax on a great industry for the alleged benefit of these would be an injustice. Were mica mining in this country a large industry the case would be different, but under the circumstances it would seem that simple justice would demand that mica be continued on the free list.

THE ELECTRIC LIGHT QUESTION IN NEW YORK.—The *World* of this city makes an attack upon what it calls the "Electric Light Trust," *i. e.*, the companies that put in bids for lighting the streets by electricity. It says: "It is a good deal better that the city should return to gas or even to whale's oil than that it should be controlled and bullied by a sordid monopoly. Electric lighting is not yet such a necessity that civilization will expire without it." The same paper hints at revelations of the methods pursued by the "Electric-Light Combine," but its expectations were not realized in the manner looked for.

THE EDISON-LALANDE BATTERY.

Reports from the users of the Edison-Lalande battery are of the most satisfactory character. The great range of applicability of this battery is one of its most important features. For telegraph closed circuit work there is nothing comparable with it. The Pennsylvania railroad have an installation of 56 cells of the Edison-Lalande battery at West Philadelphia, from which 16 wires are worked. The illustration given below shows the manner in which these 16 wires are run from the battery, and to the practical telegraph man such a record is wonderful. This plant works satisfactorily in all sorts of weather, and when it is remembered how difficult it is to work more than two wires successfully out of one battery of the ordinary type, the performance of this battery is indeed one which naturally would excite general admiration.

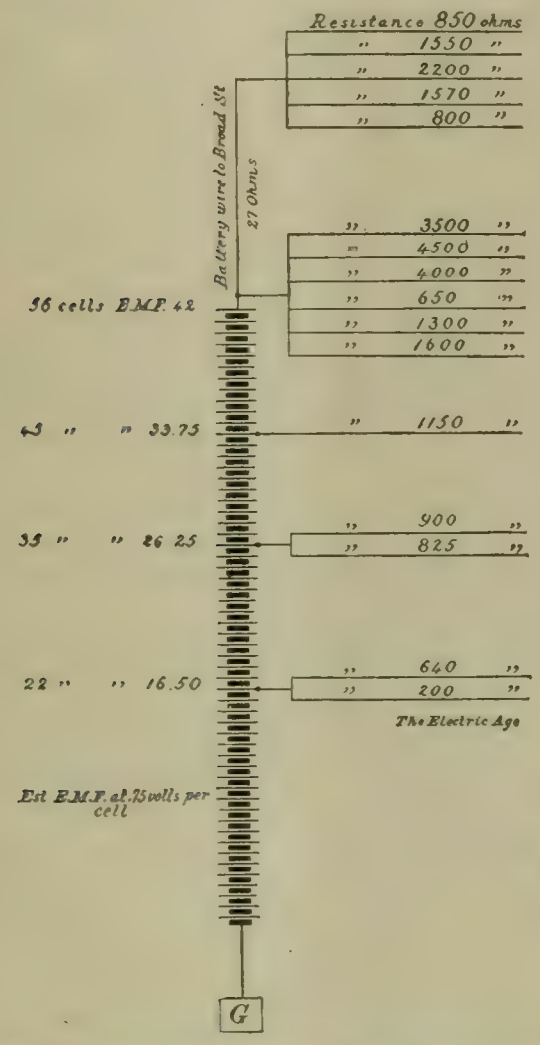


FIG. 1.—DIAGRAM OF BATTERY AND CONNECTIONS.

In the diagram the figures lying parallel to the lines representing the wires, indicate the resistance of the respective circuits. This diagram and the accompanying life table show at a glance the valuable features of this battery.

The experience of the Northern Pacific Railroad Company is that the Edison-Lalande battery is six times cheaper to maintain than Callaud or gravity battery, which has been the standard telegraph battery for many years. The Northern Pacific Railroad Company are running fifteen sounders in their head office from two (2) cells of the Edison-Lalande battery. These two cells displaced no less than eighty-five cells of Callaud battery. The Western Union Telegraph Company tested the battery and ran 30 sounders from 3 cells.

The Edison-Lalande Battery Company have just brought out two new types of their battery. One is a cautery cell which delivers 20 ampères of current, and the other is a 50 ampère-hour cell for call-bell and telephone use. The cautery cell is composed of hard rubber and is finished in a handsome manner; the other is of glass, with a nickel-plated screw-top. Both are very compact. The Edison-Lalande battery is winning for itself a name never before enjoyed by any other battery, and the uniform satisfaction it gives to users is indicative of a prosperous future for the company.

LIFE TABLE OF EDISON-LALANDE BATTERY.

This life-table is based upon an output of 20 milli-ampères of current which is sufficient for wires up to 150 miles in length.

NUMBER OF WIRES.	CURRENT CONSUMED EVERY 24 HOURS AMPERES.	LIFE OF BATTERY DAYS.
1	.48	625
2	.96	312
3	1.44	208
4	1.92	156
5	2.40	125
6	2.88	104
7	3.36	90
8	3.84	78
9	4.32	70
10	4.80	62
11	5.28	57
12	5.76	52
13	6.24	50
14	6.72	45
15	7.20	41
16	7.68	40
17	8.16	37
18	8.64	35
19	9.12	33
20	9.60	31

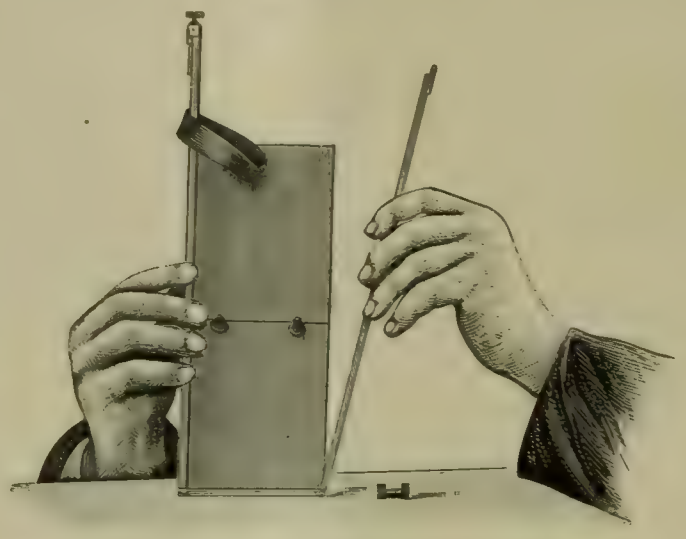


FIG. 2.—PUTTING PARTS OF OXIDE OF COPPER PLATE TOGETHER.

Fig. 2 shows the method of assembling the parts of the oxide of copper plates used in the Edison-Lalande battery, and fig. 3 shows a cell of the battery complete.

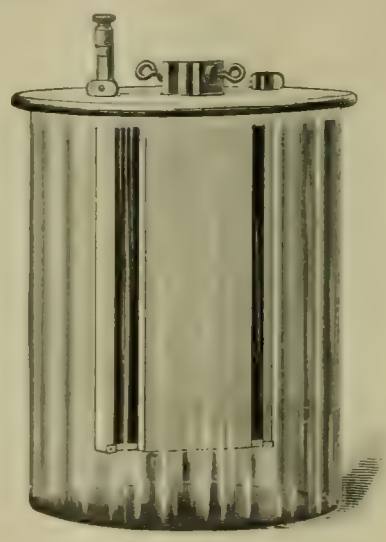


FIG. 3.—EDISON-LALANDE BATTERY.

There is practically no local action in this battery, hence there is no consumption of material while it is not working. This is one of the valuable features of the battery.

The following letter explains itself:

EXECUTIVE OFFICE,
WESTERN UNION TELEGRAPH CO.,
NEW YORK, March 14, 1890.

JAMES F. KELLY, ESQ.
Gen. Sales Agent Edison Mfg. Co.,
No. 19 Dey Street.

DEAR SIR—The Lalande battery furnished by you has been tested with the following results:

Eight cells, taking the place of four cells of bi-chromate battery of a form known as Phelps-motor battery, were put in circuit October 3, 1889, at 4 P.M., with a motor driving a transmitter used on one of the Gold and Stock systems. On October 29, at 11.30 A.M., the battery was taken off, the current having become too weak to run the motor. This test covered 129 working hours.

On November 20, at 10.25 A.M., another battery of the same number of cells was put into the same circuit and lasted until 12.55 P.M. December 19th, covering a period of 132 working hours. Measurements taken at intervals showed that the current given out during these tests was 2½ ampères, indicating that the battery is good for 325 ampère hours.

Three cells of this battery have also been used for working fifteen telegraph local sounders (4 ohms each) with quite satisfactory results; but owing to the varying demands of this class of work it is difficult to estimate with any accuracy, from this test, the ampères hours. Yours truly,

A. S. BROWN,
Electrical Engineer.

In order to appreciate the importance of the showing made in Mr. Brown's report, it should be stated that the four cells of bi-chromate battery which were displaced by the eight cells of Edison-Lalande, had to be renewed every alternate day. The Edison-Lalande cells used were of the 300-ampére hour type, the jars being in size 6 x 11—very much smaller than the cells of the Phelps motor battery.

One of the chief points in favor of the Edison-Lalande battery is the accuracy with which its life time can be estimated. In Mr. Brown's report the fact is pointed out that measures taken at intervals during these tests show that a current of 2½ ampéres was being delivered, indicating that the battery was good for 325 ampére hours. It is very important to know just how much current may be depended on from a given battery and this feature of the Edison-Lalande cell is a very valuable one, and one which no other battery possesses.

The Edison-Lalande battery is the only known source of primary electric power which will stand comparison with the dynamo; it ranks next to the dynamo. This feature is a novel and interesting one, the value of which cannot be overestimated.

As has already been stated the battery is equally efficient on open or closed work, and the local action is less than one-half of one per cent.

BUSINESS NOTICE.—Mr. J. W. Parker, late with Messrs. H. M. Sciple & Co., of Philadelphia, has taken the agency of the Ball Engine Company, and has opened an office at 34 South 4th street, Philadelphia. Mr. Parker has been selling the Ball engines for some time, and is well known to the trade, and we predict for him in his new departure, an even greater success than he has achieved in the past.

A NEW CAR APPROVED.—Gen. Hutchison, inspector to the Board of Trade, last week inspected and approved of the car which the Electric Traction Company are about to run for experimental purposes on the Liverpool United Tramways. To meet the heavy gradients on this line a heavier motor will be used, and both axles will be operated.

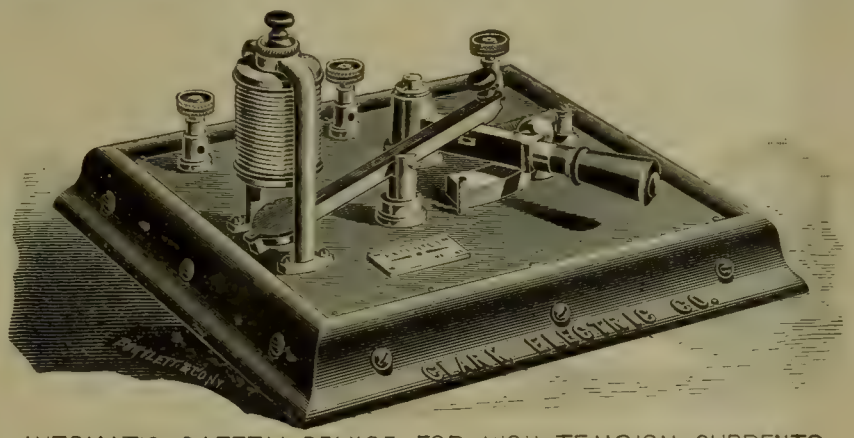
ELECTRICITY BY CONTACT.—Contact of two dissimilar metals produces electricity. This phenomenon was discovered by Volta, and subsequently verified by Sir Wm. Thomson.

ELECTRIC POTENTIAL.—A difference of electrical potential is produced by the contact of two dissimilar liquids with one another.

THE CLARK AUTOMATIC SAFETY DEVICE.

The accompanying illustration represents one form of the new Automatic Safety Device, recently placed upon the market by the Clark Electric Company, of this city, and which has been already mentioned in these columns. It is well known that in case a live electric light wire breaks, the dynamo still remains in action, maintains an E.M.F. at the ends of the broken line, which, with some forms of apparatus, may be even greater than the normal working E.M.F. of the machine. If such broken ends should now come in contact with another conductor, thus closing the circuit, the result is an enormous rush of current, which, in some cases, has been sufficient to wreck the dynamo, or if in falling, the broken lines come in contact with telephone or telegraph wires, the result is usually the destruction of the instruments attached to such wires, with the possibility of starting a serious fire. If, on the other hand, the ends of the broken wires do not, in falling, come in contact with other conductors, but hang dangling in the streets, they offer the possibility of very dangerous or even fatal shocks to any persons or animals coming in contact with them, as is shown by the numerous accidents of the kind on record.

These facts have long been considered as necessary evils by the electric companies, but an evil which it would be very desirable to overcome, if possible. This state of affairs has been particularly aggravating in New York City, where a few accidents, coupled with the ab-



AUTOMATIC SAFETY DEVICE FOR HIGH TENSION CURRENTS

urdly alarming statements of the daily press, have brought about a state of mind in which the average citizen sees certain death in every dangling wire he comes across.

The object of the Clark Electric Company's Safety Devices, patents on all various forms of which were recently issued, is to prevent such accidents by putting the dynamo out of action the instant the wire parts, thus avoiding all danger of damage to the machine, as well as of accidents from fire or shock. These devices are constructed in various forms, according as they are to be used for series or shunt wound arc light dynamos or for alternating current machines.

The illustration represents the device for series wound arc machines, and it will be noted that the mechanical construction is of the simplest possible form. The small electric magnet shown is located in the main current; and as long as the current flows its armature lever is held firmly up, locking the switch in position. Should the line break, or be cut by firemen or others, the current ceases instantly, and the armature of the electro magnet falls, releasing the switch, which flies back under the influence of its spring. The result of this movement of the switch is to close a short circuit across the field coils of the dynamo, thus depriving them of all current, and of course rendering the dynamo powerless.

The hard rubber knob, shown at the top of the magnet, is attached to a rod reaching through the magnet core, and is used as a convenient means of throwing the dynamo out of action at any time; it being only necessary to force the armature away from the magnet, by pressing down the knob, to put the machine quickly out of action without any strain or shock.

Another valuable feature of this device is that it works automatically every time the dynamo is stopped or put out of action, and it must be reset by hand, as the last thing to be done when starting the machine on its load. This, in a measure, insures its action when it is called upon, for should it get damaged or out of order, the attention of the person in charge is called to it, as he must operate it every night in starting up.

The safety device for shunt-wound dynamos, and for alternators, vary somewhat from the foregoing description in their electrical details, but the above will show the general plan on which all are constructed; the object in all varieties of the device being to put the machine out of action instantly upon the breaking of the line, and to accomplish this with absolute certainty, and without endangering the machine in any way.

THE ELECTRICAL AND MAGNETIC DISTURBANCE AT THE PARIS OBSERVATORY.—The efforts of the director of the Paris Observatory to modify the direction of the proposed extension of the Sceaux line have, says *La Lumière Electrique*, made public some very curious phenomena. The Observatory is situated between two busy suburban lines, namely, the Chemin de Ceinture, which is only 60 metres away, and the Sceaux railway, which is 80 metres distant. The passage of the Ceinture trains cause the bifilar magnetometer needles to oscillate so violently and distinctly that M. Descrois, of the Observatory staff, is in a position to supply the railway company with a sheet checking the time of their trains. The curve of the declination needle, curiously enough, exhibits no traces of disturbance. The bifilar needle is kept by torsion at right angles to the magnetic meridian, and therefore parallel to the motion of the Ceinture trains; and M. Descrois is inclined to think that the observed disturbance is due to the fact that the wheels and axles become strongly magnetized, owing to their movement in the magnetic meridian. The Sceaux trains have no effect on the magnetometer needles; but give rise on the other hand to marked disturbance of the registering electrometers. The station on this line is at a distance of about 100 metres from the Observatory, and when the driver lets off steam the electrometer partially discharges, and then immediately afterwards again rises to its normal potential. This singular phenomenon takes place no matter what the potential of the atmosphere may happen to be.

INCANDESCENT LAMP MANUFACTURE.—A company has been formed at Birmensdorf, with a capital of 250,000 fr., under the title of the Zurich Incandescent Lamp Company, for the manufacture of glow lamps.

The Hussey Battery Company will remove in a few days to more spacious quarters.

NEW PUBLICATIONS.

ELECTRICAL INFLUENCE MACHINES.—By J. Gray, B. Sc., London: Whittaker & Co.; New York: D. Van Nostrand Company; pp. 237. Price $1.75.

This volume gives a full account of the historical development and modern forms of electrical influence machines, with instructions for making them. Sir William Thomson's electrometers are described in detail, so that amateurs may construct them for themselves. The book is written in a clear style and anyone with little mathematical knowledge is enabled to understand the nature of electrical quantities. Among the machines described are those of Varley, Töpler, Holtz and Wimhurst. The subjects are very liberally illustrated, and this work is valuable in that it concentrates within its cover all that is worth knowing about influence machines.

ELECTRICAL TRANSMISSION OF ENERGY.—second edition. By Gisbert Kapp, C. E. London: Whittaker & Co; New York: D. Van Nostrand Company, pp. 348. Price $3.00

This work is full of very valuable information on this important subject, and such as is not easily otherwise obtainable in this country. It treats almost entirely of the various English and Continental systems of electrical transmission of energy, its transformation, subdivision and distribution, and will be found very useful to electrical engineers. It is fully illustrated. This second edition brings the work up to date, and the author has added his method for the predetermination of the characteristics of dynamos. A chapter is devoted to electric railways. This volume no doubt will find a welcome among American electricians on account of its giving reliable details of European systems, about which only fragmentary and disjointed reports reach this country through various sources.

THE NEW SOUTH.—"The South's redemption from Poverty to Prosperity" is the title of a neat little volume issued by the Norfolk and Western Railroad Company. It is full of facts concerning the natural wealth of this section of our land, which are well worth thoughtful consideration.

REMOVAL.—The business of the Crocker and Wheeler Company has grown to such proportions that larger quarters became necessary. The company moved into their new location last week, and are now in shape to fill their orders with greater expedition. The new quarters are at the corner of 14th and Washington streets, and are admirably adapted for the work. The dimensions of the floor are 65 x 200 feet, running through from 13th to 14th streets. The necessity for this move is indicative of prosperity, and the Crocker and Wheeler Company have a motor that is a sure basis for prosperity. For efficiency it is peerless.

SOME CURIOUS FACTS.—An arc light between carbon points of 1 cm. diameter is shorter in a horizontal than in a vertical direction; and the arc is somewhat longer in a vertical position with an ascending current than with a descending one. It is supposed that this is due to the greater heat of the anode, which must become more strongly heated when it is uppermost.

INCANDESCENT LAMPS IN FRANCE.—The French papers assert that the life of French incandescent lamps is sensibly diminishing. Some attribute it to influenza, while others think it is because there is only one lamp manufacturing company in France and no opposition.

THE THOMSON ELECTRIC WELDING PROCESS.—The provisional English company formed to show this system will shortly bring out a large company to exploit the process in England with a capital of £460,000, this sum including, it is said, the patent rights also for the European continent.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE.

Boston, April 25, 1890.

A match game of chess was played by telephone last Friday afternoon in Norwalk, Conn, between Dr. A. B. Baldwin, at the Norwalk Club, and Cashier John B. Weed, at the Stamford National Bank. The game was closely contested on each side until forty-six moves were made when Dr. Baldwin resigned.

The Woburn Electric Light Company are about to put in position two more dynamos for their Winchester and Stoneham business.

The summer resort, Hough's Neck, Quincy, has been purchased by Charles L. Willoughby, of Chicago, and the Manet Street Railway Company will run an electric road to that point from Quincy depot. The Quincy Electric Light Company will furnish the power. The following officers of the railway company have been elected; President, A. D. S. Bell; Directors, A. D. S. Bell, Geo. W. Morton, J. D. Taber, Fred. D. Maynard, James E. Lyon, ; Treasurer, Charles A. Potter: Clerk, A. D. McClellan; Executive Committee, A. D. S. Bell, G. W. Morton and F. D. Maynard.

The Electric Clock Company, of Wakefield, is to locate in Waltham, and a part of the building occupied by the Stark Lathe Company has been leased for a term of years; work is to begin at once, and fifty hands will be employed.

Hon. Moody Murrell gave a very interesting address before the Young Men's Republican Club, on "Street Transportation," last Monday night. Beginning with the stage coaches of early days, the speaker traced the growth of street transportation to the electric cars of to-day and said: "Electricity is the coming transmission power and has come to stay—whether it be surface or elevated roads. When power enough can be placed in a cell to run a car for eighteen or twenty hours then the question of street transportation will be decided.

The Gloucester Street Railway Company has closed a contract with the Daft Company to equip the entire street railway route with the overhead double trolley system.

The Gamewell Company have placed the central office table, operating instruments and fixtures for the new police signal system in the police station at West Newton. It is understood that the signal boxes are to be put in immediately, and, that the system will be in working order in two or three weeks.

At a meeting of the Board of Aldermen in Gloucester last Tuesday evening, Mayor French presented a veto of the order granting permission to erect poles and run wires for electric street lighting purposes, because the quality of the poles should be specified, and restrictions made giving the aldermen more control. The order was reconsidered and laid on the table, and another order covering the objectionable points was adopted, the poles to be of cedar, 25 feet high. The order granting the Gloucester Street Railway Company permission to erect poles and wires in East Gloucester was reconsidered, and a new order adopted, granting permission to the company, subject to the same terms and conditions as the line to Annisquam.

At the quarterly convention of the State Assembly, Knights of Labor, last Tuesday, Ex-representative James H. Miller, of Worcester, in an address, urged that gas and electric companies should be owned by the people.

Preliminary surveys of Milford's streets were made last Wednesday for the Milford & Hopedale Street Railway. Electric power will be used.

The Electric Lighting & Power Company of Leominster, are now running day times, supplying power for the Gould rolling mills and others.

An extention of the Attleboro Electric Railway to Norton, is contemplated.

The Electric Lighting Company at Woonsocket, R. I., has been granted power by the general assembly to lay gas pipes and construct mains in the city. They have not as yet secured their franchise, but permission will undoubtedly be granted by the city government. This movement was made by the electric lighting people to offset the venture of the Woonsocket Gas Company.

The Lewiston & Auburn Electric Light Company are putting lights in the Bates cotton mill at Auburn, Me.

It is expected that the new electric light station will be ready in a few weeks to receive the machinery which has been ordered. Everything will be of the latest improvement, and when the station is complete it will be one of the finest in New England.

When the Robinson Foster Electric Company was running at Peabody, a number of motors were put in on trial—at least the parties who had them so claim. Before the time was up the company's works was sold out, and now the purchaser has brought suit to recover value of the motor under contract. One firm claims that they ordered the motor out, but the company ceased to do business before they got around to take it out. In another case attachments have been put on motors by outside parties, who claim to have accounts against the Robinson Foster Company. The case promises to be very interesting.

STATE HOUSE.—Representative Kittridge submitted the following bill to the House last Monday morning.

Section 1. Any street railway company which shall convey on the platform or steps of a car propelled by electricity any person not having the management or control of such car, shall be punished by a fine not exceeding $5.

Section 2. This act shall not apply to the conveyance of policemen or firemen in the discharge of their official duty.

Section 3. This Act shall take effect July 1, 1890.

The Committee on Manufactures reported inexpedient as to repealing the Act of the year 1885, establishing the Board of Gas and Electric Commissioners.

The rooms of the Boston Electric Club, No. 7 Park street, were brilliantly lighted last Wednesday evening and decorated with flowers. It was the first "Ladies Night" and proved very successful, about two hundred being present. President and Mrs Cram received, being assisted by Mr. A. L. Roherer, Miss Carrie Gould and Mr. and Mrs. F. J. Boynton. Among the Electrical attractions on exhibition were a loud-speaking phonograph, which proved very interesting, and several novelties. A collation was served late in the evening under the direction of the club steward.

LYNN.—Great interest is manifested here in the probable establishment of another electrical industry at West Lynn for the manufacture of welded shells. The works of the Thomson Electric Welding Co. are crowded to their utmost capacity in the manufacture of welding machines, which will be used largely in the new industry. As soon as the patents of Lieut. Wood, U. S. N., for welding shells was brought to the attention of the government there was a prompt appreciation of their value and an order was at once placed for 100,000 shell for Hotchkiss guns and Shrapnell shells as soon as facilities were ready for making them. By the new process the shells instead of being made of cast iron and boxed as formerly, are made by welding the chilled point and butt to a section of soft iron pipe. In the case of Shrapnell shells the labor and uncertainty of graduating the thickness of the shell with calipers after boring, and adjusting the nicely-poised diaphragm between the powder at the butt and the bullets with which it is filled is greatly lessened. It is thought an independent company will be formed to manufacture the shells, one half of its stock to be turned into the treasury of the present Welding Co for use of the patents which it controls and the other half to be sold. The location of the works will probably be at Lynn.

At the Thomson-Houston electrical works preparations for a new building are being actively carried forward. Plans are now being prepared for a large extension to factory C. It will be of brick and three stories in height. The company is obliged to increase the heaviness of its work in the lines of dynamos and motors being constructed in factory C, so much so that it is found necessary to have some of the heavier types built in Boston, as there is no machinery large enough to build it in Lynn. This extension, therefore, will be of the heaviest construction and fitted to do as heavy work as the company will ever care to build. The contract for building the extension to factories G and I and an addition to factory H, to accomodate the shipping department has been awarded. When the additional story is built on factory D on Centre st., it is the intention to use the entire building for experimental purposes. Professor Thomson's model room will be located in it. Two heavy planers have recently been added to the equipment of factory C and are now running. It is expected the new office building on Centre st. will be occupied within a week.

At an adjourned town meeting held in Brookline last Wednesday evening it was voted to refer the matter of street lighting to the Selectmen with full power, and it was also voted that the Committee on Electric Lighting be instructed to consider the advisability of establishing a plant for electric lighting.

The joint special committee on electric light plant for City Hall has been authorized to procure estimates for furnishing and establishing an electric light plant in the basement of City Hall, for the purpose of lighting City Hall, the Court House in Court square, and the Registry of Deeds building, and report the same to the City Council, with such recommendations as they may deem advisable.

The committee of the whole Board of Aldermen met last Friday, and decided to increase the speed of electric cars on Shawmut avenue to 12 miles an hour from the starting point, in the suburbs of Westchester Park to Pleasant street, and then seven miles an hour from Pleasant street to the terminus of the road in the city proper. There will be a corresponding rate of speed in electric cars running to Brighton.

Three wealthy Cincinnati gentlemen have subscribed the necessary stock for an electric railway to run from Newton to Newton Centre; capital stock, $200,000. The company will ask for a location at the next meeting of the aldermen. The storage battery system will be used, and the name of the corporation will be Newton Electric Street R. R. Co.

The electric street-car scheme at Woonsocket has fallen through as the Woonsocket Machine and Power Company have withdrawn its proposition to equip the line which it made with the electric company.

At the State House, Friday, the Mercantile Committee reported inexpedient as to providing that all electric companies shall use metallic return circuits and also to prohibiting the use of electric currents of high intensity. W. J. P.

THE OKONITE COMPANY.—The Okonite Company present in this issue a fac-simile letter recently received by their Chicago representatives, the Central Electric Company, from Foree Bain. It is of interest to our readers as showing the thorough insulation and great durability of Okonite insulated wire under the most adverse circumstances.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BANK BUILDING,
CHICAGO, April 26, 1890.

THE AURORA ELECTRIC LIGHT AND POWER COMPANY will add to their plant a 35-light arc machine of the Thomson-Houston make.

THE ALTON AND NORTH ALTON STREET RAILWAY CO. has been formed at Alton, Ill., with a capital stock of $20,000.

A. H. BEAL, Minneapolis, Minn., is having plans made for an eight-story building at that place.

THE MOTOR COMPANY has been formed at St. Louis, Mo., capital stock $10,000, to equip the Bellefontaine Street Railway line with an electric system. The incorporators are James Campbell, Emerson McMillan, J. C. Van Blarcon, John Scullin, Robt. McCullough.

THE MUNICIPAL ELECTRIC COMPANY, St. Louis, Mo., has notified the Board of Public Improvement that their plant is now in readiness to commence operation on May 1, as per contract with the city.

THE THOMSON-HOUSTON ELECTRIC COMPANY have sold to the Atchison Gas, Electric Light and Power Company a 300-light direct current incandescent machine.

DETROIT, MICH.—Plans have been adopted for the new Union Depot. The structure will be four stories high and of brown stone and pressed brick, and will cost about $225,000.

THE MINNEAPOLIS, MINN., PUBLIC LIBRARY BOARD are considering the advisability of putting in a plant to do their own lighting. Their building is already wired and has been supplied with current from a central station.

A new company, at Minneapolis, Minn., is soon to begin the manufacture of the electric bread baker of which T. E. Hughes, of the Pillsbury Mills, is the inventor.

NORTH MINNEAPOLIS STREET RAILWAY COMPANY has been incorporated to construct and operate an electric railway line between Minneapolis, Minn., and Anoka, Minn., a distance of eighteen miles. Mr. Moen, of the Robinson & Moen Car Company, of Minneapolis, is the president.

THE HANNIBAL RAILWAY COMPANY, Hannibal, Mo., are changing their motive power to electricity and have contracted with the Thomson-Houston company for an 80 horse-power generator and three motor cars. They use a 100 horse-power Hamilton-Corliss engine. They expect to extend their line two miles soon.

THE THOMSON-HOUSTON ELECTRIC COMPANY, of Clinton, Iowa, have increased their capacity by the addition of a 1,000 light alternating current incandescent dynamo.

Ground was broken on the 17th for the new factory to be erected on the southwest corner of Woodward avenue and Baltimore avenue, Detroit, Mich., by the Detroit Electrical Works Company.

DENVER, COL., is to have a new office building ten stories high, to cost about $1,500,000. The Equitable Life Assurance Company, of New York, is to furnish the necessary capital, and it is proposed to form a company at Denver, known as the Equitable Building Company to erect and maintain the building. The structure will be furnished with all modern appliances, including electricity. Hon. Henry R. Walcott is one of the directors of the enterprise.

ERNEST HOEFER, 331 Rookery Building, Chicago, has just taken the Western agency for the well-known Trinidad wires made by the Trinidad-Heiman Insulated Wire Company of New York. Mr. Hoefer has for some time been the Western agent for the Bishop Gutta-Percha Company, and has made a number of large sales for that company.

THE SPERRY ELECTRIC COMPANY have installed a 40-light arc plant for H. F. Furber, Chicago.

THE EDDY ELECTRIC MANUFACTURING COMPANY have just established a Western office at 329 Rookery Building, Chicago, for the sale of their motors. Mr. G. A. Edward Kohler, formerly general manager of the Montague Woodrough Saw Company, is Western manager for the Eddy Company, and is pushing their interests to the front in the city rapidly.

THE MUSKEGON, MICH. ELECTRIC ROAD is now in operation, the first trip having been made a few days ago, and is a complete success. It is equipped with the Short system. Two 60 horse-power generators, driven by a 142 horse-power Buckeye engine furnish the electric power.

ELECTRIC CLUB.—Among visitors at the club this week were E. Ratheman, Berlin, Germany; Geo. P. Wilson, Philadelphia; A. E. Graham, Pueblo, Col.; Edwin W. Tucker, San Francisco; Geo. N. Black, Springfield, Ill.

CARROLL & POWELL, of St. Louis, Mo., have purchased complete lighting outfits for two steamboats. They will use the Thomson-Houston arc and focusing lamps, together with headlights and reflectors.

NEW COMPANIES.—The South Side Electric Company, at Chicago, to furnish light and power; capital stock, $500,000; incorporators, W. J. Buckley, Monroe L. Willard and Henry M. Wolf.

Colby Electrical Specialty Company, at Chicago; to manufacture electrical specialties; capital stock, $100,000; incorporators, E. J. Colby, S. A. Merrick and David Aaron.

Excelsior Power and Heat Company, at Chicago; for the manufacture and distribution of heat, steam and power; capital stock, $800,000; incorporators, Henry W. Ames, J. F. Barrett and Thomas E. Barrett.

OREGON AND FORREST CITY, Missouri, are talking up an electric motor line to connect themselves. They intend to run both passenger and freight service between the two towns, and also to light the cities by electricity.

THE STANDARD STAMPING COMPANY, of St. Louis, Mo., will install a Thomson-Houston plant of 200 direct current incandescent lights.

THE MINNEAPOLIS, MINN., CITY COUNCIL are considering the advisability of installing a municipal electric lighting plant. Under the present contract with the gas company the cost per year for city lighting is about $170,000, and it is estimated that with its own plant the city can do the work for about $35,000 per year. Mr. J. M. Lennon, a prominent electrical engineer of Minneapolis, has prepared a detailed estimate for the entire plant which has been laid before the city council. The estimate is for a 7,000 light 20 candle power alternating incandescent plant, all wires to be underground within the fire limits, and overhead outside. The territory to be lighted extends over about twenty square miles and the incandescent system has been selected because of the great number of shade trees. The estimated cost of the plant complete, including steam plant, is $225,000. The plan is to use the east and west side pumping stations as generating stations for the new plant. The matter is now in the hands of the city engineer and is being watched with interest.

OBITUARY.—In the death of E. S. Hewson, which occurred at Chicago, April 19th, the electrical fraternity is again called upon to bear a loss Mr. Hewson was but twentw eight years of age but had long been engaged in electrical work, and was an active member of the Chicago Electric Club. He had long been associated with the Westinghouse interests and was at the time of his death superintendent for that company. Mr. Hewson was born at Newark, N. J. Soon after leaving school he entered the factory of the Weston Company, at Newark, and when that company passed into the hands of the United States Company he came to Chicago as an expert of the U. S. Company and afterwards became superintendent of construction for them. Later when the United States Company passed into the hands of the Westinghouse Company Mr. Hewson occupied the same position for the latter company. Mr. Hewson's death will be regretted by all who knew him. Pneumonia, brought on by an attack of the influenza some months ago, was the cause of his death. He was laid to rest at his old home Newark, N J. A committee was appointed from the Electric Club to take proper action regarding his death.

MR. EDWARD LASELLE, of the Southwestern Electrical Supply Company, Kansas City, Mo., has been in the city this week attending to business, and spent some time visiting with friends at the Electric Club.

MR. J. E. WILSON has assumed charge of the Western office of J. A. Grant & Co., in this city, and will push the sale of the McIntosh engine. Mr. Wilson has been associated with Mr. H. E. Glasier, whose death was announced last week, in the managment of the Western office since it was established, and was formerly connected with the eastern office of the company.

ST. LOUIS, MO.—A bill has been introduced in the Council to permit the Postal Telegraph Company to tear up the streets along their main line and place their wires underground. This is the first attempt by any telegraph company to place their wires underground in this city. The plan is simply to use two 3 inch iron pipes in each of which will be placed a cable of about 25 wires. The underground system will extend about a mile, and the change will cost about $10,000. It is expected that the wires will all be underground, the poles removed, and the street repaired within two months after the passage of the ordinance.

MR. JEAN A. WETMORE, representing the Norwich Insulated Wire Company, of New York, is in the city this week pushing the sale of the paper insulated wire which his company is placing on the market. Mr. Wetmore reports several large orders for this wire and is very enthusiastic over it. Paper insulated wire has been used in telegraph and telephone work, but its adoption for underground and lighting work is new.

The Chicago Arc Light and Power Company are this week placing in two miles of No. 6 wire, having a 5-32 inch paper insulation, and the Detroit Arc Light and Power Company will place three and a half miles of the same next week.

F. M. I.

LARGE SALES OF C. & C. MOTORS.

The C. & C. Company of New York report the following sales: Edison Electric Illuminating Company, Brooklyn, one 3 horse-power for ventilating station, and one ½ horse-power for fan outfit.

One 1 horse-power to Pennsylvania R. R. shops, Altoona, Pa.

One 10 horse-power to American Press Association, Chicago, Ill.

One 1 horse-power to Messrs. Gahl & Lembke, 21 Union square, N. Y.

One 2 horse-power to T. H. Porter, Stamford, Conn., to run elevator.

One 2 horse-power to Edison Illuminating Company, Newport, R. I.

One 10 horse-power to *Sunday Telegram*, Harrisburg, Pa.

One 1 horse-power to First Presbyterian Church, Easton, Pa.

One 1 horse-power to J. H. Simpson, 154 W. 23d street, to run ventilating fan.

One 2 horse-power to Edison Electric Illuminating Company, 432 Fifth avenue, N. Y.

One 8 horse-power to the Solomon Lord Building, 18th street and Broadway, running elevator.

One 1 horse-power to "Thompson's," at 25 East 14th street, N. Y., running ventilating fans.

One 1 horse-power to Warren & Witherell, 201 Hanover street, Boston, Mass., to run coffee grinding machine.

One 2 horse-power to St. Thomas Church, 53d

street and Broadway, N. Y., to run ventilating fans.

One 1 horse-power to Edison Electric Illuminating Co , Fall River, Mass.

One 1 horse power to C. M. Gage, Champion Card & Paper Co., Pepperell, Mass.

One 5 horse power to Fletcher & Co., Portland, Maine, to run elevator.

One 5 horse-power to Dr. Kilborne, Pres. of Seattle Electric Railway & Power Co., Seattle, Washington.

One 2 horse-power to Ryan Bros., Appleton, Wis.

One 1 horse-power to *Court Journal* Publishing Co., 608 F St., Washington D. C. to run press.

One 2 horse-power to B. F. Robinson, 21 Broadway, Lawrence, Mass. to run lathe.

One 5 horse-power to Fell & Joseph, Wilmington, Del. to run elevator.

One 4 horse-power to Bradley Fertilizer Co., N. Weymouth, Mass.

A NEW AND EFFICIENT DRY BATTERY.

The accompanying illustration is that of a dry battery which has recently been put on the market and which possesses some features that are worth special mention. The principal feature of this battery is the method of chemically restoring or renewing it, when the chemicals have been expended. This is done in the manner to be described later on. The battery is of the open circuit class, and is adapted to all kinds of work usually done by open circuit batteries. When it is not at work there is no expenditure of material, as is the case in most other batteries, and when it is at rest it recuperates. Another important feature of the battery is its cleanliness. The cell is hermetically sealed excepting a small hole at the top through which certain chemicals are poured for the renewing of the battery when the charge is exhausted. There is no corrosion at the contact points and no creeping salts. The battery is very neat in appearance, and is not affected by extremes of temperature.



HIMMER & ANDERSON'S DRY BATTERY.

It is the only dry battery on the market that can be chemically restored when it has run down. This is done by simply pouring in the hole referred to above a special chemical solution, which is absorbed by the carbon element within the cell.

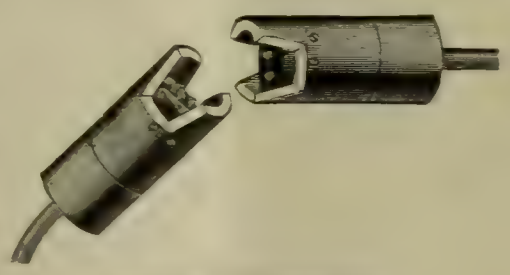
The voltage and ampèrage of this battery are remarkably high, as was demonstrated to us by actual measurement. The internal resistance of the cell is .25 of an ohm and the electromotive force 1.55 volts.

This battery has real merit and is giving excellent satisfaction to all who use them. The fact that it can be chemically renewed over and over again is a great point in its favor, and from an economical point of view this battery has, for this reason, no equal of its class.

Messrs. Himmer and Anderson, of 20 Vesey street, are the manufacturers and they report that their facilities are taxed to supply the demand for their batteries

TRAIN SIGNALING.

It is proved, to the extent of $10,000,000 damages every year, by accidents, resulting from breaking in two of passenger and freight trains that the present methods, or lack of them, for communication from any part of a train with the engineer are meagre enough. Now, this should not be when such devices as the Johnston Electric Train Signal exist. Here is an electric appliance which cannot fail to accomplish its rapid errand. It is a continuous wire or cable, coupled between cars, and is an open circuit constantly, unless the couplers are pulled



COUPLING DISCONNECTED.

apart or the current closed by pressing the buttons, which in passenger cars are tapped into the cable, then the gong rings continually in the cab or a signal has been given. This device is constructed upon the most solid basis. The push buttons are sealed, and, like the couplers are impervious to rust, water and dust. The levers inclosed in the rubber couplers are composed of non-corrosive bronze and in every part the details are absolutely complete. This statement is endorsed by the State Railroad Commissioners, the Superintendent of the Boston, Revere Beach and Lynn Railroad, Professors Lovejoy, Buck an l Pearson, electric experts and numerous railroad magnates who have used the



COUPLING CONNECTED.

device. The Johnston apparatus can be hung in the same hangers as the present bell cords. The repairs are trivial and the only cost in 2 or 3 years would be a renewal of the dry buttons, so that the expense of the device would not be as great as the present bell cord, which is either breaking the windows or continually parting, to say nothing of the vast outlay annually for loss of life and property.

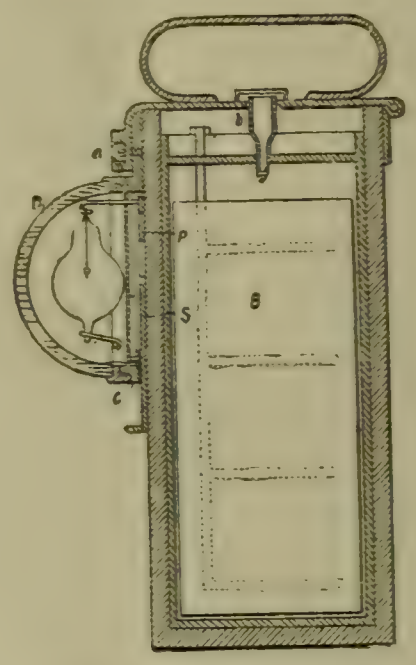
Bad Blood Between Them.—Mayor Grant and Dr. S. S. Wheeler, the expert of the Board of Electrical Control, had a little tilt on April 23, regarding the effect of heat in the down town subways. Mr. Wheeler suggested that as no remedy could be expected at present, the electric companies be allowed to string overhead wires for a short time. At this the Mayor got angry and asked Mr. Wheeler why he made such a proposition without any knowledge of the facts. The steam pipes were to be put in good order on Broadway. Things got tangled then and the Mayor adjourned the meeting by abruptly withdrawing.

Removal.—On account of increasing business the United States Electric Safety Company, of this city, have removed to 291 Broadway, third floor.

A HANDY PORTABLE ELECTRIC LAMP.

The illustration given below is that of a portable electric lamp devised by Mr. L. Bristol, of France.

The lamp is particularly applicable for use in dangerous situations, such, for example, as coal mines, powder mills and magazines, chemical laboratories, etc. The current is provided by an accumulator inclosed within a polished wood box, on the face of which, for the above purposes, the lamp is fixed within a strong glass dome, D, and backed by a reflector. The box has a metal lid with a projecting lug, which covers one of the charging terminals, so that when the lid is closed the battery cannot be short-circuited. The lid also carries a lock, *a*, by which it can be secured; a pin on this lock fixes the glass dome against being unscrewed. The holders of the glow lamp are attached the one to the positive terminal P of the battery, and the other to an independent plate, between which and the negative terminal of the battery through a groove behind the plate C.



PORTABLE ELECTRIC LAMP.

The battery plates B are of special construction, designed to give them such a degree of self-cohesiveness and rigidity that no additional metallic support is required. There is mixed with the active material a suitable proportion of fibrous substance, and the whole is made into a paste. This is cast in moulds, a conductor being inserted in each plate to aid the flow of the current. The plates are then gently pressed and dried. A hollow plug, *b*, is provided for the escape of the gas given off during charging.

The following are some data with regard to these lamps.

Candle-power.	Hours of Light.	Weight. lb. oz	Height. in.
1½	10	3 6 ...	5½
1½ ...	15	5 4	6½
1	5	1 12	4

The Electric Light in Sugar Factories.—A correspondent writing from Huy (Belgium), says: "The electric light is every day making fresh conquests in our country. Last year the large central factories of Wanze had an installation set up as a trial. The important advantages and economy of this form of lighting have led the directors to decide on installing it in its ten works. These installations have been entrusted to a Brussels firm, Bouckaert & Co.

India Lighting.—The Governor of India contemplates taking in hand the electric lighting of Secunderabad, one of the largest and most important of its military cantonments.

Electric Light in Ireland.—Galway and Drogheda intend to adopt electric lighting in the streets.

ANOTHER SOUTHERN ELECTRIC RAILWAY.

We note with interest in a list of recent Sprague railway contracts, furnished us by the Sprague Electric Railway & Motor Company that a number of these came from Southern States.

This portion of the country has been up to this t me rather slow in adopting methods for street railway propulsion, but the fact is evident that this slowness is growing less cont nually. One of the largest of these contracts made by the Sprague Company is that with the Augusta Street Railway, the principal street railway in Augusta, Ga. The equipment of this road, which will be in operation before very long, will be first-class in every respect. The cars to be equipped with electric motors are 16 in number, and each will carry two 15 horse-power motors, At the station the generating plant will consist of two80,000-watt dynamos for supplying the nece-sary current for the line which will be more than 15 miles in length. The line of the route pas-es the Union depot opera house, and the principal points of interest in the city. After leaving the center of the city, the street car tracks are laid in the center of the boulevard in the residential districts in which the roadway lies on each side. The center strip, which occupies a space of about 60 feet between the roadways, contains a double row of large elm trees running the entire length of the boulevard, so that the poles required for span work are almost entirely hidden by the foliage, and are so rendered unobjectionable even to the most critical eye. The space between the tracks will be covered with turf, so that the tracks will not eb noticeable at a little distance. It is hoped that five cars will be in operation by May 15th, and the rest of the equipment will be in operation by June 15th

ACCUMULATOR CARS IN PARIS.—About six months ago the Northern Tramway Company, in Paris, commenced the running of four electric tram-cars on the line from Levallois to La Madeleine. The cars are self-contained or accumulator cars, and were originally st rted as an experiment to see whether accumulators could be satisfactori y employed The electrical energy is supplied by Faure-Sellon-Volckmar cel s having twin plates. The number of cells in each car is 108. The connections are so arranged that on putting the cells in place they are automatically grouped three in series, thus forming four groups of 27 cells each These groups can, for working purposes, be coupled in four different ways.

A Siemens motor is placed under the front of the car. The power is taken from the motor by an endless rope running over a set of gearing actuating the car, and which reduces the speed of the motor in the propo tion of 26 to one. The motor is reversed, and the car backed by means of a special arrangement, comprising double V-shaped brushes. The weight of the car is 3½ tons, making, with accumulators, a total of five tons 2½ cwt. The cars each carry 50 passengers, and run normally at 6¾ miles an hour. At this speed on the level the power required is 4½ electrical H.P.; on an inc line of 1 per cent., 8 H.P.; on an incline of 2 per cent., 11½ H.P. At 5½ miles an hour, on a gradient of 3 per cent., 12½ E.H.P. is required; and 15½ E.H.P. is necessary on a 4 per cent. gradient. When running at 3 miles an hour on a gradient of 5 per cent the E.H.P. is 10½. The French Electric Accumulator Company estimates that the cost of electric traction on the line in question amounts to 30 centimes per car-kilometre, or about 4¾d. per car mile.

WANTS TO MANUFACTURE ELECTRICITY.—The Louisville gas company has decided not to insist upon its exclusive privilege to manufacture fuel gas, but will ask for an amendment to its charter, permitting it to manufacture electricity.

GULCHER'S THERMO BATTERY.—Mr. R. J. Gülcher, the designer of the Gülcher dynamo, has lately brought out a new type of thermo-electric battery. The electro-positive electrodes are hollow, and consist of chemically pure nickel tubes. Joined to these are the electro-negative cylindrical bars, which consist of an alloy of antimony. Each battery consists of a U shaped channel resting upon the base, and closed at the top by a slate slab, into which the nickel tubes are fixed in two rows. The top of these tubes is provided with a perforated collar of soapstone, so that the gas which passes up from the U-shaped channel is emitted from these perforations and heats the junction of the two metals directly above the perforators. Above the soapstone collar there is a second one of brass, which protects that part of the antimony alloy connected with the nickel. The negative electrode, which rests on the top of the nickel tube, turns outwardly and downwardly, and is continued in a flat copper strip, which serves as a cooling medium, and also as a connection to the next element. Each element has its own gas outlet and a separate heating flame. As the flames are very small, enough air can get at each flame to effect combustion in the same way as in the Bunsen burner, and as a consequence neither soot nor carbonic oxide gas is formed. The following data are given in the *Elektrotechnische Anzeiger* concerning the consumption of gas and electrical energy developed by a thermopile of 50 elements. The consumption of the battery amounts to about 8 cubic feet of gas per hour. Its E.M.F. is 4 volts, and its internal resistance 0·48 ohm. The manufacture of this battery has been taken up by the well-known firm of Julius Pintsch, of Berlin.

THE MEASUREMENT OF ELECTRO-MAGNETIC RADIATION.—At the last meeting of the Physical Society of Berlin, Dr. Rubens spoke on the employment of the bolometer for observing the electrical radiations of Hertz as carried out by himself and Dr. Ritter. Up to the present it had not been found possible to measure the intensity of the radiation, owing to the extraordinarily minute amplitude of the oscilations; but the speaker had been able to carry out the determination by means of a special form of bo ometer. It consists essentially of an accurately balanced primary Wheatstone bridge, two of whose arms are again converted into secondary Wheatstone bridges. If a current passes through one of them its resistance is a tered by the rise of temperature and the galvanometer gives a proportionate throw. A similar effect is produced by a wave of electrical radiation, and hence its amplitude can be measured by this bolometer when once it has been calibrated. When experimenting with the polarizing wire-grating it was found that there is a constant relationship between the intensity of the rays which pass the grating and the angle of inclination of the wires to the plane of oscillation of the rays. It was further observed that the energy which does not pass the grating is reflected, and to the extent of 98 per cent., when the wires are at right angles to the plane of oscillation.

THE ELECTRIC SUGAR FRAUDS.—The celebrated electric sugar fraud case was recalled on April 21st, in the discharge from custody of some of the participants in the swindle. These were Olive E. Friend, Emily Howard, George Halstead and Orrin A. Halstead, and all of them had been in the Tombs for sixteen months on account of their connection with the affair. The prisoners were released on their own recognizances, but the indictment against them still stands.

BUSINESS NOTICES.—The National Electric Manufacturing Company has been organized. This was formerly the electrical branch of the New Haven Clock Company. Their offices will be situated at No. 14 Vesey street. Mr. J. G. Noyes, the efficient electrician, has been elected president and general manager.

INVESTIGATING ELECTRICITY.

The Assembly Committee on General Laws met in this city on April 19, to continue its investigations in electricity. The present investigation has for its object the advisability of establishing a Board of Supervision over the electric railroads and the gas and steam companies, and what authority it should have.

Frank J. Sprague, Vice-President of the Sprague Electric Motor Company gave some interesting testimony about electric railroads. Fully 97 per cent. of the electric traction in this country, he said, was conducted by overhead wires. There were three systems of furnishing electric traction for street cars, the storage battery, the conduit system, and the overhead wires. The conduit system had proved a failure after a number of costly experiments, and one of the reasons was the lack of proper sewerage facilities. It had been found to be almost impossible to keep the conduits in such a condition that the electric currents would not be interfered with. An experiment in this system was abandoned in Boston some time ago. The climate militates against it. Such a system on Broadway would cost anywhere from $50,000 to $125,000 a mile, if properly constructed.

"There are 140 towns in the United States," said Mr. Sprague, "where electric railroads are in operation. There are about 225 of these roads running 150,000 miles a day. This represents about 2,000 cars at a cost of $15,000 to $20,000 for each car. The storage is not yet a commercial system. The weight of the batteries necessary to propel an ordinary car at a fair rate of speed is very heavy. In the overhead system the potential of the wire is between 400 and 500 volts. If this wire breaks and falls into the street, it causes a short circuit, and if a person touched it he would get a sharp shock.

Mr. Sprague did not consider the current used in the overhead system dangerous; there was no record of any serious injury to any employe by contact with the wires, and he did not see any use for guard wires.

In answer to a question, Mr. Sprague gave it as his opinion that a Board of Supervision over electrical operations would be valuable if the members were impartial. He did not think underground wires in the subways should be placed near the gas and steam pipes.

The meeting of the Committee on April 21, related chiefly to gas and steam pipes and incidentally to the injurious effect of these on the insulation of electric conductors.

THE CRANDALL ELECTRIC PROTECTOR.

Whenever a telegraph or a telephone wire enters a building the building should be protected against abnormal electric currents. The Crandall Electric Protector, manufactured by the United States Electric Safety Company, of New York, who have recently organized an eastern company under the name of the New England Electric Safety Company, is designed with this object in view, and it is one of the most efficient devices of its class in the market. It affords absolute protection against fire from overcharged wires. This protector has received the highest endorsement of the Boston Fire Underwriter's Union and New England Insurance Exchange, and is absolutely reliable in its action. All of the weak points in instruments of this class have been overcome in the Crandall Protector, and the claims made for it are based on practical experience as testified by several authorities on electrical matters.

A CURIOUS EFFECT.—If a chain were made of alternate links of platinum and silver, and a strong current passed through, the platinum links would become red hot and the silver would remain comparatively cool.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED APRIL 22ND

425,862. Multip'e Telephony. John J. Carty, New York, N. Y , assignor to the American Bell Telephone Company, Boston, Mass. Filed Nov. 13, 1889.

425,863. Telephone System. John J. Carty, New York, N. Y., assignor to the American Bell Telephone Company, Boston, Mass. Filed Nov. 13, 1889

425,866. Electric Railway Car. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed Apr. 8, 1889

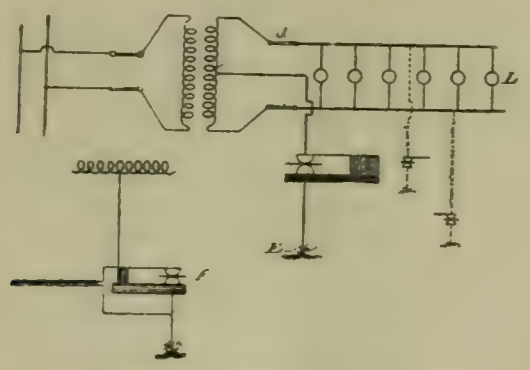
425,883 Electrically-Propel'ed Car. Rudolf M. Hunter, Philadelphia. Pa. Filed Oct. 1. 1889. The novelty of this invention consists of an automa'ically operating regulator to reduce the current in the motor circuit, upon the speed becoming abnormal through careless handling of the hand operated regulator.

425 902. Secondary B ttery. Gustave Philippart, Paris, France. Fi'ed Jan. 6, 1890.

425,911. E'ectric Railway. Richard V. R. Sill Detroit, Mich., assignor of one-half to Strathearn Hendrie, same place. Filed Mar. 13, 1889.

425,912. Electric Railway. Richard V. R Sill, Detroit, Mich., assignor of one-half to Strathearn Hendrie, same place. Filed Mar. 13, 1889.

425,913. Wire Conduit. Andrew J. Smith, Soldiers' Home, Kan. Filed Sept. 17, 1889. This is an electr c wire conduit made of hollow bricks and formed into a street curbing, certain



NO. 426,082. SAFETY CONNECTION.

of said bricks having a vertically sliding removable shutter dovetailed into said bricks, whereby access may be had to the conduit.

425,917. Electric Conductor. Eugenio Tortora, Florence, Italy. Filed Apr. 14, 1887.

425,923. Method of Operating Synchronous Alternating Current Motors. Carl Zipernowsky, Buda-Pesth, Maximilian Deri, Vienna, and Otto T. Blathy, Buda Pe-th, Austria-Hungary. Filed Aug. 9, 1889 This is a mode of operating a synchronous alternating current motor by starting the motor without short-circuiting the magnet-windings and by short-circuiting them at each reversal of the current when synchronism is reached, and introducing a suitable resistance in the supplying circuit.

425,950 Electric Railway. Walter H. Knight New York, N. Y. Original application filed Mar. 13, 1886. Divided and this application filed Sept 21, 1887.

425,957. Secondary Battery. Gustave Philippart, Paris, France. Filed Jan. 6, 1890.

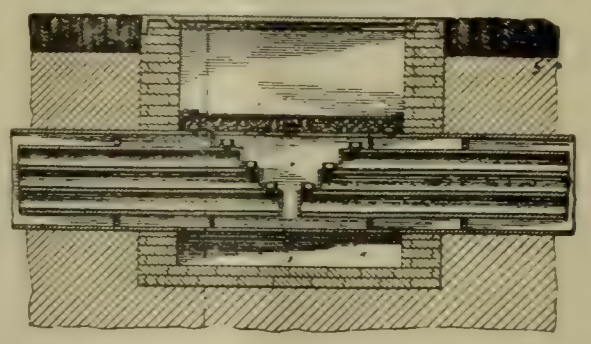
425 959 Galvanic Battery. Louis M. J. C. C. Renard, Mendon, near Paris, France. Filed Mar. 5, 1889

425,961. Electric Conductor. Philip Seubel, New York, assignor to the Edison Machine Works, Schenectady, N. Y. Filed Jan. 16, 1889.

425 963. Electric Switch. Ernest P. Warner, Chicago, Ill. Filed Feb. 2, 1889.

425,964 and 425,965. Electric Railway System. David G. Weems, Baltimore, Md., assignor to the Electric Automatic Transit Company, same place. Filed July 27, 1889.

425,966. Elec ric Railway. David G. Weems, Baltimore, Md., assignor to the El ctric Automatic Transit Company, same place. Filed Aug 1, 1889



NO. 426,197. UNDERGROUND CONDUIT,

425 990. Electric Machine for covering wire, etc. Frank E. Davis, B ston, and John Scott, Jr., Plymouth, Mass. Filed Sept. 13, 1889.

425,991. Electric Motor. Frank E. Davis, Bo ton, and John Scott, Jr., Plymouth, Mass. Filed Nov. 19, 1889.

425,995. Electric Fan. Philip Diehl, Elizabeth, N. J. Filed Sept. 24, 1889.

425,999. Process of manufacturing Electrodes for Secondary Batteries. Ludwig Epstein, Berlin, Germany. Filed May 31, 1889.

426,024. Magnetic Circuit Closer. John von der Kamme, New York, N. Y., assignor of one-half to James Ward Packard, same place. Filed Apr. 25, 1889.

426,049. Electric Switch. James P. Norton, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed Feb. 20, 1890.

426 055 Incandescent Electric Lamp. James O Packard, New York, N. Y., assignor to the Westinghouse Electric Company, of Pennsylvania. Filed Dec. 7, 1889.

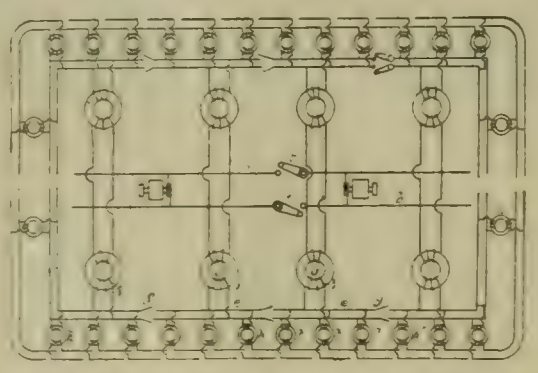
426,066. Trolley Support. Frank B. Rae, Detroit, Mich. Filed Feb. 4, 1890.

426,082. Safety Connection. Elihu Thomson, Lynn, Mass. Original application filed Oct. 8, 1888, Serial No. 287,564. Divided and this application filed Aug. 5, 1889.

426,102. Electric Railway Contact. Francis O. Blackwell, New York, N. Y., assignor to the Thomson Houston Electric Company, of Connecticut. Filed July 23, 1889

426,108 Safety Device for Dynamos. Ernest P. Clark, New York, N. Y., assignor to the Clark Electric Company, same place. Filed Dec. 30, 1889.

426 109. Safety Device for Dynamos. Ernest P. Clark. New York. N. Y., assignor to the Clark Electric Company, same place. Filed Dec 30 1889.



NO. 426,269. ELECTRIC RAILWAY SYSTEM.

426,110. Safety Device for Dynamos. Ernest P. Clark. New York, N. Y., assignor to the Clark Electric Company, same place. Filed Jan. 13, 1880.

426,121. Insulated Joint. Emil F. Gennert, New York, N. Y. Filed Mar. 22, 1889.

426,127. System of Electrical Distribution. Charles J. Kintner, New York, N. Y. Filed Dec. 20, 1889.

426,134. Electric Signaling Apparatus for Hotels. John J. Miller, Cleveland, Ohio, assignor to James P. Langley, East Saginaw, Mich. Filed Feb. 15, 1889.

426,153. Converter. Edmund Wagemann, Little Rock, Ark., assignor of six-sevenths to John D. Adams, Dean Adams, Oscar Davis, John W. Davis, Horace G. Allis, and John B. Jones, all of same place. Filed Aug. 22, 1889.

426,156. Fuse Block. Frederick G. Warrell, Philadelphia, Pa. Filed Feb. 3, 1890.

426 196. Apparatus for Hauling Through Electric Cables. James F. Munsie, Chicago, Ill., assignor to Thomas L. Coles, New York, N. Y. Filed May 8, 1889.

426,197. Underground Conduit. James F. Munsie, Chicago, Ill., assignor to Thomas L. Coles, New York, N. Y. Filed May 6, 1889

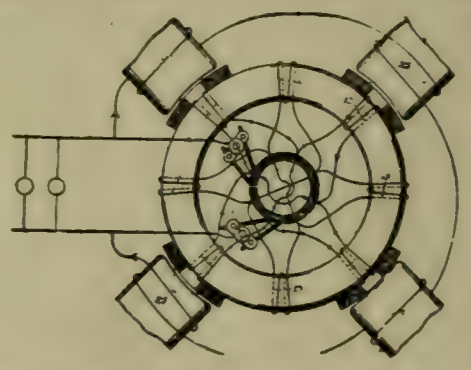
426,198. Insulator. James F. Munsie, Brooklyn, N. Y., assignor to Thomas Leonard Coles, same place. Filed Oct. 29, 1889.

426,199. Duct for Electric Conductors. James F. Munsie, Brooklyn, N. Y., assignor to Thomas Leonard Coles, same place. Filed Oct. 29, 1889.

426,200. Flexible Connector. James F. Munsie, Brooklyn, N. Y., assignor to Thomas Leonard Coles, same place. Filed Oct. 30, 1889.

426,201. Insulating Lining. James F. Munsie, Brooklyn, assignor to Thomas L. Coles, New York, N. Y. Filed Jan. 17, 1890.

426,202. Insulating Compound. James F. Munsie, Brooklyn, a signor to Thomas L. Coles, New York, N Y. Filed Jan. 17, 1890.



NO. 426,348. DYNAMO ELECTRIC MACHINE.

426,203. Insulator. James F. Munsie, Brooklyn, assignor to Thos. L Coles, New York, N. Y. Filed Jan. 17, 1890

426 204. Binding Post. James F. Munsie, Brooklyn, assignor to Thomas L. Coles, New York, N. Y. Filed Jan. 17, 1890.

426,205. Duct for Electric Conductors. James F. Munsie, Brooklyn, assignor to Thomas L. Coles, New York, N. Y. Filed Jan. 17, 1890.

426,206. Man Hole for Underground Electric Conduits. James F. Munsie, Brooklyn, assignor to Thomas L. Coles, New York, N. Y. Filed Jan. 22 1890.

426,222. Electric Railway Signal. Geo. A. Tower, Richmond, Va. Filed June 14, 1889.

426,247. Electro Magnetic Instrument. Patrick B. Delany, South Orange, N. J. Filed Jan. 30, 1890.

426,269. Electric Railway System. Ludwig Gutmann, Fort Wayne, Ind. Filed Jan. 5, 1889.

426,317. Coupling for Electric Cars. Louis Pfingst, Boston, Mass. Filed Feb. 27, 1890.

426,335. Armature for Electric Meters Oliver R. Shallenberger, Rochester, assignor to the Westinghouse Electric Company, Pittsburg, Pa. Filed Jan. 16, 1890.

426,348. Dynamo Electric Machine. Merle J. Wightman and Elihu Thomson, Lynn, Mass., assignors to the Thomson-Houston Electric Company, of Connecticut. Filed Sept. 17, 1888.

WHAT IS A PATENT?

BY CHAS. J. KINTNER, C. E.

Just how few inventors have ever seriously asked themselves this question, and have candidly sought an intelligent answer, is evidenced by the enormous number of absolutely worthless patents granted by the Patent Office. More than 15,000 patents for electrical inventions have been granted since the first electrical patent was issued, and of this enormous number it is safe to say that not more than 10 per cent. have recompensed the patentees in amounts equal to the government fees, of $35 in each case. To the careful and painstaking expert familiar with patent property and its value when properly protected, it is a matter of wonder how great a number of valuable electrical inventions are absolutely lost to inventors through worthless patents.

A patent is a grant in the nature of a contract between the inventor and the public, based upon mutual considerations; those of the inventor being, that he will give to the public a full, free, and exact disclosure of his invention, and of the best manner of making, compounding, constructing, and using the same, and that the description shall be in such full, clear, and exact terms as will enable anyone skilled in the art to which it relates to make and use it; that he will follow this description with a distinct and well-defined claim, clearly pointing out the feature or features which he regards as his invention or discovery. In the preparation of this description, it is the intent of the law that the inventor shall point out, if his invention be an improvement, the distinguishing features between that which is novel with him and that which has gone before.

The consideration upon the part of the public is, that it will grant to the inventor, for the aforesaid disclosure, unlimited protection in the free and exclusive right to make, use and vend, or sell the invention described and claimed throughout the United States and Territories thereof, for a period of seventeen years from the date of signing of the contract by the Secretary of the Interior and the Commissioner of Patents, with the distinct understanding that, at the end of this period the invention is to become the property of the public.

The law presupposes that an inventor who files an application for a patent is an expert in the art to which his invention is applicable; it presupposes that he is well versed in the existing state of the art; it presupposes that he knows enough of contract law to give to the descriptive portions of his contract such scope as will fully protect his interests; it presupposes that he is conversant with the rules of practice governing the prosecution of the application to patent issue; it presupposes that he is thoroughly conversant with the doctrine of equivalents, and is so far versed in the principles of patent law enunciated in the Federal and Supreme Courts of the United States as to have a fair appreciation of that which constitutes invention.

The revised statutes recognize four classes or types of patentable inventions; namely, a new and useful art; a new and useful machine; a new and useful article of manufacture, and a new and useful composition of matter, or any improvement thereon.

The law presumes that the inventor is capable of pointing out in his specification to which of these types his invention belongs, and that he has prepared his specification as descriptive of this particular type, so that when a suit is brought in Court, based upon the claims of his patent, a shrewd patent lawyer, backed by an equally shrewd expert, will not be enabled successfully to attack the theories advanced, mode of operation, or to in any way make it appear that the patentee has disclosed an inoperative invention, or sought to obtain a patent for more than was his just right, or has wrongly classified his invention.

On the part of the public the Government has provided a system of self-protection in the nature of an Expert Examining Corps, embracing now about thirty principal examiners, with their individual corps of assistants, the principal examiner being an acknowledged expert, presumably as well versed in his particular art as can be found.

Under this condition of affairs the inventor finds himself confronted with a critical expert who makes it his duty oftentimes unnecessarily to limit the scope and the claims of an application, and to raise objections which, if properly parried by a skillful expert, can be overcome. At the outset, then, the inventor finds himself confronted with an expert whose duty it is to protect the public interest by limiting his (the inventor's) portion of the contract in every possible way. There is nothing in the revised statutes which makes it the duty of an examiner to give aid or counsel to an applicant for a patent; in fact, the presumption is that the inventor is able to meet and cope with every argument which the skilled expert examiner is expected to advance.

How many inventors are there in any of the arts to-day who are capable of presenting their cases before the Patent Office in such a light as to obtain for themselves their just rights, based upon a patent contract? Indeed, it may be asked with much pertinency, whether or not even skilled patent solicitors, with the aid of the inventors themselves, can always fullfil the requirements, unless such solicitors be also acknowledged experts in the particular art.

It is a remarkable fact that inventors, as a class, are excessively careless and shiftless in the protection of their interests by patents. In the transfer of real property, or in entering into a contract where monied interests are involved, the average business man, as a rule, is very careful to procure the best legal and expert talent in securing valid titles and contracts in his interest, while to patent matters there seems to be a general and well accepted impression among the majority of inventors that simply to secure the seal of the Patent Office, and the signature of the Commissioner of Patents, is a guarantee of protection for all that is described and shown in the patent specification.

They do not understand that whenever a valuable invention is protected by the seal of the government, it is immediately subjected to the scrutiny of shrewd lawyers and skilled experts, who make it their duty to pick it to pieces, and expose all the vulnerable points of attack which can be made an issue in a court of law.

There are instances on record in the courts where patents have been rendered absolutely valueless because the inventor had secured and claimed a machine when, in reality, his invention was an art, or an improvement in an art; that is to say, his invention consisted in performing certain steps or acts whereby a certain result was obtained independent of any mechanism, while the mechanism whereby the result was obtained was found to be old.

The practice laid down in the Supreme Court decision in the case of Miller *v.* Bridgeport Brass Company, precludes the possibility of the reissue of a patent, once granted, with broadened or expanded claims, or the reissue of a patent for one class of invention as a method, when it had been originally granted for another class as a machine.

Our American patent system has reached such a stage of advancement in the various arts, that under the present exacting system of practice in the Patent Office, it is not possible for any one person, or firm acting as solicitors, to do justice to all inventors in all the arts.

The time has come for specialists in patent practice, as in other branches of the law, and as he who would assure himself of a valid title to his real property, now looks to the specialist in realty law, or as he who would enter into a contract involving the expenditure of large amounts of money looks to the specialist in contract law, so it should be the duty of the inventor who has an invention in any of the special arts, involving more than mere mechanical knowledge, to subject his invention to the scrutiny of a careful and well-trained expert in his specialty before accepting the seal of the Patent Office as conclusive of validity and novelty.

A LARGE NUMBER OF NEW STREET RAILWAY CONTRACTS.

We understand that the Sprague Electric Railway and Motor Company have closed a large number of contracts for the electrical equipment of street railways during the last month. These contracts came from all over the country, a large number of them being noticeably from street railway companies which already have a number of cars in operation upon the Sprague system.

No argument of the popularity of electric railways could be made more convincing than this fact, which is so common, of additional equipments ordered by Street Railway Companies where the system has been tried. A street railway company may be dissatisfied by an electric system before it has been put in actual operation, but when a company continues to order additional equipment there is only one conclusion to be drawn, *i. e.* that the system is a success.

The most recent contracts in regard to the Sprague Co. are as follows:

Augusta Street Railway, Augusta, Ga., 16 car equipments.

Paducah Street Railway, Paducah, Ky., 9 car equipments.

Fort Worth and Arlington Heights Railway, Fort Worth, Texas, 4 car equipments.

Troy (N. Y.) and Lansington Railway, Troy, 12 car equipments.

Passenger and Belt Railway, Lexington, Ky., 4 car equipments.

Atlantic City, (N. J.) Electric Railway, 1 car equipment.

Detroit, (Mich.) Rouge River and Dearborn Railway, 4 car equipments.

Union Street Railway, St. Joseph, Mo., 6 car equipments.

Sioux City, (Ia.) Street Railway, 5 car equipments.

Dallas, (Tex.) Rapid Transit Railway, 1 car equipment, and one from the Metropolitan Railway, Portland, Oregon.

AMPERE'S THEORY OF MAGNETISM.—Ampère, finding that solenoids act precisely as magnets, conceived that all magnets are simply collections of currents, or that, around every individual molecule of a magnet an electric current is ceaselessly circulating. We know that such currents could not flow perpetually if there were any resistance to them, and we know that there is resistance when electricity flows from one molecule to another. As we know nothing about the interior of molecules themselves, we cannot assert that Ampère's supposition is impossible. Since a whirlpool of electricity acts like a magnet, there seems indeed reason to think that magnets may be made up of rotating portions of electrified matter.

WAR BALLOON.—BERLIN, April 4.—Edward Damm, of the United States Army, is making a sensation at Berlin, by an exhibition of a monster balloon for war purposes. The balloon is called the Bismarck. It is lighted by electricity and is capable of signaling at a tremendous distance. The machine will, it is said, be adopted in the German army.

DEVELOPMENT OF HEAT.—A current of one contomb flowing through a resistance of one ohm develops 0.24 heat-units per second.

SAUNDERSON'S IMPROVED ARC LIGHT.*

For many years there have been efforts made for the improvement of carbons for electric arc lamps with some measure of success, also for introducing various materials into the arc, but in no case has any important advantage been gained. In many cases certain substances have been ground up and incorporated with the carbon, with the result that ashes or clinkers have been formed to such an extent as to render the light of less rather than greater intensity. The most successful carbons have been those made up with finely powdered soft carbon dust, compacted together by well known methods, which we need not now discuss. A very remarkable discovery has been made which will certainly give an enormous impetus to electric lighting. The inventor, Mr. Llewellyn Saunderson, of Kingstown, county Dublin, while experimenting with the arc lamp in his endeavors to improve its powers to pierce fog, so as to minimize loss of life at sea, determined upon introducing into the arc minute quantities of intensely heated hydrocarbon vapor so as to enrich the light with the well known fog-piercing rays, viz., yellow and red. Having succeeded by this means in producing a beautiful sunshine yellow, he discovered that at the same time the intensity of the light was enormously increased. A plant was put down consisting of gas engine, dynamo and electric arc lamps, and the question was followed up by introducing various gases into the arc in a number of curious ways, only a few of which can now be described. The first consisted of a jet through which the vapor was projected into the arc; then two jets, and so with a number of other contrivances. The hydrocarbon was vaporized in the tube leading to the jet, and retarded in its passage by asbestos, etc., to give the carbon time to bring the vapor up to an intense heat, and a wick was employed to prevent the vapor from going back, as well as to supply fresh fluid by capillary action. Having thoroughly convinced himself that a substantial improvement of the light could be produced without requiring additional power from his gas engine and dynamo, the inventor now contemplated bringing his new light forward for actual tests against the best light that could be produced by the carbons now universally employed in arc lighting. He made inquiries as to who he should ask to assist him, and Lord Crawford very kindly allowed some temporary tests to be made at the store of the London Electric Supply Corporation in the Adelphi Terrace, but the exigences of the business of the corporation were such that the long and laborious investigations required could not be continued. Subsequently the inventor was recommended to apply to Mr. Apps, 433 Strand, London, so well known for his work in connection with physical science, and after careful consultation it was decided to put down a plant consisting of gas engine, dynamo, storage cells, and two large Brockie Pell arc lamps, each taking about 45 volts and 12 ampères. This plant began running in May, last year, and was designed and fitted up by Mr. Apps, with a full complement of testing instruments of the most approved design. The two lamps were arranged at the ends of a long photometer scale, the photometer being in the center and the lamps vertically placed at each end. The exact candle-power of either lamp was not thought to be important, but the precise relation of the lights of the two lamps was the point to be ascertained, the energy to each being indicated by the sets of instruments placed on the walls opposite. At this stage the experiments were greatly extended, and many thousand observations taken, with a general mean result agreeing with that separately, and afterwards determined by Dr. Hopkinson. It was found, however, that for very exact measurements greater steadiness was absolutely necessary. Having now procured readings of a reliable nature, and of the most extraordinary character, the inventor was advised to call in Dr. John Hopkinson, to report to him on the power of the new light as compared with the old arc light. A pair of black velvet screens were ordered to be placed behind the lamps, and the whole of the framework also was colored a dull black. The tubes of the photometers were also lined with black velvet, and special arrangements were contrived to get the maximum steadiness of light from the lamps. At this point some measurements were taken which were fully verified subsequently, but the unsteadiness of the light was still a serious source of difficulty. The lamps were now made to rotate in their own frames, and to be inclinable at any angle also—the automatic regulating mechanism being entirely removed, and a screw arrangement added for hand regulation. By this means the possible errors due to craters were almost entirely eliminated, and, after taking a great number of readings, Dr. Hopkinson decided to make his report.

Among the great advantages of this discovery we may mention increased steadiness, and, instead of the bluish tint always present in the ordinary arc, a fine rich yellowish-white color, very agreeable to the human eye, is produced, being almost exactly the same as sunlight, and having an enormously increased power of penetrating fog, so important for lighthouse purposes, and for use in the military and naval electric light projectors; the actual amount of light, as reported by Dr. Hopkinson, being nearly double that of the old arc light, and more than double, if we allow for the difference in energy taken by the two lamps tested against each other. The item of expense in applying the new system is so small that it may be neglected altogether, and very little or no alteration of the present arc lamps is required. The simplicity and cheapness of manufacture is, in fact, so great that it is probable not more than 20 per cent. or 30 per cent. in total cost need be added to the present cost of the carbons against the diminution of the general cost.

It may well be asked how these results are attained. Up to this moment there is, perhaps, no sufficient explanation; but it is highly probable that the exceedingly fine particles introduced into the arc, and impinging against the upper carbon by the ascent of the hydrocarbon vapor, are acted upon with great advantage by the electrical energy, whereas the harder particles of the carbons have to be taken from their state of cohesion, greatly reduced in size, and even then only a small percentage are found suitable for the higher incandescence (from which most of the light is derived), the grosser particles falling in dust, found after the lamp has gone out; while portions more refractory are discharged at all angles, and sometimes with considerable force. For instance, such particles have been found embedded in the surface of massive glass lenses placed some 4 or 5 inches distant from the arc flame in a horizontal direction. The work done in heating a refractory and unsuitable body for the production of light must evidently be attended by considerable loss of energy. On the other hand, the hydrocarbon vapor is (by means of the waste heat of the carbon, at a point not far from its lower end) obtained from the absorbent wick, from which it ascends, being lighter than the surrounding air, and after being raised to an intense heat as it passes upward, and having enormously expanded, it passes into the arc.

The quantity of vapor required is astonishingly small; that which can be produced from a drop of oil lasting, with ordinary carbons, nearly a minute. It is, however, not necessary to employ oil, but almost any substance or semi-liquid which, on being heated, gives off the vapor will answer well. For example, vaseline inclosed in a small capsule of the same size as the rod of carbon, and not more than about one-half inch long, will hold sufficient for the burning of the carbon down to the usual length at which it is generally taken out and thrown away. It is probable that the minute quantity of vapor required is acted upon freely, and that in its turn the incandescent gas or particles of vapor assist largely in effecting the separtion of the particles of the carbon electrodes; for the consumption of carbon is increased by about one-seventh part. The light is said to be far more agreeable to the eye, and of much greater steadiness; while as to economy, arc lighting with this improvement, it is contended, is equal to gas about 1s. per 1,000 cubic feet. With reference to search lights, it is evident that by adopting the invention the illumining power, and generally the actual value of these appliances, will be doubled, which may be an important factor in some not very distant naval action. These lights would also be found much better able to pierce the fog and haze so often found on the surface of the sea, and most important in finding coast lines and "rocks ahead."

* *Scientific American.*

THE HORSE MUST GO.—It is estimated that at least fifty thousand horses now in use will be thrown upon the market presently, says an exchange, owing to the rapid development of electricity as a motive power. The exactness of this estimate does not matter, but it is a fact from which there is no getting away that soon the horse-breeding industry will be seriously disturbed by the encroachment of the electric motor, the use of which will eventually become universal. The carriage of the future, both public and private, will be moved by the electric motor, the power to operate which will be furnished by a light and efficient storage battery. Electricity will be the motive power of the future because it will be cheaper than horseflesh. An electric motor has only to be fed when working; a horse's digestive organs have to be kept in food at all times, whether working or not.

ELECTRIC WELDING.—The largest welding machine constructed by the Thomson Company welds a bar of iron three inches in diameter, a brass bar one and one-half inches in diameter, and a copper bar one inch in diameter. A current of thirty thousand ampères at a pressure of between one and two volts is used. This enormous current is generated by a dynamo differing but little from the ordinary alternating machine. The primary current is of moderately large volume and high potential, and is reduced to one of great volume and extremely low potential by means of a converter in which the primary coils contain many turns of small wire and the secondary consists of but one turn of massive copper casting. There are what might be termed movable secondary coils, or series of coils, which may be substituted for the one above, and by which the pressure may be varied to suit the convenience.

STORAGE BATTERY.—A man in Springfield, Mass., invented a new storage battery which, if practically successful, will be a long step toward its ultimate, economical and universal application. The new battery is composed of nine compound plates, 6x4½ inches, and has a capacity of 125 ampère-hours. It weighs but half as much (eighteen pounds) and takes up only half as much room as the lightest and most compact now on the market. One of the features claimed is a combination of the usual leaden plates, by which the active material is prevented from being lost, as is now the fate, sooner or later, of most of the batteries now in use.

OMNIPOTENT ELECTRICITY.—There seems to be really nothing that electricity cannot do. It is now practically possible to see through iron or steel ingots and discover any flaws or bubbles in their interior. We do not see these flaws in the popular sense, but a curious little electrical instrument called the "Schiseophone" will indicate the exact spot in which they are located, which is just as good.

THE TELEGRAPHONE.—The telegraphone, recently patented, enables the sender to record his message on a cylinder attached to the receiving instrument in the absence of any one to hear it, and even to repeat the message back to himself for correction.

A SUGGESTION.—Dr. Lowenberg suggested recently before the Polytechnic Society of London that, properly worked, it may be possible to insulate electric light wires by a coating of oxide. If wire could be insulated by oxidation, the problem of the dangerous wires would be forever solved, perhaps.

LONG DISTANCE TELEPHONY.—In Russia the extraordinary feat has been accomplished of telephoning from St. Petersburg to Bologne, a distance of 2,465 miles. The Russian engineers further state that they propose soon to converse over a distance of 4,665 miles.

A GAS-METER DETECTIVE.—An electric gas recorder now spies upon the gas company, and tells the hitherto defenceless consumer to what extent the gas company is robbing him.

AN AUTOMATIC TELEPHONE PROTECTOR.—The New England Telephone & Telegraph Company is understood to be about to introduce into its system a machine for the protection of telephone instruments from lightning and electric light currents. The instrument has stood very severe tests and proved its ability absolutely to protect telephones and other electrical instruments against overcharges of electricity caused by lightning or other sources of current. The protector automatically grounds or shunts the excess of current so long as it exists. As soon as it ceases the protector readjusts itself automatically, and restores the circuit to its normal conditions.

THE PHONOGRAPH AND GRAPHOPHONE.—An English contemporary says: Arrangements have been made with Mr. Edison by which a new company is being formed to control both these machines in all countries outside the United States and Canada. The company will have possession of all machines and instruments under the patents, and the capital backing the syndicate is unlimited.

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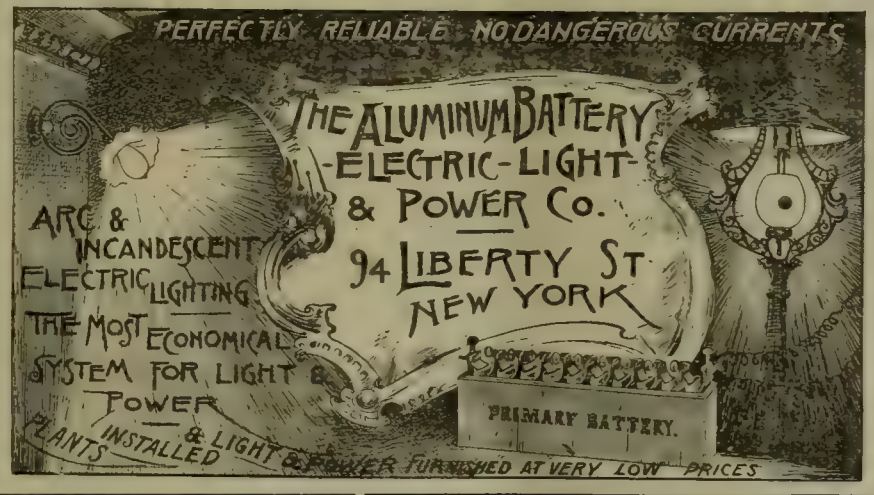
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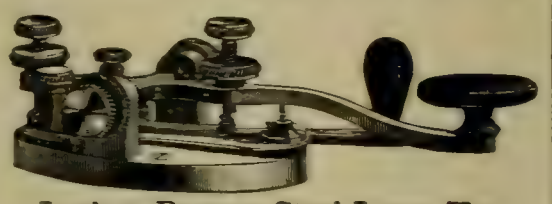


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THE ELECTRIC LIGHT IN AUSTRALIA.

A co respondent of a London contemporary gives a history of electric lighting in Australia. The first introduction of the electric light into New South Wales was in 1881. At the present time there are upwards of 5 000 incandescent and 500 arcs in the colony. In 1883 the Legislat ve Assembly was lighted with incandescent lamps; Edison machines were used with great success, but lately it has been deemed necessary to increase the light, and new machines of the Manchester type have been installed But it was really in 1887 that the advantages of the electric light were properly recognized. In this yea Her Majesty's Theatre Company decided to adopt this system of illumination for their new building, and a plant for 900 lamps was ins alled, Manchester machines being used. "It would be more satisfactory to all parties concerned." says the correspondent, "if the fire underwriters' rules were more stringently enforced; as, although we have so far been very fortunate in Australia, having had no accidents that could be attributed to the electric light, it is more by good luck than good management; and now that the number of installations is increasing, it is most necessary that every precaution possible to prevent acci dents should be taken."

Last year was a busy year in electrical circles in all the Colonies: in Melbourne, on account of the extensions of central stations, and in New South Wales on account of the number of country bo oughs who called for tenders; but perhaps the most important event of the year was the introduction into New South Wales of the first alternating current transformer plant, instal ed by Messrs. Kingsbury & Co., in Young This plant is on the Thomson-Houston system, and the success has been such that the firm have received the contracts for Penrith and Lambton. It should, however, be mentioned that although this is the first introduction of the alternating current in New South Wales, both the Thomson-Houston and Ganz & Co. have been working the system in Melbourne for some time with great success.

So far as motive power is concerned there appears to be a general leaning towards engines of the semi-portable type, and it is an exception when a plant is erected with separate boilers and engines.

Up to the present there is no central station lighting in Sydney; whereas in Melbourne there is a considerable amount of lighting done from the stations in operation, and there are other stations in contemplation. The reason for this difference in progress between the two largest cities in the Southern Hemisphere may perhaps be accounted for by the fact that in Sydney the Gas Company have a monopoly of the lighting; in Brisbane there has lately been a cons derable movement towards the electric light; and central st tions will, I think, shortly be an accomplished fact in the Northern Colony.

So far as traction is concerned, very little has been done in any of the colonies. Some time ago a trial was made of a car on the Julien principle; but, although the trial was successful, nothing more was heard of it. At the present moment an electric tramway is talked of for Balmain, a suburb of Sydney. It is believed to be on the Sprague system. Victoria once more takes the lead in the matter of electrical tramways, having one at Box Hill, which is giving satisfaction. The correspondent thinks that the exaggerated reports printed in the home papers in regard to the dangers of electric lighting, more than anything else, is the cause of the indifference towards the electrical industry in the Colonies.

Train lighting by electricity is also receiving some attention in Victoria, but not much encouragement as to its adoption.

New Zealand and Tasmania have an abundance of water power which engineers think should be utilized for electric light purposes.

A SYSTEM OF ELECTRICAL DISTRIBUTION.—We describe and illustrate on another page one of the most comprehensive systems of electrical distribution ever patented in this country. It appears to completely overcome every difficulty met with in present systems and is the most efficient and complete we have yet seen. Mr. Charles J. Kintner, the well-known electrical expert, is the patentee, and there is probably not another individual in the United States who better understands the subject than he. Long ago, foreseeing the absolute necessity for a reliable and efficient system of distribution, Mr. Kintner gave the matter considerable thought and study with the result of evolving the system described. All of those in present use sooner or later fail, for one reason, on account of moisture collecting inside of the conduit. Difficulty from this source is impossible by Mr. Kintner's system. The practice of placing lead-covered cables in iron conduits is also a source of very much trouble. It is well known that chemical action takes place when lead and iron are placed in contact with each other. The gases evolved by this action are very destructive to the iron (of the pipe in this case) and it is a question of a very little time when the pipes will be destroyed. Strange to say, this very point seems to be frequently overlooked by many electrical engineers, and an early failure of the system, of course, is the result. This difficulty and many others have been overcome in Mr. Kintner's system, and it really looks as though a reliable and safe system of electrical distribution is at last an accomplished fact.

NOT IN FAVOR OF MUNICIPAL LIGHTING.—After a discussion of two years or more in Revere, Mass., for and against municipal electric lighting, the authorities have d cided that it is inexpedient for the town to operate a light plant, and have therefore awarded the contract to the local company.

OBITUARY.—Mr. Daniel L. Gibbens, who was formerly one of the subway commissioners, died at 8:30 P. M., May 2, at the Worth House, in this city, of pneumonia, the result of a cold which he contracted a few days previous. Mr. Gibbens was 31 years of age, and was born in Waltham, Mass. He was graduated from Columbia College and Law School. While a member of the Subway Board, Mr. Gibbens was its leading spirit. He was aggressive and fearless, and the encounters he and ex-Mayor Hewitt had are still fresh in the minds of most of our readers. During the latter part of his term as Subway Commissioner he was very severely criticised by the general press on account of the part he took in the late crusade against electric light wires. This led to his resignation three months ago. Mr. Gibbens' death was a great surprise to the electrical portion of the community. His remains were taken to Boston, for bur al.

IN FAVOR OF MUNICIPAL LIGHTING.—In our issue of April 19th we published a communication signed by M. J. Francisco, President of the Rutland Electric Light Company, of Rutland, Vermont, on the subject of and against municipal control of electric light plants. In this issue we present a communication from Mr J. M. Lennon, of Minneapolis, Minn., who takes a diametrically opposite view of the question. The subject is a very important one, and, as we have already said, can be argued *pro* and *con ad infinitum*. The two articles make interesting reading, and no doubt these discussions will be valuable to all interested in such matters, in that they will bring out new points and ideas bearing on the subject.

THE KEMMLER CASE.—The case of Kemmler, the murderer condemned to be executed by electricity, is a remarkable one. All preparations had been made to carry the sentence of the Court into effect, presumably on the 30th of April, when, on the day previous, execution of sentence was stayed by a writ of *habeas corpus* issued by Judge Wallace, of the United States Court. This action takes the case out of the hands of the State authorities and places it within the jurisdiction of the United States. It is likely that the case will finally be taken to the United States Supreme Court for settlement. One reason given for this last step is that the proposed use of a Westinghouse generator would take it outside of the district prescribed in the original patents; such use therefore would be illegal.

THE ELECTRIC MOTOR INTERESTS.—Reports from the West are to the effect that there will be, in the near future, lively times between the electric motor companies controlled by or allied to the Edison and Westinghouse interests. Since the Westinghouse Company has announced its intention to engage in the motor business, a good deal of interest has been developed as to what will be the result, and we will watch the course of events in this direction with considerable interest. This is a large country, however, and the electric motor field is a great and rapidly-growing one. There is, therefore, plenty of room for both concerns.

ELECTRIC ROAD IN MUSKEGON.—In Muskegon, Mich., an electric street railway was opened on April 17th with considerable enthusiasm on the part of the inhabitants. The motor cars worked with entire satisfaction. The Short system is used.

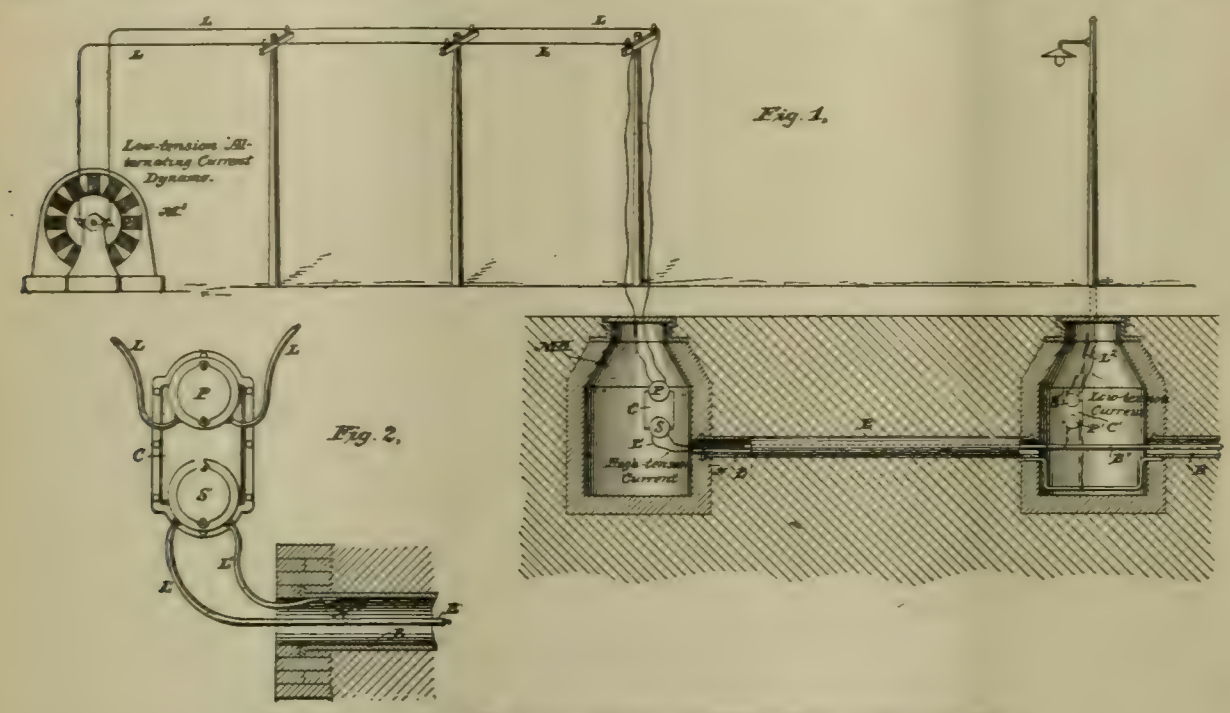
WINDING OF FIELD MAGNETS.—A greater body of wire in the central portion of the magnets than near the ends gives a more even current, less subject to fluctuations.

ELECTRICITY IN A PLANING MILL.—A 20-horse-power Sprague motor is to be used to run a planing mill in Haverford College, Pa.

RESISTANCE TO MAGNETIC ACTION.—The resistance of air to magnetic action is much greater than that of iron.

THE KINTNER SYSTEM OF ELECTRICAL DISTRIBUTION.

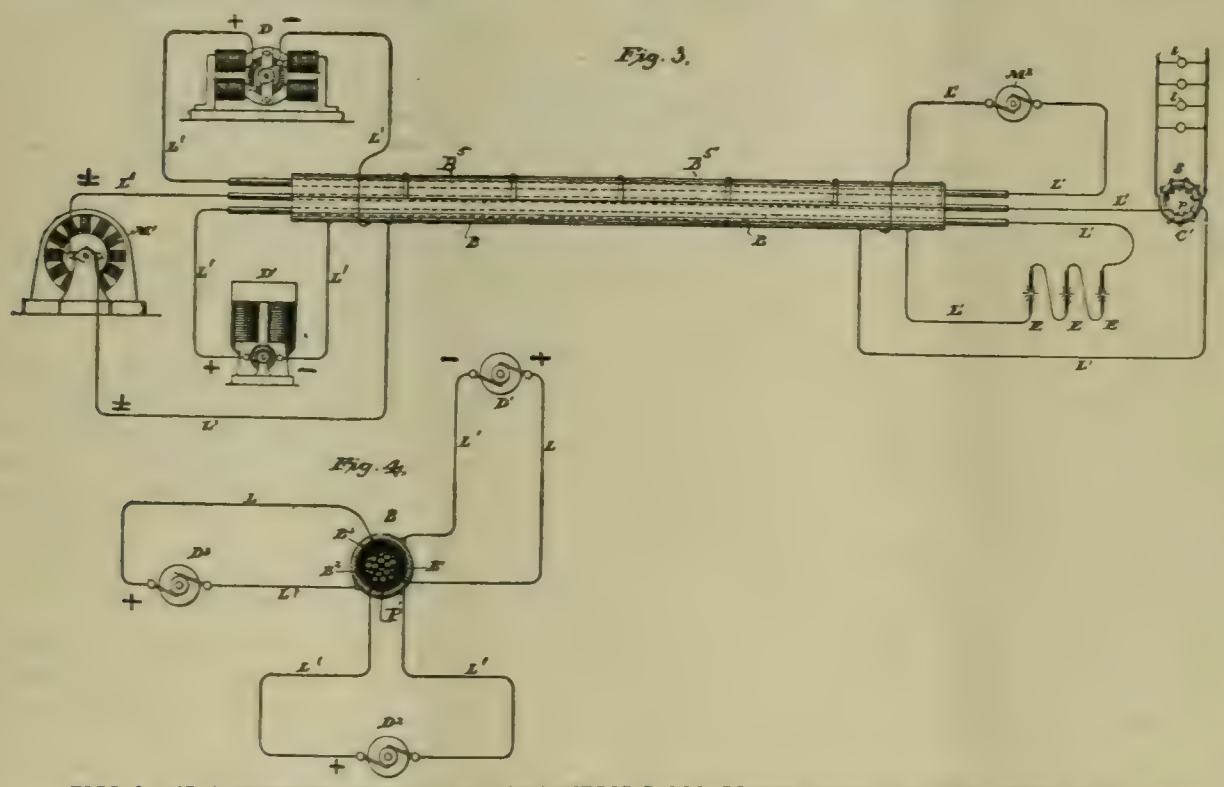
Mr. Charles J. Kintner, the well-known electrical expert of this city, has just received letters-patent on a system of electrical distribution. The invention relates particularly to the distribution of electric currents for electric lighting and the transmission of power by electricity, and has for its special object safety against accidents which arise through the use of high tension currents of electricity in electric lighting and kindred electric systems. Fig. 1 illustrates in elevational and sectional views the plan of the system. Fig. 2 is a detail view of a converter box with connections to a system. Fig. 3 is a diagrammatical view showing several independent generators of electricity and as many kinds of apparatus for utilizing electrical energy, all connected up in accordance with Mr. Kintner's novel principle. Fig. 4 is a cross-sectional view of a concentric system of conductors with dynamo electric machines connected in circuit, the exterior shell constituting the direct or return conductor for the current from the several generators.



THE KINTNER SYSTEM OF ELECTRICAL DISTRIBUTION, FIGS. 1 AND 2.

Mr. Kintner proposes to utilize a metallic or conducting conduit, casement or shell for the return circuit of currents of all classes, and to carry the advance currents to the source of consumption by insulated conductors located within the conduit or shell, whether the latter be located above or beneath the earth. Mr. Kintner prefers, however, to locate the conduit in the earth for the reason that it would attain the same potential as the earth thereby diminishing the potential ordinarily required in all wire conductors. With such an arrangement of circuits a minimum amount of danger is incurred.

According to Mr. Kintner's plans it is possible to either generate low tension currents above ground, carry them to the distributing system below ground, there convert them into high tension currents which are carried through concentric conductors to outlying points of consumption still below ground, and then reconvert them into low tension currents for use above ground, or generate the high tension currents in the concentric mains and convert them into low tension currents at the individual manholes. They are then carried above ground and distributed.



FIGS. 3 AND 4, SHOWING DETAILS OF CONCENTRIC CABLE CONNECTIONS AND END VIEW OF SAME.

In Fig. 1, M is a low tension alternating current generator, generating say 1000 amperès at 100 volts in a central station and carried by overhead conductors L L to the street and into a man-hole, M H, to the primary, P, of a converter, C. S is a high tension secondary converter for converting the current into, say, one thousand volts and one hundred amperès, which is conducted by the insulated central conductor, B', to the successive converters, C', etc., in multiple arc or series, as desired, back by the return conducting conduit, shell, or casement B, connected directly to earth, and therefore of the same potential as earth. The converters, C C, are all in the man-holes, M H, and concealed in insulated converter-boxes, the conductors L L and L' L' being in each set continuous without joints at any point beneath the surface of the earth, with the single exception of the contact-joints N in the interior of the metallic casement or conduit B. By this arrangement of continuous central or interior conductor, Mr. Kintner obviates unnecessary leakage, and hence there is little liability of short-circuit. To accomplish this result he prefers to construct, or at least put together, the parts of the primary in their positions in the man-holes. The cores of the converters, being of well-known sectional parts, may be slipped in place when the converter-boxes are set up.

In the arrangement shown in Fig. 3 the lower portion of the conducting casement or conduit is continuous, or is made so that there is no possibility of any electrical discontinuity, while the upper portion, of metal or other conducting material or not, as desired, is made in separable sections which may be removed. With this arrangement, should any one of the direct cables or conductors L' L' become damaged, testing instruments of the usual pattern may be used in the man-holes at the points of generation and service and the fault located definitely, after which the particular cap or cover B^5 could be unearthed and removed, the fault remedied, and the cover restored: or the cables or conductors L' could be drawn, if desired, in the usual manner. Mr. Kintner prefers, however, the former method, as being less liable to do damage to the conductor itself and to neighboring conductors. In this system (shown in Fig. 3) the dynamo D is supplying current to motor M^2, dynamo D' to arc lights E E E, and the alternating current dynamo M' is supplying alternating currents to the converter C' through primary P and secondary S to lamps *l l l* in multiple arc, all three of said machines receiving their return current through the common concentric conducting casement B B, in contact with the earth throughout its length. This feature of earthing the exterior shell or tube, however, when located in the open air, and the method of giving decreased potential to an all-wire circuit will be covered by a divisional application for patent, the granting of which is now pending.

In Fig. 4 is shown several interior advance or direct conductors B' B^2 B^3, &c., each connected to its individual dynamo D' D^2 D^3, &c., and all individually insulated from each other and collectively insulated by a central insulating pipe P' from their common return conducting casement or conduit B.

By the term "concentric" conductor or conductors as used in this specification is meant two or more conductors, one of which surrounds the other or others and acts as a return circuit.

The system above described is equally applicable to overhead conductors, and Mr. Kintner adapts it to such use by simply connecting the outer casement or shell B, when used as an overhead conductor, directly to earth at each point of support. In this way, there being absolute earths at definite intervals, there can result no harm to any person or persons touching any part of the system.

With a proper insulation aud such precaution against the admission of moisture into the casement or conduit by methods already well known to those skilled in the art, absolute safety to the public and to employés of electric light and power corporations is insured.

Mr. Kintner, of course, does not limit himself to the specific details of construction herewith described. His invention covers broadly improved methods and systems of electrical distribution and the principle of conducting elec-

trical currents of high potentials through concentric conductors.

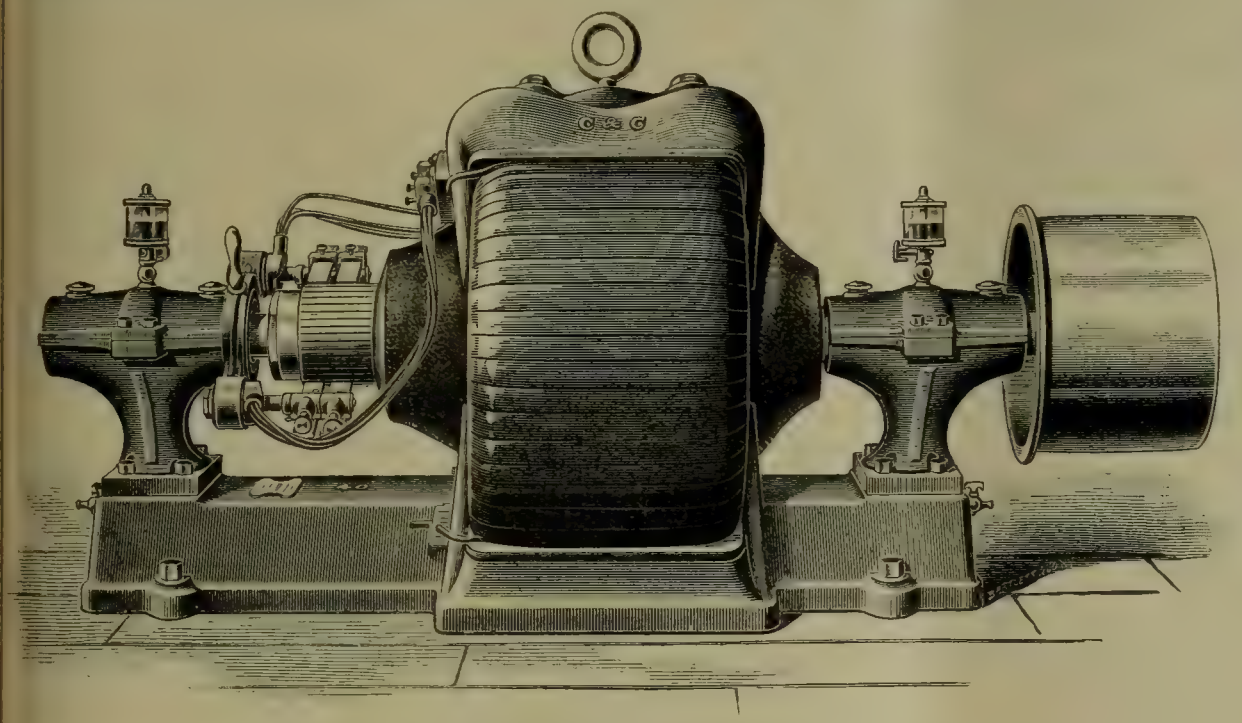
The idea of running insulated conductors through iron conduits and using the conduit as a return circuit is not new, Mr. T. A. Edison having taken out a patent for such a system. Mr. Edison's system, however, was directed particularly to low tension currents, and the conductors were fixed and inaccessible, while Mr. Kintner's invention is directed to the application of high-tension currents in concentric conductors, the inner conductor or conductors of which are removable at will.

LATEST C. & C. MOTOR.

The C. & C. electric motors are now constructed on their new designs in the circular form, in all the usual standard sizes from one horse-power to fifty horse-power.

The accompanying cut was taken from the most approved and latest form of their twenty-five horse-power motor. The most striking feature of these machines is the shape of the magnetic circuit, which forms a perfect circle around the center of the armature shaft.

This construction gives the shortest possible magnetic circuit, it is free from corners and projections where leakage may occur, and makes the motor very compact for a given power.



LATEST FORM OF C & C. MOTOR.

The advantage of this form of construction is shown by the remarkably small amount of current absorbed by the various sizes when running either with and without any load. This fact has been conclusively proven by some recent tests in New York City and Chicago, where it was found that they absorbed less current than any other make of motor of equal power, and the company would be glad to submit figures illustrating this fact.

The larger sizes are fitted with self-oiling bearing, or sight-feed oil cups are provided at the option of the user. The speeds are relatively slow, that of the twenty-five horse-power here represented being 350 revolutions per minute.

ELECTRIC RAILROADS IN THE CENSUS.

The use of electricity as a motive power for street cars will be an important section of the Census investigation of the electrical industry. None of the many forms of the application of electricity has been developed more rapidly or accompanied by more satisfactory results than that of the transmission of power for street car purposes.

The Census investigation of the general subject of transportation, has been very properly assigned to Prof. Henry C. Adams, statistician of the Interstate Commerce Commission. He has divided the subject in several sections, one of which is "Rapid Transit in Cities." This section has been assigned to Special Agent, Charles H. Cooley, a son of Thomas M. Cooley, Chairman of the Interstate Commerce Commission.

The plan of investigation that has been adopted, is designed to make a comparison between the different motive powers employed—animal, steam dummy, cables and electricity—to show the relative economic value of each. Electricians can wish for nothing better than this. The only danger is, that they will experience from it an embarrassment of success. Street railroads are now being transformed into electric railroads as fast as manufacturers and construction companies can take care of the business. How they will manage with an added impetus given to the business, is hard to predict. We are now witnessing the fulfillment of a prophecy made in 1889, regarding the adoption of electric motor power by all street car roads in the country.

* "The change will not be a development. It will be a transformation."

If the investigation by the Census Office of the relative economic value of the motive powers now in use for street car service, results as I believe it will, the "horse car horse" will disappear. The places that know him now will know him no more.

The schedules for the section of rapid transit in cities, will include the inquiries to be made regarding electric railroads. That part of the schedules pertaining to the electrical branch of the subject, will be prepared under my supervision, and that portion of the report pertaining to the uses of electricity as a motive power for street cars, will be embodied in my report on the investigation of the electrical industry, as well as in the report of the section making the investigation.

The Census Office is performing a service of great value for the public in making such special investigations. All who have to do with questions of municipal management or public affairs, are keenly aware of the necessity of securing reliable data by which to guide their actions. The cost of obtaining such statistics through the Census Office, is but an infinitesimal tax on the capitalization of the industries interested, while its impartial and impersonal character gives it the weight of an unquestioned authority.

Mr. Cooley is anxious to have electric railroad men impressed with the great help they can give him by filling out and returning their schedules promptly. I tell him that he will find in this, as in all other matters, electrical men lead the world. They can't help it. It is the nature of the "fluid" they imbibe to make them "quick as lightning."

ALLEN R. FOOTE,
Special Agent.

* Economic Value of Electric Light and Power, p. 121.

BALL ENGINES.

The engines of the Ball Engine Company, of Erie, Pa., continue to grow in favor among electric light and power people. The company reports the following shipments of their engines:

The Algonquin Company, Dundee, N. J., one 25 horse-power standard.

Denver Electric Illuminating Company, Denver, Col., two 30 horse power standard.

Pueblo Light, Heat & Power Company, Pueblo, Col., 100 horse-power standard.

U. S. gunboat Concord, (Edison Mfg. Co.) two 15 horse-power vertical.

U. S. gunboat Bennington, (Edison Mfg. Co.) two 15 horse-power vertical.

House of Correction, Chicago, Ill., one 35 horse-power standard.

Philadelphia & Reading Coal and Iron Company, Pottstown, Pa., one 35 horse-power standard.

Chicago House of Correction, one 80 horse-power standard.

Guarantee Loan Building, Minneapolis, Minn., two 100 horse-power standard.

Pennsylvania Depot, Chicago, Ill., one 80 horse-power standard.

Albany *Journal* Company, Albany, N. Y., one 35 horse-power standard.

Louisville Hotel, Louisville, Ky., one 80 horse-power standard.

Ferd-Heim Brewing Company, Kansas City, Mo., one 25 horse-power standard.

Willimette Bridge Street Railway Co., Portland, Ore., one 150 horse-power standard.

Pennsylvania Normal School, Lockhaven, Pa., one 35 horse-power standard.

Tuscarawas Electric Light Company, Canal Dover, O., one 100 horse-power standard.

Manitou Springs E. L. Company, Manitou Springs, Col., one 80 horse-power standard.

Manitou Springs E. L. Company, Manitou Springs, Col., one 100 horse power standard.

Cleveland Arcade Company, Cleveland, Ohio, two 100 horse-power standard.

Cleveland Arcade Company, Cleveland, Ohio, one 125 horse-power standard.

Greenwich Gas & E. L. Company, Greenwich, Conn., one 100 horse-power standard.

Pensacola E. L. & Power Company, Pensacola, Fla., one 100 horse-power standard.

The Devereaux Lumber Company, Charleston W. Va., one 150 horse-power standard.

Tom L. Johnson, Esq., Cleveland, Ohio, one 100 horse-power standard.

The Ball Engine Company have the following orders on their books for their special vertical engines adapted for electric lighting on shipboard.

Four vertical compound engines for the U. S. gunboats Concord and Bennington, ordered by the United Edison Company.

One vertical compound engine for the New York Life Insurance Company, of Minneapolis, Minn., ordered by the Brush Electric Company.

One vertical compound for new steamer for the Brazilian Steamship Company, ordered by the Complete Construction Company of New York.

Two vertical double engines, ordered by the Brush Electric Company for the U. S., ship Miantonomoh.

Two vertical compound engines, ordered by the United Edison Company, for steamer Plymouth, of Old Colony Steamship Company.

CENTRAL STATIONS AND ELECTRIC ROADS.—According to Whipple's electric reports, April 1st, there are in the United States 1,498 central lighting stations, and 87 in Canada. Cuba has 2 and Mexico 9. There are 208 electric roads in the United States and 4 in Canada.

C. & C. MOTORS.

The C. & C. Electric Motor Company, of New York, report sales of their motors to the following parties :

One 4 horse power to Allen & Kenway, 220 Devonshire St., Boston, Mass., to run ventilating blower.

One 2 horse power to Howard & Co., 264 Fifth avenue, New York, to run jewelers' lathe and polishers.

One 1 horse power to Trinity Church, Easton, Pa.

One 3 horse power to Whiting Manufacturing Company, Union square, New York, to run jewelers' lathe and polishers.

One 4 horse power motor to Prof. C. A. Young, Halstead Observatory, Princeton, N. J., to turn observatory dome.

One 5 horse power to Fraser & Chalmers, Salt Lake City, Utah, to run a dynamo.

One 3 horse power motor to Leighton & Wilson, Phœnix Building, Salem, Mass.

One 2 horse power motor to Kobe, Japan.

One 5 horse power motor to G. B. Grant, 137 Franklin street, Boston, Mass.

One 15 horse power to Snyder & Black, 92 William street, New York, to run lithograph and printing presses.

One 1 horse power to Wickstead Umbrella Co., 47 John street, New York, running machine shop.

One 1 horse power to Church of Holy Communion, 6th avenue and 20th street, New York.

One 3 horse power and one 10 horse power to W. R. Sanderson, 194 Water street, New York, running printing presses.

One 10 horse power to Trask Milling Machine Company, 118 South street, Boston, Mass., running machine shop.

One 1 horse power to Southern District Telegraph and Electric Company. Birmingham, Ala., to run printing presses.

One 1 horse power to Roanoke Electric L. and P. Co, Roanoke, Va., used in printing the Roanoke *Daily Herald.*

One 1 horse power to General Society of Mechanics and Tradesmen, 18 E. 16th street, New York, to run ventilating fan.

One 1 horse power to St. John's Church, Reading, Pa.

One 15 horse power to William Silverman, the Wire Buckle Suspender Company, Williamsport, Pa., to run shop.

One 5 horse power motor to John J. Tuomey, Jackson, Mich.

One 15 horse power to W. W. Bullock, Wilmington, Del.

One 3 horse power to D. P. Gosline, 32 Oliver street, Boston, Mass., ventilating fan.

One 15 horse power motor to Queen City Electric Light Company, Gadsden, Ala.

One 1 horse power to the Silvey Electric Company, Lima, O.

One 2 horse power motor to Meyer & Singer & Co., Lycoming Pants Factory, Williamsport, Pa., to run sewing machines.

One 4 horse power to D. Coughlin, 5 Mill street, Lawrence, Mass., to run 28" saw.

One 1 horse power motor to Trinity Episcopal Church, West Fourth street, Williamsport, Pa., to run organ bellows.

One 7 horse power motor to Mercantile Printing Company, Wilmington, Del., to run presses.

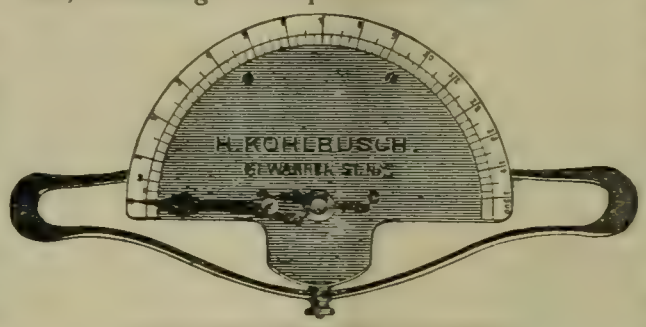
One 20 horse power to Perry & Woodworth, Smith Building, Cincinnati, O.

THERMO-ELECTRIC TENSION BETWEEN COMPRESSED AND UNCOMPRESSED MERCURY. — Dr. de Coudres, of Leipzig, is reported to have succeeded in detecting a thermo-electric tension between compressed and uncompressed mercury. The compression was produced either hydraulically or by means of its own weight acting through a column of mercury. It was found possible to determine with certainty the direction of the thermo-electric current, and to measure its intensity for given pressures and temperatures.

A RELIABLE DYNAMOMETER.

In electric railway practice the pulling power of electric motors is an important factor in the calculations. This power is determined by an instrument known as the dynamometer. The dynamometer, illustrated below, is the only one made in this country, and has of late attracted the attention of motor companies. The springs are made of double-shear steel and are tempered with great care to secure accurate results. They are made to record a pulling force up to 10,000 pounds, and the readings are given with great accuracy.

The internal mechanism of this dynamometer is very simple, and cannot get out of order. The springs are so perfectly tempered that the instrument may be kept under the maximum tension for an indefinite length of time, and the moment the pull is relaxed the pointer returns to zero with great exactness. These dynamometers are frequently subjected to tests of this sort, extending over a period of a week.



THE KOHLBUSCH DYNAMOMETER.

This instrument, of course, is applicable anywhere where it is desired to measure pulling force, and is used very generally by farmers to ascertain the draft of plows, mowing machines, etc. Street railway companies are also large users of this dynamometer. It can also be used as a weighing machine, and the weight of a horse or any other animal can be readily ascertained.

There is a demand for such an instrument as this in electric railway work for the reason that the means now used in measuring pulling power are generally unsatisfactory and unreliable.

Mr. Herman Kohlbusch, No. 59 Nassau street, is the manufacturer of this instrument, and he reports that electric railway people who have used this dynamometer are well pleased with its operation, which is always reliable and accurate.

THE WOMAN'S EXCHANGE ELECTRICAL DISPLAY. —The electrical display at the Woman's Exchange Exhibition at the Lenox Lyceum in this city continues to draw immense crowds. Never before has the country had such an opportunity to see the wonders of electricity, and they are availing themselves of it. The phonographs and telephones of course continue to draw the greatest crowds, and the entertainment afforded by these instruments are at once novel and interesting. We hear efforts are being made by other cities to secure the loan of the entire electrical exhibit for similar use. Wherever it goes it certainly will draw large crowds.

ELECTRIC POWER IN SWITZERLAND.—A plan has been worked out for utilizing the power of the Rhine in Switzerland for the generation of electrical energy. The idea is to excavate a canal parallel to the river, in which the water of the river, carried by sluiceways, will have a net fall of about twelve feet. This will turn turbine wheels. The scheme, which is considered of great importance, calculates on 9,440 horse-power.

ELECTRIC LIGHTING OF MADAME PATTI'S RESIDENCE.—Adelina Patti's private theatre and winter gardens, at Craig-y-nôs Castle, are being lighted with the electric light, the installation of which has been entrusted to the Wenham Company, Limited, of London, the whole of the work being carried out by their own staff in the electrical department.

TRAIN LIGHTING IN SWITZERLAND.—The application of electricity for the lighting of railway trains is a problem which yet remains to be satisfactorily solved ; but, notwithstanding this, many experiments are being conducted in various localities to arrive at a definite decision. The most recent to take up this subject were certain Swiss engineers, who have been making comparative tests with the electric light, oil lighting, and the Pintsch system of gas lighting. The experiments took place in a carriage attached to a passenger train which travels between Zurich and Richtersweil. The carriage contained one first-class and two second-class compartments, and a toilet cabinet. One incandescent lamp was suspended from the middle of the roof of each compartment, and one glow lamp was also placed on each platform at the ends of the car, the two latter lamps being only in circuit when passengers entered or departed from the carriage. The battery was placed in a box under the floor of the vehicle, and weighed 3 cwt. It consisted of eight cells, and contained sufficient energy to last for eighteen hours, when it had to be recharged. The results obtained from the experiments were that a 6 C. P. glow lamp is equal to an ordinary oil lamp ; but this was considered to be insufficient. A 10 C. P. incandescent lamp, however, enabled the passengers to read with facility small newspaper print when the lamp was provided with a good reflector.

ELECTRO-PLATING DEAD BODIES.—The scheme is again revived for electro-plating the bodies of our dead. Many persons, indeed a vast majority, are prejudiced against cremation. It will not be denied, however, that the practice we have of burying our dead in the ground, hundreds to the acre, is, in a sanitary sense, a great mistake. Custom and sentiment, however, are hard to overcome. In a broad way it might be held that it is a duty we owe to nature to give her our empty house when we are through with it, to enrich the soil from which we have drawn during our life. But this end is not reached by huddling thousands of decaying bodies together. It is, in fact, a fruitful source of disease ; hence the revival of the electro-plating idea. By this method the body would remain intact for centuries, and the living would be spared the dangers from the present systems. Sentiment would also be satisfied even in a greater degree than it is now, for, though the face of the dead would assume the color of the metal used in electro plating, the form of the features and its expression would be forever preserved, and could be gazed upon at any time. The horror of change from established custom will prevent any radical departure from the existing mode, just at present, perhaps, but it will surely come in the future.

KEELY MAKES ANOTHER DISCOVERY.—At last we have it. Keely, psychologist, the man who has broken the joints of his fingers, smashed three ribs, paralyzed his left side, temporarily lost the sight of one eye and spent the fortunes of many stockholders in the search for the principles of the new power, announces that his force is closely related to electricity. It produces, in fact, an interruption or interference with the magnetic current of the earth, the result being the phenomena which he shows now and then to mystified scientists and confiding investors. Mr. Keely further states that this is the same sympathetic force which holds the planets together. The sympathetic negative disassociates molecules, and the positive associates them. He believes electricity a substance, not a force. Not long ago Mr. Keely gave an exhibition of the workings of his force in the presence of Prof. Joseph Leidy of the Universty of Pennsylvania and Mr. James M. Wilcox. The experiments were satisfactory to those present, the phenomena produced being wonderful on all accepted hypotheses. The scientists present could not explain the effects, either on the basis of extraneous electricity or compressed air.

REMOVAL. —The Aluminum Battery, Electric Light and Power Co. have removed to 78 and 80 Cortlandt street.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED APRIL 29TH.

426,338. Lightning Arrester. Arthur D. Spear, Greenville, S. C. Filed Jan. 10, 1890.

426,379. Electric Railway Car. John C. Henry, Kansas City, Mo. Filed July 5, 1887.

426,381. Electric Gas Lighter. Charles H. Hinds, New York, N. Y. Filed Aug. 20, 1889.

426,382. Electr c Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor, by mesne assignments, to the Thomson-Houston Electric Company, Boston, Mass. Original application filed Sept. 23, 1886, Serial No. 213,309. Divided and this application filed May 15, 1889.

426,436 Trolley Equalizer. George F. Corliss, Mansfield, Ohio. Filed July 30, 1889.

426,437. Electric Heater. Chas. W. Drew and Edward R. Francis, Minneapolis, Minn. Filed Feb. 20, 1890.

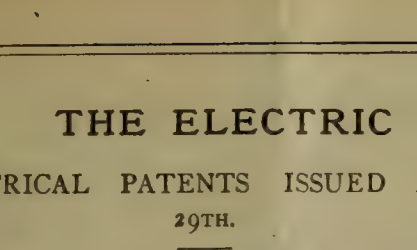
426,452. Crossing for Overhead Wires. John Kuehnle, Detroit, Mich. Filed March 11, 1890.

426,462, Tablet for Telephones and Clamp Attachment for the same. John B. Morris, Cincinnati, Ohio. Filed Feb. 14, 1890.

426,471. Brush and Holder for Electric Machines. Edwin W. Rice, Jr., Lynn, Mass. Filed March 30, 1889.

426,479. Apparatus for Manufacturing Electric Light Carbons. Henry A. Tremaine, Cleveland, Ohio, assignor to the Standard Carbon Co., same place. Filed Aug. 30, 1889.

426,499. Device for Measuring Electrical Currents. Thos. H. Hicks, Detroit, Mich., assignor to the Electrical Invention Company, same place. Filed Sept. 9, 1889.



No. 426,563. INDUCTION COIL.

426,522. Electrical Train Signal. George D. Burton, New Ipswich, N. H. Filed Nov. 22, 1887.

426,527. Automatic Determining Device for Phonographs. Thomas A. Edison, Llewellyn Park, N. J. Filed July 2, 1889.

426,554. Message Recording Instrument. John C. Wilson, Boston, Mass. Filed June 25, 1888.

426,555. Message Recording Instrument. John C. Wilson, Boston, Mass. Filed Oct. 29, 1889.

426,563. Induction Coil. Anthony M. Frankenberg, Baltimore, Md. Filed June 21, 1889.

426,570. Regulator for Dynamos and Motors. Wm. T. Peel, St. Paul, Minn., assignor of one-half to Jacob R. Steiner, same place. Filed July 12, 1889.

426,573. Potential Controlling Device. Wm. Stanley, Jr, Great Barrington, Mass. Filed July 3, 1888.

426,574. Regulation of Electric Motors. Wm. Stanley, Jr., Great Barrington, Mass. Filed July 10, 1888.

426,576. Dynamo Electric Machine. Jonas Wenström, Orebro, Sweden. Filed August 31, 1889.

426,580. Electric Railway. Edward M. Bentley, New York, N. Y. Filed January 20, 1888.

426,583. Switch Apparatus. Minor M. Davis, Brooklyn, N. Y. Filed June 11, 1889.

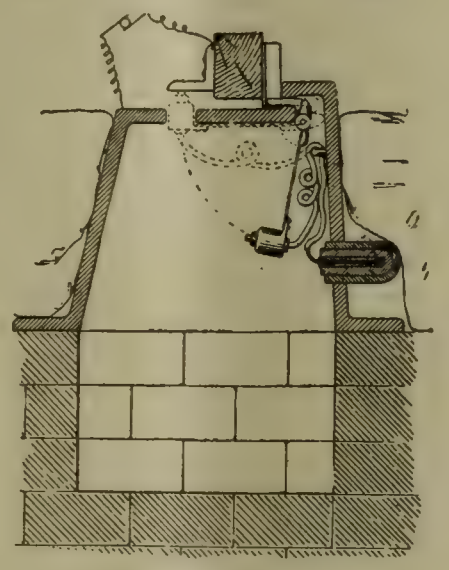
426,591. Quadruplex Telegraphy. Francis W. Jones, New York, N. Y. Filed January 3, 1889.

426,621. Electrical Signalling Apparatus. James U. Mackenzie, New York, N. Y., assignor to the Gamewell Fire Alarm Telegraph Company, same place. Filed Oct. 9, 1883. Patented in England April 11, 1883.

426,650. Electric Engine. Robt. W. Thompson, Cleveland, Ohio, assignor of one-eighth to Geo. W. Tibbitts and James C. O'Neil, both of same place. Filed Jan. 23, 1890.

426,657. Electric Motor Car. John A. Brill, Philadelphia, Pa. Filed Feb. 14, 1890.

426,658. Electric Motor Car. John A. Brill, Philadelphia Pa. Filed Feb 18, 1890.



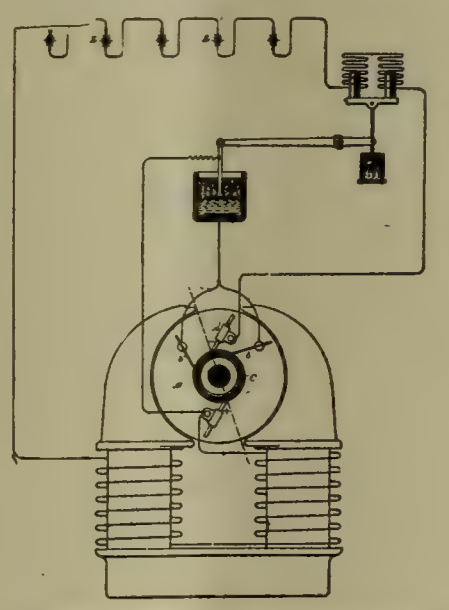
No. 426,580. ELECTRIC RAILWAY.

426 660. Electric Lamp Post. Wm. Carroll, Chicago, Ill. Filed April 12, 1889.

426,691. Fire Alarm Telegraph System. John Speisher, Jersey City, and Frederick T. Fearey, Newark, N. J., assignors to the Newark District Telegraph Company, of New Jersey. Filed Feb. 15, 1889.

426,699. Regulator for Dynamos. James J. Wood, Brooklyn, N. Y. Filed Aug. 20, 1889.

426,705. Circuit Closing Hinge for Electric Burglar Alarms. Wm. M. Bleakley, Verplanck, N. Y. Filed Feb. 15, 1890.



No. 426,699. REGULATOR FOR DYNAMOS.

426,706. Burglar Alarm. John E. Bleoo, Brooklyn, assignor to the Mutual District Telegraph Company, New York, N. Y. Filed Aug. 5, 1889.

426,708. Electric Railway Car. John A. Brill, Philadelphia, Pa. Filed May 18, 1889.

426,724. Method of Making Electrodes for Secondary Batteries. George E. Heyl, Charlottenburg, Prussia, Germany. Filed June 8, 1889.

426,749. Automatic Telegraph. Frank Anderson, Peekskill, N. Y. Filed September 30, 1889.

426,778. Safety Hook for Electric Lights. John Dalton, Danvers, Mass., assignor to Theodore G. Lee, same place. Filed Aug. 28, 1889.

426,781. Electric Refrigerating Apparatus for Railway Cars. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed Feb. 10, 1890.

426,788. Apparatus for Producing Sheets of Metal by Electro-Deposition. Moses G. Farmer, Eliot, Me. Filed Nov. 20, 1888.

426,789. Electrolytic Apparatus for Forming Copper Ingots. Moses G. Farmer, Eliot, Me. Filed July 29, 1889.

426,819. Duplex and Quadruplex Telegraph. Francis W. Jones, New York, N. Y. Filed June 11, 1889.

426,832. Automatic Fire Extinguisher. Jos Madden, Providence, R. I. Filed December 24, 1889.

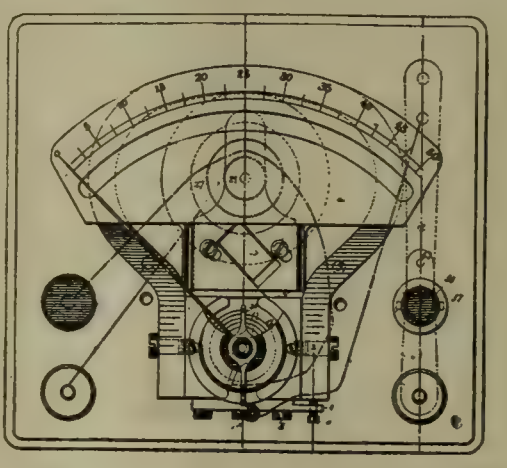
426,917. Thermostatic Circuit Closer. Wm. H. Chambers, Fulton, Ky., assignor of one-fifth to Jesse T. Holman, Harris Station, Tenn. Filed Dec. 21, 1889.

426,932. Galvanic Battery. Fernand Gendron, Bordeaux, Gironde, France. Filed Feb. 8, 1889.

426,941. Telegraph Key. Oscar Kleber, Allegheny, Pa. Filed August 28, 1889.

426,989. Apparatus for Electrical Communication. James L. Cutler, Piketon, Ohio. Filed Feb. 8, 1890.

427,014. Electrical Tell-Tale Device. Edward F. Roberts, Rochester, N. Y. Filed June 11, 1889.



No. 427 022. ELECTRICAL MEASURING INSTRUMENT.

427,022. Electrical Measuring Instrument. Edward Weston, Newark, N. J. Filed Jan. 18, 1890.

427,024. Circuit Closer. Henry B. Whitaker, River Point, R. I., assignor of one-third to James A. Matteson, same place. Filed Feb. 1, 1890.

REMARKABLE LONGEVITY OF AN INCANDESCENT LAMP.—The following is a copy of a letter received by the Sawyer-Man Electric Company, which explains itself:

GADSDEN, ALA., April 26, 1890.

SAWYER-MAN ELECTRIC CO., NEW YORK:

Gentlemen: We have something wonderful in the way of an incandescent lamp to report to you. On July 4th, 1888, we started our incandescent dynamo. Among the lamps in the station was one over the engine which has been running all night long every night since and is still running. Counting from July, '88 to July, '89, we have 365 days, and from July 4th, '89 to May 1st, '90, we have 300 days more, which together make 665 days of 12 hours, equal to 7,980 hours. No doubt some will discredit this statement, but nevertheless it is true. The above described lamp is a Sawyer-Man 16-candle power, 110 voltage. Very truly,

QUEEN CITY ELECTRIC LIGHT CO.

This is a wonderful record for one lamp, and, as far as we know, has never been equaled.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE, ROOM 10, COOK BUILDING.

BOSTON, May 2, 1890.

Holliston, Mass., is to have an electric road.

There is talk of an electric belt railway in the town of Winthrop, Mass.

Work on the construction of the Essex electric road at Salem has commenced.

An addition to the electric light station at Zylonite, Mass., is to be built shortly.

The City Council of Milford, Mass., has granted a franchise for a street railway in that city.

The street railway company at Whitington, Mass., are about to make extensions to their line.

An appropriation for lighting the streets of East Providence, R. I., by electricity has been made.

The Board of Trade at Wallingford, Conn., are talking of an electric light plant for that town.

The Hartford and Wethersfield Railway Company are to extend their line to East Hartford.

The Naugatuck and Waterbury Tramway Company will commence the construction of their road immediately.

The Greenwich Gas and Electric Light Company have been authorized to light the streets of Greenwich, Conn., by electricity.

A special town meeting was held in Franklin, N. H., May 3d, to see if the town will vote to put in and operate an electric light plant.

The Gloucester Electric Light Co. have commenced the erection of poles and have completed the line as far as East Gloucester.

The selectmen of Brookline are to contract with the Brookline Gas Light Company to light the streets by electricity for three years.

The Lynn City Council has voted to continue the contract with the Lynn Gas and Electric Company for lighting the streets by electricity.

The Essick Printing Telegraph Company are asking for bids for a ten-wired copper line to New York which they propose to build at once.

It is understood that a syndicate of Boston capitalists are negotiating for the Beverly and Danvers and the franchise of the Essex electric roads.

The New England Telephone and Telegraph Co. have had a large force of men at work on the line of the B. & L. R. R. changing poles and wires.

The Amesbury Electric Light Company have made a proposition to the authorities of Merrimac, Mass., to light the streets of that town by electricity.

The Johnston Electric Train Signal Co. has agreed to locate in Woburn provided $10,000 is subscribed. Of this amount over one-third has been raised without solicitation.

The West End Railway Company is disappointed in not getting electric cars enough to open the Hampden street line, and the opening has been postponed.

The contract for building the Manet Street Railway to Hough's Neck, Quincy, has been awarded to Soul, Bellingham & Co., of Boston. It is expected the road will be in running order June 10.

The Thomson-Houston Company has bought the estate on Federal street, Lynn, owned by Stephen N. Breed & Co. It is understood that fifty cents per foot was paid for 50,000 feet of land.

Mr P. Fisher, formerly Superintendent of Construction for the Postal Telegraph Co. in this city, is now in New York waiting orders to proceed to Alabama where he is to erect 1,400 miles of wire.

The contracts for the new building of the Lowell Electric Light Co. have been awarded. The building is to cover a ground area of 90 x 210 feet and will cost about $31,000 above the foundation.

The Massachusetts Electric Engineers and Mechanics Association held their fourth meeting at Brunswick Hall last Friday night; about twenty-one new names were added to the membership list.

Mr. E. Bibber, the popular "commercial tourist" of the Holtzer Electric Company has returned from a seven weeks' trip through the South and Southwest, extending as far as the border of Mexico.

Surveyors have been at work for several days on land at the eastern end of Chester Park, on which the Suburban Electric Light Co. contemplate the erection of a lighting plant of 1,000 horse power capacity.

The electric locomotive, built by the Thomson-Houston Company for the West End Railway Company has arrived in Boston. It is capable of running at a speed of 20 miles an hour and drawing four loaded cars.

The friends of Willis Gunney of the Thomson-Houston Works at Lynn presented him with a fine French marble clock last Monday evening. Mr. Gunney is to assume a position in the employ of the Edison Company of New York.

The Taunton Electric Lighting Co. have received the plans for their new building, but will do nothing beyond getting the estimates of what the cost will be until the application of the Bristol County Co. for a franchise has been decided.

The Washburn and Moen M'f'g Co., of Worcester, have purchased a tract of land in South Chicago, Ill. Wharves are to be built and extensive shops erected, and, after the style of Pullman, cottages will be put up for the numerous employes.

The Thomson-Houston Electric Co. has secured the Newhall property on Federal street, West Lynn, which adjoins the Otis lot recently purchased. This will make it possible to build the three story addition to factory C, which is intended to cover the Robinson and Otis lots, some forty feet longer than it would have been, otherwise.

At the State House, last Wednesday, the mercantile committee reported a bill to authorize the Boston Electric Light Co. to increase its capital stock to an amount not exceeding $2,000,000, making the entire amount $3,000,000. The new stock may be sold or issued from time to time in accordance with existing laws relating to the increase of capital of manufacturing corporation.

A spirited town meeting was held in Revere last Monday at which there was a lively discussion over lighting the streets by electricity and whether the town would do its own lighting. It was finally voted to contract with the North Shore Electric Company for a term of three years for 175 incandescent lights of 26 C. P., at a cost of $16 a year each, and also 15 arc lights of 1,200 C. P., at a cost of $72 a year each, the lights to burn from sundown to 12.30 a. m.

The Suburban Electric Light and Power Company have erected lines from their station on Norfolk avenue to the Dudley street station of the N. Y. & N. E. R. R. This company is now wiring the Hotel Langham for two hundred and fifty 16 C. P. incandescent lights. They are also extending their lines along Tremont and Washington streets where they have contracts for lighting a large number of stores and offices with both arc and incandescent lights.

In the Board of Aldermen last Monday evening, the petition of the Suburban Light and Power Co. for permission to erect 861 poles in Roxbury, Dorchester, West Roxbury and South Boston, was rejected by a vote of five yeas to seven nays. The following order was passed by a vote of ten to two. Ordered, that permission be granted the Boston Electric Light Co. to erect 81 poles for the support of wires in Jamaica Plain and Boston.

Mr. L. F. Jordan, of the Jordan Tram Lighting Co. has purchased the controlling interest in the Duralite Company, whose office is at 85 Water street, this city. This company is prepared to furnish all kinds, shapes and sizes of insulators made of their material. The fact of Mr. Jordan being connected with this concern is a guarantee of its future success. The factory, which is now located in Leominster, will shortly be removed to Boston.

Geo. W. Gregory, treasurer of the Municipal Signal Company, has brought suit against it for $25,000, *ad damnum*. Mr. Gregory has also brought a bill in equity in the Suffolk Superior Court, setting up an agreement by Wilson to assign him a half interest in his patent, alleging his refusal and praying a temporary and permanent injunction against his assigning the patents. Colonel Pope, the President, has said that the suit is brought to straighten out the affairs of the company.

Professor Thomson, the genius of the Thomson-Houston Works, at Lynn, has just moved into his magnificent new mansion on Burrill street, Swampscott. The Professor is one of the most unpretentious and guileless of men, and is well pleased with his new home. When he gets it fitted up one of the wonders of his estate will be his laboratory or "shop," as he calls it, which is on the second floor of his stable and connected with his house by a very artistic bridge. Both house and stable are of brick and in the old colonial style.

The citizens of North Abington are anxiously awaiting the decision of the gas commissioners upon the matter of electric light franchise. The franchise was originally granted to John F. Simmons, H. H. Pratt and two others The Westinghouse Electric Light Co., it is asserted, claims to hold an assignment of this franchise, but have not filed it with the commissioners, although three hearings have been held. As soon as a decision is rendered by the commissioners as to who holds the franchise work will begin.

The advantage of single over double trolley systems was the subject of a discussion at the rooms of the Boston Electric Club last Monday evening. G. W. Mansfield's paper opened the debate, and was confined to a presentation of the commercial side of the question. The difficulties under which the system of double trolley wires would work in stormy weather, and the crowded streets of a large city, to say nothing of the expense, were, in the opinion of the speaker, insuperable objections to a complete metallic circuit for electric railways. W. J. Denver, of the New England Telephone and Telegraph Co. was the only speaker in opposition. His remarks aimed to determine the responsibility, as between the telephone and railway companies, for increased outlay in the more elaborate construction. Brief remarks were made by F. M. Gilley and L. S. Dumoulin, Electrician for the West End Railway Company.

The Tripp Manufacturing Co., of Boston, are at present engaged in building a double truck car for the West End Street Railway Co. The car will have eight wheels, will be 28 feet long from door to door, 7 feet 3 inches wide, 7 feet 9 inches in height from the floor and will have a seating capacity of forty passengers. Each truck has four 30-inch steel wheels and two 15 H. P. Thomson-Houston motors. The car will be provided with vacuum and hand brakes, and the brakes will be

operated by a toggle joint arrangement giving immense power. The Tripp patent roller bearings will be used throughout, and the car will be hung on trucks of entirely new design (on which patents are pending) the equalizing bar being connected direct to the journal boxes underneath instead of passing around on top as hitherto. There are less parts and fewer bolts on the new Tripp truck than on any other form of truck, and they leave plenty of room for the application of the motive and electrical apparatus. The car will be in service about May 10.

There is on exhibition at the rooms of the Electrical Safety Co., 146 Franklin street, this city, the Cartwright Electrical Protector and other devices, for the protection of circuits and instruments from abnormal currents of electricity. During the past week several prominent gentlemen, including the Fire Commissioners and Superintendent of Fire Alarms have witnessed the practical workings of these devices, expressing themselves as perfectly satisfied with its merits for the protection of instruments, circuits, and buildings from fire in case of the entrance of an abnormal current of electricity. The company have installed at their office a fire alarm circuit, each box being protected by a Cartwright Protector. A complete set of telegraph and another of telephone instruments are also protected and wires leading direct from the Edison electric light circuit are used to demonstrate the effects of abnormally strong or weak currents as they occur in practice. In regard to the application of their devices to a fire alarm circuit, any box can be "rung in," whether the wires are charged with a strong or weak current by being crossed. Mr. J. H. Coombs, manager of the company, will be pleased to show the operation of the instrument to anyone interested. At a recent test made by the Boston Fire Underwriters' Union, this protector fulfilled all the requirements perfectly, no other being so well adapted for use on fire alarms and metallic circuits. W. J. P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BANK BUILDING.

CHICAGO, May 3, 1890.

DIXON, CAL., is to have electric lights.

AN ELECTRIC RAILWAY is talked of from Algonac, Mich , to the club houses on Harson's Island.

THE CONSOLIDATED LIGHT & POWER CO , Kansas City, Kansas, have filed certificates of increase of capital stock to $200,000.

GRAND RAPIDS, MICH., will soon have an electric street railway in operation, the contract having been closed for the Daft system.

THE MILWAUKEE HOTEL CO., will build a hotel at Milwaukee, Wis., seven stories high, at a cost of about $400,000. It is to be lighted by electricity.

THE CHICAGO ILLUMINATING CO. has been incorporated to furnish electric light and power, capital stock, $500,000; incorporators, F. S. Wheaton, D. S. Gooding and E. M. Miles.

THE ST. LOUIS ELECTRICAL SUPPLY CO. has been formed at St. Louis, Mo.; capital stock, $25,000; incorporators, William L. Scott, Henry C. Scott, Joseph F. Porter and George W. Brinck.

THE CENTRAL ELECTRIC CO., Chicago, are displaying an especially fine assortment of incandescent globes this week, in all styles of cut and ground glass. They are also handling a handsome line of electroliers.

A COMMITTEE of Toronto Aldermen, composed of Messrs. Ritchie and Bell and R. J. McGowan, Secretary of the Fire Department, visited the City Hall in this city to-day. They came to inspect the workings of the electric light, and Professor Barrett initiated them into all the mysteries.

THE SPERRY ELECTRIC CO., report the sale of a 50-light plant to the Booneville Electric Light & Power Company, Booneville, Mo., also an increase of 30 lights to the Willimantic Electric Light Company, Willimantic, Conn.

THE CHICAGO & WESTERN RAPID TRANSIT RAILROAD CO., has been formed at Chicago to construct a line of railway in Chicago. Capital stock, $8,000,000; directors, E. Louis Kuhns, Harry A. Ritter, A. F. Shuman and others.

THE NATIONAL HOME & NORTH GREENFIELD CO., has been incorporated at Milwaukee, Wis., for the purpose of operating an electric railway; capital stock, $100,000; incorporators, Paul Bechtner, Hugo Lovenbach, Wm. D. Gray, G. M. Hinkley and others.

WORLD'S EXPOSITION.—The Board of Directors of the World's Exposition of 1892 adopted by-laws this week and elected the following officers: Lyman J. Gage, President; Thomas B. Bryan, 1st Vice-President; Potter Palmer, 2d Vice-President.

SAN ANTONIO, TEXAS, is to have an electric railway from the heart of the city to various parts of the suburbs, the cost to be about $200,000. Mr. Edwin McCrellis and other Denver capitalists have given a $10.000 bond to begin work in 90 days and to have the road in operation in 10 months.

MR. F. G. HEUTIG, general manager of the Electric Rapid Transit Company, Los Angeles, Cal., reports work on their line progressing rapidly, and that their plant will probably be in operation by July 1st. They expect to make the line the model road of the Pacific slope. The Sprague system is being installed.

ST. LOUIS, MO., is now a well lighted city, the electric lights having been turned on May 1st. Great satisfaction is expressed on the part of the residents in those sections of the city now lighted by electricity over the change from gas. The gas company, with whom a temporary arrangement had been made by the city, have been notified to shut down their lights.

THE THOMSON-HOUSTON ELECTRIC CO. report the following sales for the past week: Geo. Meritt & Son, Woolen Mill Co., 100 incandescent lights for their woolen mill at Indianapolis, Ind. C. C. Travis, Tecumseh, Mich., fifty 1,200 C. P. arc, and 650 16 C. P. alternating current incandescents. Aurora El. Lt. & Pr. Co., Aurora, Ill., 35 2,000 C. P. arc lights. Camden El. Lt. & Pr. Co., Camden, Ark., 650 alternating incandescents.

THE ELMER A. SPERRY CO., 205 Canal street, Chicago, are increasing the plant of the Consolidated Copying Company by the addition of one of their special 40,000 candle-power focusing lamps. The entire power of a 20-light dynamo is used to operate the lamp, the carbons of which are about one inch in diameter. The focus is maintained automatically. With the use of this lamp an entire print 36x24 inches can be made by an exposure of one fifth of a second.

MR. J. H. REID, Chicago, has secured the contract for the lighting plant to be installed by Messrs. Hanna & Hogg, in their Madison street building, in this city. The 35-light arc dynamos of the Easton system, and two 500-light incandescent dynamos of the Mather system are required. The engines, two of 125 horse-power each, are of the Phœnix type. The plant will be double throughout, one dynamo and one engine being held in reserve. The entire installation will cost about $25,000, and the building will be one of the best lighted in the city.

NEW COMPANIES.—The Electric Wheel Co., to manufacture metal wheels by the use of electricity. Capital stock, $25,000; incorporators, S. R. Emory, Jr., Thomas Hill, C. G. Comstock.

City Electric Lighting Co., Kalamazoo, Mich. Capital stock, $30,000; President, George C. Burnham; Vice-President, George E. Stockbridge; Secretary, G. I. Goodenow; Treasurer, Horace Prentice.

Electric Merchandize Co., at Chicago; to manufacture machinery used in the construction of electric railroads. Capital stock, $50,000; incorporators, Cyrus Emery, John L. Ludwig, Wm. R. Mason.

Waukegan Light, Heat & Power Co., at Waukegan, Ill. Capital stock, $60,000; incorporators, William Stubbs, Dewitt Stearns, W. L. Duston. F. M. I.

PERSONALS.—Mr. C. H. Talmage, a well-known electrician, of Kansas City, Mo., the inventor of the Talmage Electric Heater has opened an office as civil and electrical engineer in the Massachusetts Building, Kansas City. Mr. Talmage is now in the East, extending his circle of acquaintance.

Mr. W. J. Pilicy, the Eastern representative of this paper, has been appointed New England agent for the Card Electric Motor and Dynamo Company, of Cincinnati, O., whose motors have made such a fine record in the West. Mr. A. H. Walters, the General Manager of the company, has shown good judgment in his selection, as Mr. Pilicy is well known in the electrical field in the East, and will prove a strong acquisition to the company. His headquarters will be in the Cook Building, 146 Franklin street, Boston.

LONGEVITY OF UNDERGROUND CONDUCTORS.—The article printed elsewhere in this issue on the longevity of underground wires is an important one, and can be read with considerable profit by electric light people. The fact that our English cousins have found that iron ducts for underground conductors are the most durable, is one worth knowing. There is a good deal of iron piping underneath our streets, and a good deal of other kinds, but our experience with underground work has hardly extended over a sufficient length of time to prove which of our systems is the most durable. English experience in this regard, however, is valuable in that it gives some basis for comparison.

THE ELECTRIC MOTOR FOR IRRIGATION WORKS.—There are hundreds of thousands of acres of dry sterile land in California that is now worthless, but which with irrigation could be made fertile and highly productive. So it is proposed to bring water by the aid of the electric motor applied to pumps, and store it in suitable reservoirs, thus being independent of draught. These same motors could drive the machines to dig the ditches.

THE LAW TELEPHONE COMPANY.—We are in receipt of a handsome picture gotten up by the Law Telephone Company of this city, representing allegorically the World's Fair to be held in Chicago. The enterprise is a sure indication that the Law Telephone Company will do as much to make the World's Fair a success in Chicago as it would if the Fair were to be held in New York.

SOUND INDICATOR FOR VESSELS.—A large revolving funnel on the deck of a vessel receives the waves of sound caused by the movement of another vessel, on a membrane from whence they are transmitted by means of a microphone to a receiver where, with the aid of electro magnets, the point of compass from which the sound comes is indicated. The invention should prove very valuable in a fog.

REMOVAL.—Messrs. Zimdars & Hunt, the well-known manufacturers and dealers in pneumatic and electric bells, burglar alarms, etc., have moved their office to No. 127 Fifth avenue. This location is more central than the old, and the necessity of this move is indicative of prosperity.

FORT WAYNE ELECTRIC CLUB.—The Fort Wayne Electric Club, of Fort Wayne, Indiana, has just opened its club rooms. Within it lie the germs of power and influence in the great field of electricity. It has our best wishes for prosperity.

MUNICIPAL ELECTRIC LIGHTING.

Editor of THE ELECTRIC AGE:—In your issue of April 19th I notice a communication from M. J. Francisco, President of the Rutland Electric Light Co., on Municipal Electric Lighting, which I think is false and misleading to a painful degree. I am led to suppose from his article that the subject brought up in Rutland was for a street lighting plant and not for general commercial business. While I do not believe any city has the right to do a general lighting business, or that even if they did have the right that it would be at all wise, I do believe that any city, town or village has the right, and that it is extremely wise, to do its own municipal lighting in so far as the lighting of the streets, public buildings, parks, offices, etc., as well as furnishing the power for said buildings, offices, etc., but no further than this, and the line can as well be drawn here as elsewhere. Now the whole fact of the Rutland matter is doubtless the bringing up of some economical plan for stopping the flow of (blood) money from the city treasury (taxpayers) to M. J. Francisco *et al*, if one is to judge by the MONOPOLISTIC CROW at the end of the above mentioned article. There can be "no doubt, no shadow of doubt, no possible shadow of doubt whatever" but that many of M. J. Francisco's so-called taxpayers were well paid for their trouble in voting down such a plan, if he is to be believed, and in favor of town monopoly. And now to facts: I have nothing to say against the gentleman's arguments in favor of electric light, its prevention of crime, etc., they are mainly true; nor to the amount of capital invested in a good business, but here comes a false statement which we will designate No. 1. "Some party who desires a chance to dispose of a plant or secure a position raises the cry that the municipality should own and furnish the light." This is false from the bottom up, and if the gentleman knows no better than this he deserves to be forced to attend school again as his education is unfinished; aye, far from it, for many of the highest and most enlightened men of the nineteenth century advocate just what the gentleman weakly tries to argue against.

Does the gentleman claim that the author of the article in the New York *Independent* is writing solely to sell apparatus or to obtain a position. His position at Johns Hopkins, I should suppose, would be better than that in any city and the stand he takes is right whether his figures are or not. As for myself, I can safely say that I should be very sorry to exchange with M. J. Francisco if the plant was run so badly, with a town monopoly attached, if I could not make it pay at least 20 per cent. dividends annually, even with coal at $5 per ton. I think, without self-praise, that I can safely say that I have seen as many electric light plants which are paying, and have paid ever since their erection, as high annual dividends as 15 per cent. on the actual money invested, as the gentleman has plants paying less than 15 per cent.

Now, for false statement No. 2. "The electric light companies have been held up as monopolies, yet with all their extortions the records show that the average return or dividend received by these bloated monopolies has been only about two per cent., thus showing that they have proved of greater benefit to the public than to their stockholders." What records show this? Where are they to be found? Are the personal and household expenses of the officers added into the *gross* expenses and the two per cent. then found? Is this the dividend paid upon the authorized capital which often amounts to from five to fifty time sactual capital invested? Some one, two or all, must be true or else the two per cent. dividend is untrue. Would any man, woman or even child be foolish enough to put money into an investment which will only pay two per cent. at its best, and which is more likely to run behind if the gentleman knows whereof he writes, when there are thousands of safe investments for any amount of capital which will pay double and treble two per cent.? Why, even Government, State, City or town bonds pay better than that and are as safe as if they had the money in their pockets? What God-like, Christianily, unselfish "do-as-you-would-be-done-by" people these stockholders are, who are saving, working, worrying and losing their money that the rest of their fellow men may be benefited! Why, the presidents, secretaries, treasurers, and stockholders should stand high above the rest of us poor, groveling, take-care-of-ourselves mortals, and are on an equal footing with the twelve apostles. Where in all the rest of mankind will you find a record like this? Are these gentlemen not deserving of medals, public honorable mention, fame, and to be sainted; in fact, to be handed down to future ages as angels in disguise whose abode on this poor earth was a mistake? *No!!* The officers and stockholders of electric light companies are no better than the rest of mankind, who know a good investment when they see it. How can a company pay bonuses to city officials often amounting to hundreds of thousands of dollars to obtain franchises, contracts, etc., when even if they obtain them (which is often doubtful), they will only pay two per cent.

Statement No. 3. Can a city secure labor or buy material or dynamos any cheaper than a corporation? Labor, certainly not; but material vastly cheaper, by reason of unlimited credit and ability to buy and pay for in greater quantities. If, as the gentleman states, Boston companies pay $4 or $5 per ton for steaming coal some one is being swindled. Here, in this city, we can get Scranton, etc, coal which steam at 2.5 lbs. per indicated horse power per hour for less than five dollars, while the distance is over six times as great, and yet Minneapolis pays $30 per lamp per year less than Boston, and the company somehow manages to pay a very good dividend, and even with the under-book-keeper as manager. This company pays heavy taxes as well as Boston companies.

Will the gentleman of Rutland answer for me the following questions, which I must confess are an enigma to me, as there appears no reasonable solution to the quesrions? What does the Chicago city water-front plant cost per year to run, total and per lamp? Prof. Barrett says $50, all night and every night. Why does Milwaukee pay $150 per year, all night, and Racine, Wis., with a less number, only forty miles south, only pays $70 for the same time? Why Reading, Pa., $164; Erie, Pa., $146; Wilkesbarre, Pa., $144, and Harrisburg, Pa., only $93? Is Harrisburg, Pa., nearer the coal fields than the other cities? Why Council Bluffs, Ia., pays $240 for moonlight schedule while Davenport only pays $145 for the same light, or De Moines' lights all night and every night for $120? Why the actual city treasurer's reports of municipal electric light plants in Bay City, Mich., Lewiston, Me., Michigan City, and Madison City, Ind., and Chicago, all fall below $60 per year, all night running? Can the gentleman prove that Ypsilanti pays nothing for water power? If electric lights run by the city of Topeka, Kan., actually cost $132 per year, which I very much doubt, there is serious need of a thorough overhauling of the plant and *attachés* or else a few removals and indictments of city officials for boodle practice in that enterprising village.

I was recently called upon to make out specifications for a city plant of 7,000 20-C. P. lamps to be erected in the city of Minneapolis; 300 H. P. steam and 450 H. P. water. These specifications were made out for both low pressure constant current and high pressure alternating transformer systems. The cost, including everything except buildings, and inclusive of 60.25 miles of underground conduits of various sizes, municipal lamp posts and everything in running order, the total of which was for C. C. two wire system, the sum of $436,960.15; while that of the high potential two wire alternating system was $222,581.35; or, per lamp the C. C. was $63.25, and the alternating $32.60. This was for enough lamps per block to equal one arc lamp at each street junction, at which rate the surface covered would equal 38.89 miles of solid street lighting. The running expenses of said plant, including *all expenses*, with twelve attendants whose salaries would range from $720 to $2,500 per year, steaming coal suitable to steam at 2.5 pounds per I. H. P., and the cost of six mill powers at $1,000 each per year was also calculated and found to be as follows—either system:

Grand total per year,		$26,650.840,	without int.
"	day,	73.111	"
"	hour,	5.954	"
Total per H. P. per year,		38.072	"
" "	day,	.104	"
" "	hour,	.007	"
" lamp,	year,	3.807	"
" "	day,	.010	"
" "	hour,	.0007	"

Grand total running expenses, including 4 per cent. interest, was: alternating system, $35,554.09; constant current system, $44,129,250.

This plant will take the place of 875 arc lamps of 5,000 nominal C. P. each, which would cost at present prices the sum of $131,250.00, or 8,000 gas lamps costing $116,000.00. Some slight difference, and even if our and council and city officials were so dishonest as to each take $2,000 a year we should still be on the top with a dividend of nearly 5 per cent.

I only have one thing to say in reference to the gentleman's reference to Philadelphia, that if they have sunk $3,500,000 in the last six years which I *do not* believe, the city of Brotherly Love is run by as rank and unrighteous set of thieves and sharpers as ever escaped from a penitentiary; as any one who understands gas-making knows well that the net cost of 1,000 cubic feet of gas is less than 10 cents. If the Rutland Electric Light Company pays $4.25 per ton for steam coal they are allowing themselves to be shamefully swindled, and if they are not being swindled the president of the Rutland E. L. Co. ———. "The taxpayers of Rutland displayed their 'foolishness' when they voted at the annual meeting by an overwhelming (?) majority," to re-burden the village with a monopoly.

J. M. LENNON, E. E.,
Minneapolis, Minn.

A MAGNIFICENT ENDOWMENT.—The Drexel Institute, for the construction of which in West Philadelphia, contracts have just been signed, is to be lighted throughout by electricity. The engines and dynamos will occupy the central part of the basement under the central hall. They will be used for the instruction of the pupils in electric lighting. Electrically-driven fans will ventilate the entire building. Seventeen hundred incandescent lamps will be required to light the building. The contract for the electric light plant was awarded to M. R. Muckle, Jr., & Co., of Philadelphia. Mr. Drexel's gift, when complete, will have cost $1,500,000.

ELECTRIC BELTS SWINDLE.—Judge Sage, of the United States Court, has sentenced a swindler to pay a fine of $500 and fifteen months in prison, for selling "electric belts." It is hard to make people understand why the belts cannot hold any electricity.

A BIG DYNAMO.—A philosopher advances the theory that the earth is a big dynamo, and by virtue of its dynamic action electricity is drawn into it. This doesn't account for so many shocking things happening on this earth; but it may explain why our girls are so attractive.

BRITISH INSTITUTION OF ELECTRICAL ENGINEERS.

A DISCUSSION OF MESSRS. SWINBURNE'S AND ESSON'S PAPERS.

The general discussion on the papers read before the British Institution of Electrical Engineers recently, on "The Theory of Armature Reaction on Dynamos and Motors," by Mr. James Swinburne, and "Some Points in Dynamo and Motor Design" by Mr. W. B. Esson, was very interesting.

Before the commencement of the discussion proper, Mr. Esson made a few remarks on the construction of the armature cores in the machines used as dynamos and motors. The Gramme and Pacinotti, he said, were built up of thin discs, whilst the Burgin had wire cores carried by six armed spiders. He thought the great difference between the E.M.F. of the latter when used as dynamos and motor might be due to the iron wires having been brought into electric contact by forcing the spiders in the rings and thus causing parasitic currents. He also corrected an error made in stating Mr. Ravenshaw's rule where, instead of the ampère-turns being 24 and 48 times the area of the field magnets, 35 and 70 times the area of the armature cores should be substituted. With reference to this rule, Mr. Esson said, if it were true, then by doubling the length of an armature the load might be doubled without giving rise to sparking. In his opinion the ampère-turns should remain the same. Again, Mr. Ravenshaw's rule would, when applied to similar machines give the ampère-turns on armature proportional to the square of radial depth of core, whereas this was shown to be proportional to the first power of the depth.

Professor Ayrton then made some pertinent remarks. As regards magnetic lag, this, he said, had often been denied, but quite recently, Professor Ewing had shown that such did occur, amounting in some cases to several minutes. With reference to the increased resistance of revolving armatures due to self-induction, he thought some misunderstanding existed, for Mr. Swinburne in his paper says that "power cannot be lost by self-induction." In their original paper, Prof. Perry and himself had given a formula for calculating this loss when the brushes were placed at the neutral position, and this they confirmed experimentally. When, however, this condition is not fulfilled, a modification is necessary. If the brushes could be placed at an absolutely non-sparking position the resistance of the armature would not be increased by rotation, for then a section leaves the brush and is thrown into circuit with the proper current in it and hence no further E.M.F. is needed to bring the current up to its proper value. In fact the energy used in starting the current is supplied by the belt whilst the coil is short-circuited. He also said that in a dynamo with sparkless lead, the coils between the neutral line and the brushes acted as motor coils and assisted the rotation of the armature, whereas in a motor they act as dynamo coils and oppose the rotation.

As regards the question whether motors should or should not be made different from dynamos, the speaker said that in an Immisch series motor run as a dynamo and as motor at the same speed and current the E.M.F. (neglecting self-induction) was 14 per cent. greater as a motor, and when the maximum possible effect of self-induction was allowed, a difference of 10 per cent. still remained. This has since been confirmed by measuring the induction in the field magnets, both when a current was sent through the magnet coils alone and then through both magnets and armature, the latter revolving at 1,400 revolutions as a motor. In the latter case the induction was 5 per cent. greater than in the former. Experiments on the characteristics of a magneto Gramme used as a generator and as a motor with equal lead and trail, shows that as a dynamo the curve falls, as in Fig. 15 of Mr. Esson's paper, whereas as a motor the curve rises with increase of current. On trying the same experiment with a separately excited A Gramme the E.M.F. as a motor always increased with the current through the armature, whatever the strength of exciting current used, but as a generator the E.M.F. always decreased, and with a weak field became negative when the armature current increased. In conclusion, Prof. Ayrton contended that the above experiments, as well as those of Mr. Esson on the Bürgin machine, proved conclusively that a relatively powerful armature strengthens the field of a motor and weakens that of a dynamo.

Mr. Ravenshaw said as regards Mr. Esson's expression for the ampère-turns, which may be carried on an armature, he could not say that it held good in practice. He himself had experimented a good deal on the subject, and the results seemed to point to the fact that for all sizes and shapes of well-designed machines, their behavior at the brushes would be very similar when the ratio between the ampère-turns and the total induction in the armature was the same.

Mr. A. T. Snell, speaking of machines run as dynamos and as motors, said he always found it possible to get a greater output at a given speed when running as a motor, and that the trail as a motor was always less than the lead as a dynamo. In fact, with motors used for tramcars they worked without lead, and run in either direction with the same pair of brushes. Another point in which motors differed from dynamos was the possibility of using very thick brushes with advantage in the former, whereas in the latter such a proceeding proved disastrous. These differences seemed to him to show that the magnetic distribution in generators and motors are not the same, and that in dynamos the field was more straggling and subject to greater distortion. Referring to Mr. Esson's formula for the loading of armatures Mr. Snell said he had tested it on machines with which he was acquainted, and although he found a certain agreement, this was by no means so close as the numbers given in the paper. He had himself been in the habit of using the formula

$$\text{Electrical horse-power} = l\, d^2\, n\, K,$$

where l and d are the length and diameter of the armature, n the speed, and K a constant; and this gave close approximations where the armatures have the same proportions. Alluding to rise of temperature in large machines after long runs, he mentioned that in some machines designed to work between 50 and 100 horse-power this amounted to 50 deg. Fahr., the temperature being taken on the wire on the inside of the cylinder armatures.

Professor Ayrton exhibited curves, representing results of experiments on the Gramme-magneto and Gramme dynamo when run as motors and generators. Another curve showed similar results obtained with a Manchester dynamo separately excited with half its normal current. In this machine, run as a generator with a lead of 11deg., the E.M.F. decreases with increase of current in the armature, whereas when run as a motor, with a trail of 11 deg., the E.M.F. rises under the same conditions. From these observations he concluded that Mr. Swinburne and Mr. Esson were wrong in saying that the back E.M.F in a motor could not be greater than the forward E.M.F. in a dynamo working under the same conditions as to speed and current. The secret of obtaining this increased E.M.F. in motors was, he believed, the employment of a relatively powerful armature.

Professor Forbes could not accept Mr. Swinburne's statement that self-induction *prevents* waste of power, for all sparking is due to self-induction, and consequently it *causes* a waste of power. Another point about which he had grave doubts was the efficiency of the method of throttling cross-induction. He congratulated Mr. Esson on the many experimental results given in his paper, and on the valuable and interesting way in which he had treated the subject of loss by hysteresis, and the distortion of the field produced by the armature current. His own experience with non-commutating dynamos had brought the latter phenomenon prominently before him, for he had found the E.M.F. at full load to be about half its value at no load. This he attributed to the fact that a given demagnetizing force produces a much greater change of induction than that produced by an equal magnetizing force when the iron is not saturated.

Mr. Sayers questioned the accuracy of Mr. Swinburne's view of the action of coils short-circuited by the brushes, and thought the various statements were not consistent. The real effect was a diminution of the induction in dynamos, and an increase in motors. One serious cause of sparking, which had not been referred to in either paper, was the want of accuracy in making all the sections and commutator bars exactly alike, and spacing them with rigorous exactness round the armature. In his opinion, nothing short of the accuracy obtained by engineers in cutting wheels would effectually overcome sparking. Neglect of such precaution causes variation in the non sparking position, the result of which may sometimes be seen in some segments being marked whilst the other remain perfect.

Remarks were made by many other members, and the discussion closed.

THE TATLOW BATTERY.—This battery is composed of zinc and peroxide of lead couple in dilute sulphuric acid. The peroxide of lead is obtained as follows: A lead foundation plate is filled in with a paste of lead oxides, made of red lead and sulphuric acid, or litharge and lead acetate solution—a plate, in fact, similar to an ordinary storage battery plate. When the paste has set hard the plate is placed in a solution of chloride of lime, whereby the salts and oxides of lead are gradually oxidized to lead peroxide, the rapidity of the reaction depending on the temperature and degree of concentration of the solution. It is absolutely necessary that there should be enough free lime present to keep the liquid alkaline. When completely oxidized the plate is taken out of the solution, well washed, and is ready for use in the cell, given with zinc and dilute sulphuric acid an E.M.F. of 2 to 2.3 volts. After the plate has ceased to be active it is to be washed and returned to the hypochlorite solution. The same plate thus serves again and again, acting as a carrier of oxygen between the hypochlorite and the zinc. The reaction in the hypochlorite solution possibly involves the formation of a lead or lead-calcium hypochlorite during the process.

THE MARX ACCUMULATOR.—The principle of an accumulator recently brought out by Herr Marx, of Berlin, is briefly as follows: If an electric current is passed through a dilute solution of hydrochloric acid and perchloride of iron, in which are immersed carbon electrodes, the following reaction takes place: $2\,FeCl_2 + 2HOP = Fe_2\,Cl_6 + H_2$. If, then, a carbon and an iron electrode are plunged into the electrolyte the following reverse action, giving rise to a powerful current, takes place, $Fe_2\,Cl_6 + H_2\,O = 2\,FeCl_2 + 2\,HCl + O$. The perchloride may be prepared by taking 450 parts of protochloride of iron, 900 of water, and 500 of hydrochloric acid (25 per cent.) The perchloride can then be concentrated, or even crystallized by evaporation, and in that state may be carried about. The carbon electrode in the second case must be very porous, or pierced with numerous holes. The iron electrodes are not consumed; on the contrary, an open circuit iron is deposited on them, so that they must be removed when the battery is not at work.

THERMO ELECTRICITY.—A hot metal placed in contact with a cold piece of the same metal produces a difference of potential.

ELECTRICAL THEORY OF THE UNIVERSE.

At the recent meeting of the Chatauqua Society of History and Natural Science, Henry Raymond Rogers, M. D., of Dunkirk, N. Y., read a paper on sun heat and sunlight, in which he advances a novel and ingenious theory regarding the origin of electricity in nature.

After referring to the revelation of electricity to mankind 2,500 years ago in the amber, and the nature attributed to it through different periods of the world's development, he comes down to the present day. "Electricity," he says, "is not a self-existent entity; it cannot exist without a cause. Whether developed on the scale of the universe, or of the atom, it must be the product of the same causes and subject to the same laws. * * * The earth is a vast magnet and the atmosphere is more magnetic than any known substance except iron, nickel and cobalt. This terrestrial, magnetic ball is thus *filled to repletion* with this stupendous force. If the strength of a magnet may be judged by its dimensions what must be the amount of power contained in the earth, the sun, and all the starry dynamo-magnets? When we contemplate this power we become astounded, staggered!

The whole universe is made up of in conceivable magnetic force. Though the sun and earth are separated by the distance of 93,000,000 miles, yet electrical currents traverse that immensity of space with as perfect facility as if those bodies stood side by side. The instantaneous and incessant action between sun, earth and all the starry host is one of the most vital and fundamental principles in physical science. Yet, notwithstanding the fact that this principle has been repeatedly demonstrated and publicly announced and, in fact, is a fundamental principle in gravity, it has been utterly ignored and disregarded as an element in the great cosmical problem." He then cites as proof of this the simultaneous electrical disturbances on the earth with the appearance of sun spots.

"The distinguished scientists, Zantedeschi and Barlocci," continues Dr. Rogers, "demonstrated that magnets both acquire and lose strength as their poles are relatively exposed to the direct rays of the sun; gaining strength, even more than doubling it, when the north pole is exposed, and losing strength when the south pole is exposed. These effects were intensified by the use of a lens. To produce these effects it is clear that the sun's rays must be electrical, or magnetic, as the sun could neither add to, nor take from, the power of the magnet except its rays were of a like character. These experiments are invaluable to science as rare and exact data. They were misinterpreted by their authors when they attributed their results to the action of the sun's *light*, instead of its electrical currents.

The foregoing facts must be accepted as actual demonstration that there are incessant inter-actions between the sun and earth, and inferentially between all celestial spheres, and that such inter-actions are electrical, of electrical origin and governed by electrical laws. Distance as between the celestial spheres is thus practically annihilated, and consequently sunheat, sunlight, gravity and chemical action, must be developed and act, precisely the same at Neptune, nearly 3,000,000,000 miles distant from the sun, as at the earth, only 93,000,000 miles distant.

That grand old master in science, Aristotle, has told us: 'All terrestrial phenomena, every conceivable form of force, must be referable to the impulse of the motions of the heavenly spheres,' and a more recent and also a distinguished authority in the field, Wm. H. Preece, F. R. S., London's electrician tells us: 'All physical phenomena, without a single exception, may be traced to the mere transformation of the electrical energy.' Most fortunately for science, both of these assertions are now abundantly demonstrable. Since space and distance are practically annihilated, and electrical currents play freely to and fro between sun and earth and all celestial spheres. Therefore these *missing links*, these fundamental factors in the problem of the universe being supplied, its solution becomes simplified. It is merely a matter of the practical application of well established electrical principles.

The questions now arise! How can the motions of the sun and stars be trasmuted into every form of motion, or force, both of worlds and atoms and whence the source of the electrical supply for all demands of the universe?

The electrical laws which hold here on this earthly platform, hold also throughout the universal domain. Our study of practical electricity has been the study in miniature of the grand operations of celestial spheres. It is a fundamental principle in electrical sciences, that the rotation of bodies opposite to magnets, induce circulating electric currents. Upon this principle is constructed the dynamo-electric machine, with which we are now so familiar and which gives to us our electric light, heat and power. This machine is constituted essentially of two parts, viz.: 1st, a revolving armature; and 2d, stationary magnets. An armature consists simply of a piece of soft iron wound around with very many turns of covered wire, this armature revolving with great velocity, *near* to, but *not touching*, the magnets, develops electricity ready to be carried from the machine by wires, on its mission of light production and other work.

Guericke and Volta experimentally demonstrated that, 'every movement of one body *near* another, disturbs and puts in motion the electric current *in both bodies.*' Extending this law from the lesser, or terrestrial, to the grander, or celestial field, the inference becomes legitimate, that the heavenly spheres, whirling with inconceivable velocity in space, evolve between them electrical currents in Great Cosmical Circuits, that the sun and earth (which stand practically, '*near to* but, *not touching* each other') revolving with such inconceivable velocity thus become actually vast dynamo-electric machines, or batteries, through the action of which, currents incessantly pass to and fro between those bodies. Inferentially, this process is universal. Thus is verified that grand conception of Aristotle, viz.: that the Universal Force has its *source in the Motions of the Celestial Spheres.*

An important element in electro-dynamics, is *resistance.* Heat, light and power are developed through the agency of resistance to the passage of the electric current. The current devoloped by the dynamo-electric machine, shows no evidence of its existence while its passage remains unobstructed. The machine itself and the conducting wires are dark and cold, but through the resistance offered by the "carbon-point." and "platinum coil." its unseen powers are brought into manifestation. The electric currents incessantly coming from the sun through the darkness and cold of space find their first *resistance* in our atmosphere. This magnetic atmospheric mass thereby becomes awakened into heat, light and power. The sun's current, like the current of the little dynamo machine, is invisible; gives no manifestation; passes through spaces like electricity through wires. Without being itself hot, it develops heat in our atmosphere, and without being itself luminous, it develops light therein. *In this process is therefore demonstrably shown, both* THE SOURCE, AND MODE OF DEVELOPMENT, OF SUNHEAT AND SUNLIGHT.

Thus, sunheat and sunlight are the results of an electric system which differ from the Edison and Brush patents, only in the stupendousness of its scale.

We may no longer claim that the vast power of the sun resides in itself alone—that heat and light both proceed forth from it in all directions, and to all distances, as from a great center. These questions are now virtually settled, and forever, through the laws of conservation of force. This law stands as a demonstration of the fact that neither power nor influence can go out from the sun in *any* direction, through the instrumentality of force *inherent in itself.* It follows therefore, that so far as the sun alone is concerned, neither heat, light, nor gravity, have even an existence. According to this law, all celestial bodies hold to one another the relation of *inter-dependence.* If, for example, sunheat is developed at a planet, both sun and planet must necessarily share in its production, each in the ratio of its mass. So also of light, gravity, etc.

The terms "radiation," and "emission," now so constantly employed by scientists as signifying the sending, or throwing out, of heat and light by an inherent propulsive power resident in the sun itself, are baseless, and therefore, wholly misleading. The wastefulness implied in the current theory of universal radiation is altogether beyond computation, involving as it does, the most prodigious and inconceivable squandering that science permits us to contemplate; even the complete destruction of cosmical equilibrium.

Any cosmical theory which involves waste, stands already self-condemned, and should not for a moment be tolerated, yet strangely enough, *actual dissipation, or waste,* is a fundamental element in every system of physical philosophy, hitherto advanced.

Conservation is the very essence, or soul, of the electric law. Electricity cannot move from atom to atom, or from world to world, except a return current of equal magnitude and power quickly follows. It cannot move except in a circuit. Herein is a perfect exemplification of the law of conservation. The electrical theory herein advanced is the only great cosmical theory which involves no waste. This theory will be found in entire harmony with every demonstrated law or principle, or fact now known to science: *ergo, The Electrical Theory* is the only rational theory of the universe.

According to this theory the sun may heat and light the earth, and still be a dark, cool, habitable body."

ELECTRICAL STORM AT SEA.—The passengers on the Cunard steamer Aurania, which arrived at this port on April 28, were treated, on the voyage, to an unusual spectacle. When eighty miles off Fire Island, Sunday night, in a dense fog, the ship ran into a great electrical storm. For three-quarters of an hour the lightning flashes were almost continuous, and the thunder terrific. In spite of the fog the lightning was blinding in its brilliancy. One of the officers describes the phenomenon as follows:

"The continuous light looked through the mist as if some one were swinging a gigantic lantern behind a curtain. This of itself was very bright, enabling us to see the rigging with distinctness and the sea for a wide space around. There was no wind and hardly a noticeable swell on. At frequent intervals, certainly no more than a few seconds, there came vivid flashes so bright that we seemed to be looking squarely at the sun. These were accompanied by loud thunder claps, some of the loudest I have ever heard, and for that matter I have never seen so continuous a display of lightning at sea or anywhere else. I do not think that more than two or three passengers came out of the cabin, for the rain was drenching and the thunder terrifying. There was no danger of any consequence to the ship. We moved out of the electrical storm, or it moved away from us, at about 10:15, after which the night was perfectly dark and the rain continued for some time longer. I saw no fire balls or other illumination of the yards, except the natural reflection of the water drops, which made yards and rigging glisten at the edges."

ELECTRICITY EVERYWHERE.—Electricity has invaded our steamboats, railway cars, workshops, factories, stores, offices and homes. It has now invaded our prisons. The Tombs in this city is being wired for electrical purposes.

ANSWERS TO INQUIRIES.

Editor of THE ELECTRIC AGE:—Can you inform me how much surface there is on one mile of No. 8 galvanized iron wire and on the same length of No. 6, and oblige. J. H.

ANSWER.—228.04 square feet on No. 8; 280.37 on No. 6.—Ed. ELECTRIC AGE.

Editor of THE ELECTRIC AGE:—What is the largest number of alternations per minute in a dynamo? I have been told that there is a dynamo which gives a million or more alternations per minute. If that is correct, what dynamo is it? H. WRIGHT.

Pecouic, L. I.

ANSWER.—Probably the Gordon Dynamo is the one referred to. It is the most powerful yet constructed. When run at maximum speed it gives 1,474,560 alternations per minute.—Ed. ELECTRIC AGE.

J. V. R. asks what advantage there is in constructing dynamos whose magnets are made to revolve instead of the armatures as in most machines. The advantage gained by the revolution of the field magnets instead of the armature consists in the fact that the rotating disc can be made stronger and more massive. In the construction of armatures it is desirable to use a minimum mass of iron for important reasons.—Ed. ELECTRIC AGE.

"STUDENT," New Orleans. In the condenser the discharge is always opposite in polarity to the charging current The static charge of a wire varies accord ng to leakage and moisture. In damp or wet weather there is practically no static discharge from a wire for the reason that it is dissipated rapidly in the surrounding atmosphere. The drier the atmosphere the more pronounced is the static discharge. The resistance of a given wire changes but slightly with changes in temperature. You probably mean decided change in *insulation* when you say "decided change in *resistance.*" It is a common error to say, in wet weather for instance, that the resistance of the wire has changed. The fact is the resistance does not perceptibly change but the *insulation* decreases. Under these circumstances the static discharge would vary.—Ed. ELECTRIC AGE.

A. D. H.—"Buckling" in storage batteries is caused by the formation of sulphate in discharging, which produces unequal expansion.—Ed. ELECTRIC AGE.

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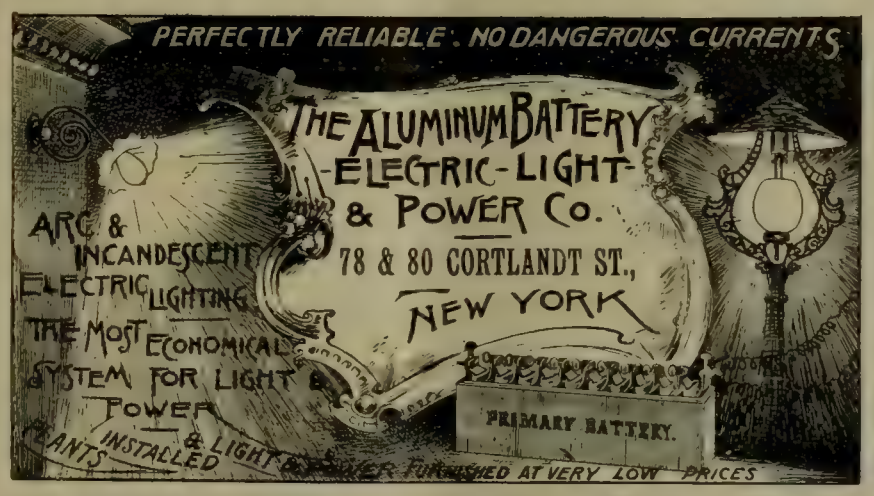
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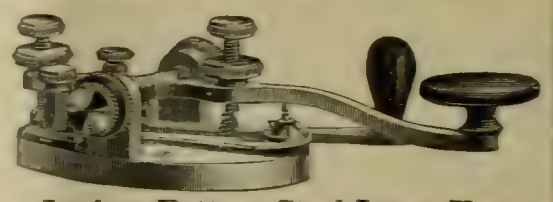


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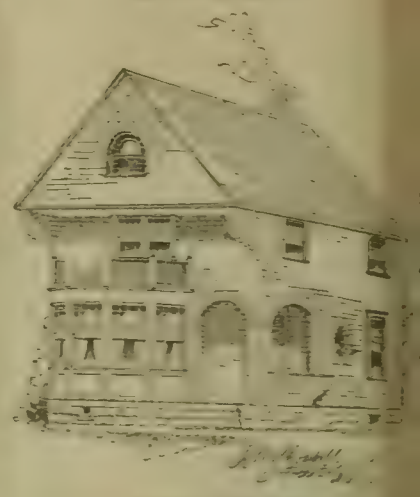
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NEW YORK, MAY 17, 1890.

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ELECTRICITY AND INSURANCE.

At the annual meeting of the National Board of Fire Underwriters which took place in this city a few days ago, a remarkable report was made with reference to what was called the danger of fire from electric wires. The figures astonished those present at the meeting as much as those outside. Electric light people will naturally look upon the figures with considerable distrust. and well they may, for there is a wide difference between the facts in this report and those that were accepted as correct from an electric light standpoint.

The figures showed that the losses from fires caused by electricity had increased from $460,-59 in 1886, to $5,553,820 in 1889 This showing is indeed startling, on the face of it, but the fact is that, if the real fire losses chargeable to electricity could be ascertained the amounts would be far less than those given, particularly in the case of the latter year.

Before electricity was introduced for lighting purposes there were hundreds of fires started that were charged to unknown causes. The same, if not greater percentage, of such fires occur to-day, but as electricity is yet to a great extent looked upon with considerable suspicion by those who understand it least, and by many who ought to understand it better, it has become fashionable to charge fires from unknown causes to electricity. No doubt. some are attributable to this cause, but by proper care and workmanship none need occur. The trouble in the past has been that the work of running wires and performing much electrical work that should have been done by experts in electrical knowledge was done by inexperienced and irresponsible persons. Naturally enough trouble would result.

No one would engage a butcher to put gas pipes into a building. If he did, the gas from the leaky pipes would sooner or later be the cause of fire, and the property would be destroyed. It is a simple matter to obviate all danger in using large electric currents, but the work attending the introduction of such currents into buildings must be done by responsible persons, and their work afterward inspected. The sooner the insurance companies wake up to the necessity of seeing to it themselves that this class of electrical work is properly attended to, the sooner will their distrust in electricity be overcome. Electricity is here to stay, and everybody interested must conform to the new condition of things. Electricity is moreover harmless to life and property when properly handled.

As to the figures of the report in question, we can only say that they will likely be looked upon by electric light people as untrustworthy. No doubt the compiler of the statistics truly believed that his data were perfectly reliable and accurate. The report is from an insurance standpoint as against electricity, and a report from the other side would, we think, materially alter the showing.

GELATINOUS ELECTROLYTE FOR ACCUMULATORS.—The *Elektrotechnishe Zeitschrift* says that the Oerlikon Works have for some time been using accumulators having a gelatinous electrolyte formed by treating potassium or sodium silicates with sulphuric acid. The resistance of the cell is practically the same as that of the liquid ones, and the chemical reaction is the same in both. The treatment of the cells remains as before, except that they are charged at constant potential instead of constant current. The advantages of the new form are that no gas is evolved, short circuiting through the dislodgement of the active mass cannot occur, and breakage of the glass does not immediately incapacitate the cell. The efficiency is stated to be from 80 to 95 per cent.

THE MINNEAPOLIS ELECTRIC ROADS.—The electric railway system which is being introduced in Minneapolis is somewhat different from that in other places. A single line of poles, with a cross piece on the top, will be erected in the center of the street between the tracks. These will carry the trolley wire. The circuit feeders will be placed underground in conduits, and connections will be made at suitable points. The contract calls for 100 miles of lead-encased cables for underground use, and 100 miles of wire for overhead use.

THEFT OF A LIGHTING PLANT.—A Parisian paper gives an account of a case of theft which was remarkable owing to the size, weight and character of the stolen goods. A battery of accumulator cells used in lighting a variety theatre in Paris was stolen, and could not be found or traced for a long time, when, finally, they were returned as mysteriously as they disappeared. There were thirty-eight cells, with a total weight of over twelve cwts. How the battery was removed without attracting attention remains a mystery.

MUNICIPAL ELECTRIC LIGHTING.—The discussion going on in this country as to the wisdom of municipalities controlling electric light plants for public lighting is not confined to our borders alone. We find the question is receiving considerable attention in other countries as well. In Germany the matter has received very thorough consideration, and elsewhere in this issue we print a report on the subject by Herr J. Baumann, of Munich, which no doubt, will be read with considerable interest and profit.

BID ACCEPTED.—The Standard Underground Cable Company's bid for the supply of wire for the New York Fire Department, at $47,771,59 has been accepted. The specifications cover the furnishing and laying of 650,000 feet of No. 14 conductor in standard lead covered underground cables braided and painted with P. & B. paint, also the laying of 30,000 feet of two inch pipe.

ENGLISH CONSERVATISM.—In discussing the subject of electric welding, the London *Electrician* takes occasion to make some observations on the conservatism of English manufacturers and business men. Referring to the activity and wide-awake character of the Americans, it says: "In England the mind of the average man moves more slowly. A British manufacturer hears of a new process; and because it is new he pooh-poohs it. He will wait until some one else has tried it, and lost money over it or gained, as the case may be. Not until he finds his own business suffering does he seriously think about adopting the innovation; at least, too often this is his way. But in a new country, where new things are snapped up, and tried simply because they are new, novel inventions have a much better chance of getting a fair trial on a practical scale; they flourish and become large industries in an incredibly short time. It will hardly be believed that at Lynn there exists a very extensive factory, employing several hundred hands, not only capable of producing, but actually turning out, one welding machine per week. Yet such is the simple truth."

ELECTRIC MOTORS ON GATLING GUNS.—Electricity is becoming an important factor in all calculations pertaining to warfare, and should there ever be another war between two of the foremost nations electricity would certainly perform a very important part in the operations. The latest conception in this line is the firing of Gatling guns by electric motor power. The Crocker-Wheeler Motor Company now have in their new shop a Colt Gatling gun, to which they propose to attach one of their motors, by the operation of which it will be possible to fire 1,000 shots per minute. The heating of the barrels will be the only limitation to rapidity of firing. By the hand method it is possible to discharge 500 shots per minute. One thousand shots a minute would soon annihilate an army.

THE IMCHENETZKI BATTERY.—In this battery the exterior containing cell is of tinned iron, with a base of cast iron. The interior cell, open at the base, is of paraffined cardboard, and contains eight porous diaphragms. Melted paraffin wax is poured at the bottom of the first cell, and when this is cold the second is introduced. There are thus nine compartments perfectly insulated, of which four contain sulphite of soda with plates of zinc, and the other five are filled with chromic acid with electrodes of specially prepared compressed graphite. In certain types both electrodes are of graphite. The E M.F. of this battery is 2.12 volts, or 0.8 volt if both electrodes are of graphite. The battery, when short-circuited, gives a very constant current for several hours.

CHANGE OF ADDRESS.—We are advised by the Sprague Electric Railway and Motor Company, that they have temporarily discontinued their Philadelphia office, and that all business will hereafter, until further notice, be conducted directly from their New York office at 16 & 18 Broad St.

The Weston Electrical Instrument Co., of Newark, N. J., have recently moved into more spacious and better appointed quarters at 114 William St. The excellence of their goods is attested to by the thriving business now being done by this establishment. Their voltmeters and ammeters particularly are giving general and well deserved satisfaction.

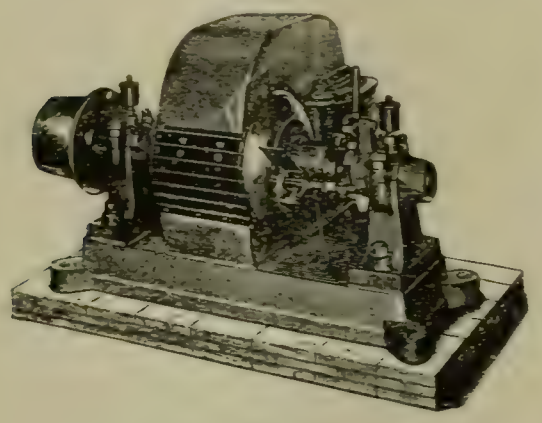
OPENED AN AGENCY.—The Economy Foundry Company, of Syracuse, N. Y., have opened an agency in this city, at No. 265 West 24th street. This company manufactures superior grades of iron castings, and pays particular attention to dynamo and motor castings. Mr. J. W. Ellsworth has been appointed the New York representative of the company.

CALL THEM "HENRYS" AND "FRANKS."—A number of scientific gentlemen are discussing the question of giving the names of Henry and Franklin, and perhaps some other Americans, to the electrical units which have not yet been definitely named.

HAUBERG'S DYNAMO AND METHOD OF COMPOUNDING.*

Amongst the numerous improvements in the construction and making of dynamo machines, the application of cast iron in the field magnets is certainly of importance. It has made it easy to build even very powerful dynamos cheaply by casting in one piece the field magnets and frame, and thus avoiding any division or interruption in the metallic part of the magnetic circuit The weight of copper on the field magnets is also reduced, although one would think that the larger section of cast iron would increase the length of the windings. However, the more perfect proportions in the well-constructed dynamos of the latest date explain this.

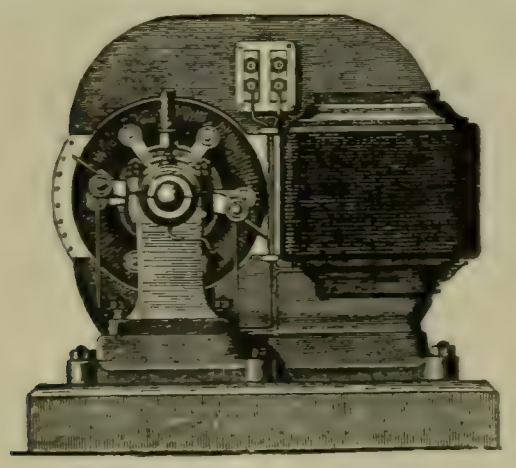
The figures show a dynamo constructed by Mr. S. C. Hauberg (Messrs. Koefoed and Hauberg, Limited, Copenhagen); it is entirely made of cast



HAUBERG'S DYNAMO.

iron of selected brands, and is as plain and compact as possible. The field magnet is of the horseshoe shape, cast in one piece with the frame; the wire for exciting the magnet is wound on the vertical part of the magnet. This shape gives the shortest way for the lines of force, and there is no interruption in the magnetic circuit except the space between the pole-shoes and the armature; this allows a very solid construction and an extremely accurate run of the armature without vibration, and with but little distance from iron to iron in the magnetic field. It also enables the winding of the wire to be done on a common turning lathe.

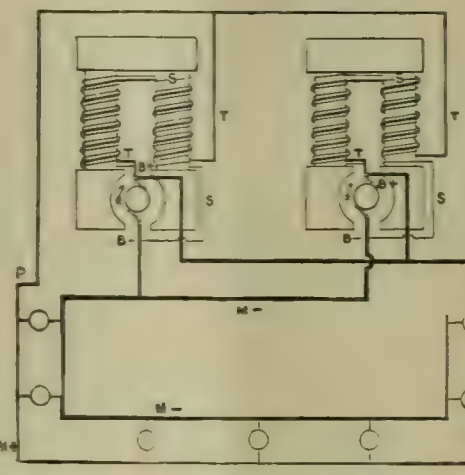
To show how small the weight of copper is on this type of dynamo, we give the following example from a private electric installation in Copen-



HAUBERG'S DYNAMO—END VIEW.

hagen, which required two dynamos, each able to supply the current for 1,000 lamps of 16 C. P. The dynamos are working with 100 volts at the lamps, and give a current of 500 ampères when running at 500 revolutions per minute. The armature has a diameter of 23½ inches, and is 29½ inches long; it is wound as a Gramme ring with 88 copper bars, divided in a suitable manner to avoid any heating through Foucault currents; the copper bars are connected with a commutator divided into 88 parts. The field magnet has a section of 12 inches × 29½ inches, and is wound according to a new system to obtain self-regulation, which is described further down. The weights of copper are: On the armature, 194 lbs.; on the field magnet, 346 lbs.; as the dynamo, when working at 500 ampères, has a difference of potential of 115 volts at the brushes, we get 57.7 volt-ampères per lb. of copper on the armature at 100 revolutions, and 20.75 volt-ampères per lb. of total weight of copper on the dynamo at 100 revolutions. The electric efficiency is 96 per cent.; the cooling surface of the machine is very great, and the heating is therefore insignificant.

The above-mentioned new system of self-regulation is invented by Mr. F. V. Schioedet, electrical engineer to Messrs. Koefoed and Hauberg, and consists of the following arrangement in the winding of the magnet. The purpose of the system is to make it possible to work two or more compound-wound dynamos in parallel circuit without any danger of the one dynamo reversing the magnetism of the other; this is a point of the greatest importance. The new system may be used whereever by one system or another a larger loss of potential is allowed in the main conductors than is allowable between the different lamps or points wherefrom wires are leading to the lamps. If, for instance, the dynamo is placed, by some reason or other, at a distance from the rooms to be lighted, we may, to save the expense of a very heavy cable, which would give no loss of potential, use a smaller cable and have a higher potential at the dynamos, and then take these compound-wound according to this system. If we have water-power, and the dynamos therefore are placed far away from the lamps, it would be of the greatest importance to have them compound-wound and self-regulating, and yet involving no danger if two or more are working together. We may also apply this new



HAUBERG'S DYNAMO—METHOD OF COMPOUNDING.

system in such installations, when the main conductors are laid, as invented by Gülcher, in the manner that they form a positive and a negative bend or interrupted ring, both with the one end in connection with a brush of the dynamo and the wires leading to the lamps leaving the said bends at suitable points of the conductors, so that the loss of potential in the positive conductor to such a point of it added to the loss of potential in the negative conductor to the corresponding point is the same for every two points wherefrom wires are leading to the lamps. In the diagram M + and M — are the two main conductors connected with the brushes of the two dynamos of the said installation. With 500 ampères the loss of potential in the conductors is 15 volts. Now, if we use compound dynamos, working in parallel circuit, we shall not get the same potential at the brushes if we work one dynamo with 500 ampères, as if we run two with 250 ampères each, as the increase of potential is dependent upon the current passing the main wire on the field magnet. If we shift the current from the one dynamo to the other we should also get a lower potential until the whole current was supplied from one dynamo only. This is avoided thus: in a common compound dynamo we have on the field magnet a shunt wire connecting the two brushes, always being passed by nearly the same current, and then we have the main current passing round the magnet in a thick wire; in Mr. Schiodet's system we have the shunt wire in the same way, but instead of the main current he applies a shunt on the main conductor, connecting two points either on the positive or the negative conductor; this main shunt is passed by a current, dependent upon the loss of potential between the points. By this way the increase of potential is only dependent upon the total current in the main conductor causing a larger loss of potential; little and large dynamos can be coupled together, their potential being increased simultaneously in proportion to the loss of potential between the two ends of the said main shunt. The diagram will explain it sufficiently. M — and M — are the main conductors, in which we are working with a certain loss of potential. B + and B — are respectively the positive and negative brushes with which the shunt windings, S, are in connection. The two positive brushes, B +, are, by the main shunt, T, connected with the point, P, at the farthest away end of the positive main conductor, M +. By a correct calculation of the loss of potential from the brush, B +, and the point, P, and putting a suitable number of windings of the main shunt, T, on the field magnet, this current will just increase the potential at the brushes as the loss of potential requires. It will be quite clear from the diagram that the one dynamo cannot reverse the magnetic poles of the other, as the main shunt and the ordinary shunt both are passed in the same by the current, even if the one dynamo sends its current through the armature of the other.

* London *Electrical Review*.

THE PHONOGRAPH IN MEXICO.

The conditions of the contract made with the representative of Mr. T. A. Edison in November last for the establishment of a postal phonograph service, says a despatch from the City of Mexico, have been republished with the following additions: The Government agrees not to grant to any other parties the right to place phonographs or similar apparatus for public use in the post offices while the present contract with Mr. Edison remains in force, and the concessionaires bind themselves to employ in the service only those instruments embodying the latest improvements.

If, in the first six months of the operation of the contract, it be found that its working be attended with serious difficulties or inconvenience the concessionaires bind themselves to follow the suggestions given to them by the Government for the removal of such difficulties, but, if the efforts for their removal prove ineffectual and if the trouble be of a nature to seriously hamper the postal service, the Government may terminate the contract by giving one year's notice of its intention to do so, and the concessionaires shall lay no claim to an indemnity. The concessionaires are authorized to sell or transfer their rights. The time for placing the phonographs in the post-offices ready for public use is extended until July 1, 1890.

ELECTRIC RAILWAY IN SIAM.—An electric railway in Siam has been incorporated and will be built at once from Bangkok to Paknam, a distance of thirty miles. The road is to cost $400,000, and Siamese capital will alone be used. An electric light company has also been organized and the plant ordered for Bangkok.

ELECTRIC HEADLIGHT.—An electric headlight recently tested throws the light from a half to three-quarters of a mile ahead. This is far enough to enable the train to avoid colliding with an obstruction, even though running at the rate of sixty miles an hour. If this should be adopted many lives and much property would be saved.

PHOTOGRAPHING COLORS.—An English photographer thinks that he has discovered the way to retain the tints of nature in a photograph. Just as the operator was about to make an exposure of the plate, a blinding flash of lightning came and to the astonishment of the photographer the resultant picture, so he claims, showed the natural colors of the scene before the lens.

RESEARCHES ON THE REVERSAL OF POLARITY OF SERIES DYNAMOS.*

Series dynamos are subject to sudden reversals of polarity, and I was led to the study of this phenomenon by coming across a machine of an extremely unstable character. I was engaged on some transmission of energy experiments, and employed for that purpose two small Edison machines, which only differed from each other in the method of exciting their fields. The generator was connected in series, while the receiver was separately excited. The machines having been started, the difference between the two E. M. F.'s remained constant so long as the opposing couple was the same. The slightest decrease, however, in the work to be done caused the receiver first to speed up, then suddenly to slow down, and finally to stop and reverse. A periodic reversal of motion then took place with surprising regularity, identically the same number of revolutions being made first to the right and then to the left. As the poles of the generator were reversed at the same time, we had the phenomenon of a periodic reversal of polarity in a series dynamo. This curious phenomenon, which I thought was unknown, had, so M. Hospitalier was good enough to point out to me—been previously observed by that distinguished physicist, M. Gerard Lescuyer, to whom in 1880 it was an inexplicable electrodynamic paradox. To-day the phenomenon is, as I shall endeavor to show, less mysterious.

The experiment can be repeated in any laboratory with any series machine driving a magneto or a separately excited motor. If the receiver were also a series dynamo, we should have a demagnetization of the generator, and a consequent stoppage of the receiver. The alternations of polarity and of rotation are easily produced when the magnets are of soft iron, and with some difficulty when they are of cast iron. The stronger the field of the receiver the more rapid the reversals. When the receiver is fitted with a fly-wheel the experiment is facilitated, especially if the receiver is running light. In short, this phenomenon is not peculiar to any particular type of machine; but it is easier to produce with some machines than others, and it was this consideration that induced me to carefully study the little machines which possessed such unusual sensibility.

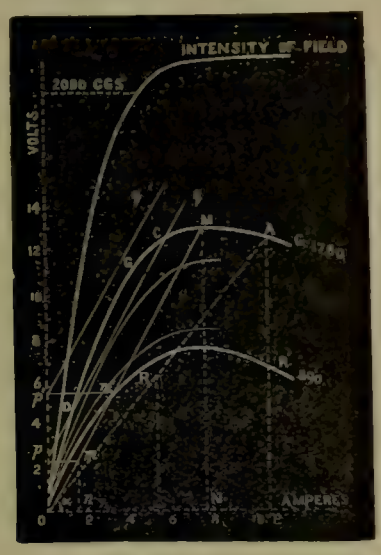


DIAGRAM OF CHARACTERISTICS.

The most singular characteristic of this periodically reversed rotation was the following: After having reversed the poles of the generator, the receiver first of all exhausted the energy stored up in its fly-wheel and then revolved in the reverse direction until its velocity was sufficient to reproduce the phenomenon. Now this velocity was relatively small; considerably less than that necessary to make the counter E. M. F. equal to that of the generator, as indeed the following figures will show. The generator making 1,781 revolutions, a Gramme laboratory machine attained the maximum speed of 252 revolutions: now the 252 revolutions of the receiver could not develop .98 volt—that is to say, at the most, one-tenth of the E. M. F. of the generator. Another observation which I made is worth recording. An ammeter placed in the circuit showed that at the moment when the reversal was about to take place, the current slowly fell to zero, and then suddenly attained a value $-i$ equal to its permanent value. I would also remark that a variation in the resistance in no way contributed to the reversal of polarity.

In order to give an exact description of these various complicated phenomena, it is first of all necessary to set out the exact data of these machines.

FIELD MAGNET.

Diameter of wire = 2.8 mm.
External diameter of the magnet = 110mm.
Diameter of the soft iron core = 35mm.
Height of the magnet = 234mm.
Resistance = .25 ohm.
Residual magnetism = 100 C.-G.-S. units.
Commencement of saturation = 12 ampères.
Strength of field at 12 ampères = 2081 C.-G.-S. un.
" " 14 " = 2124 "
Coefficient of self-induction at .3 ampères; L = 354 $\times$ 10^9 cm.

ARMATURE.

Diameter of wire = 1mm.
Diameter of ring = 72mm.
Breadth of ring = 64mm.
Resistance cold (static) = .4 ohm.
Resistance hot (dynamic) = .6 ohm.
Equivalent area = 72,000 cq.
Number of bars on cummutator = 17.
Coefficient of self-induction for .2 ampères; L = .476$\times$$10^9$ cm.
Normal speed = 1780.
" current = 7.
" volts = 13.5.

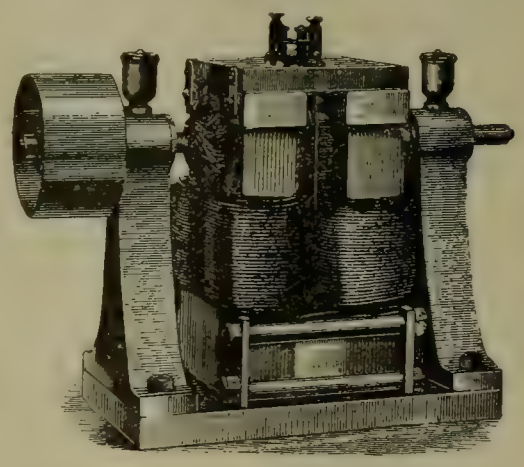
The accompanying figure shows the characteristic at 1,780 and 890 revolutions, and the curve of the strength of the magnetic field at the air-gap for various exciting currents From the diagram it will be seen that these machines presented no anomalies; but I must call attention to their high self induction, which explains the large difference between their static and dynamic resistance and which, of course, is an unfavorable feature where transmission of energy is concerned, since the loss due to self induction is equal to $N L \frac{I^2}{4}$. I will now endeavor to explain the phenomena observed. Let us suppose that energy is being transmitted under the conditions of maximum output defined by Jacobi's law; the fields being equal, and the speed of the motor being half that of the generator, their respective curves will be R R′ and G G′. The efficiency (P) of 50 per cent. will be realized if the total resistance R is equal to 1.19 ohm. In fact if the line O M makes an angle A O B such that tan A O B = R, we can easily see that the counter E. M. F. e is half E; hence $p = \frac{1}{2}$. But as the resistance of the generator when at work is .85 ohm, that of the motor .6 ohm, and that of the leads .25 ohm, R = 1.7 ohm and O M must be at an angle of 60 degrees. Hence E = M N = 13.6 volts and $e = m n = 2.72$ volts; the efficiency being, therefore, only 20 per cent.—very bad conditions to work under, imposed by low E. M. F. of the current and the relatively large resistance of the machines. Now draw $m p$ parallel to the axis of x, and $p q$ parallel to O M; $p q$ cuts the curve of the generator both at C and D, and the value of the current at C is its real value, which will remain constant so long as the speed of the machines does not vary. But diminish the resistance couple of the motor, and its speed will immediately increase and the ordinates of its characteristic will become higher. The counter E. M. F. becoming greater, $p' q'$ replaces $p q$, for the two points C and D have become one; the secant has become a tangent, and there is no intersection, except on the other branch of the curve; the current has also decreased to zero, and then increased negatively—the precise phenomenon observed. We can also see from the diagram that if the ordinates of the generator curve were lowered the same result would ensue. The ordinates are lowered when the current decreases, since the strength of the field *ipso facto* diminishes. In short this second effect is added to the first and operates in the same direction. I observed above that the reversals were more rapid in proportion as the field of the motor was stronger. This should be so, so long as the characteristic curve of the motor rises in proportion to the increased strength of field. It can also be seen that an increase in the circuit resistance ought to have no effect since the speed of the motor is dimished as well as that of the generator.

In short, these reversals of polarity are by the light of the diagram no longer a paradox, and we can understand how it is possible to reverse the poles of a generator by means of a motor of far lower E. M. F. than that of the generator. These considerations, however, while telling us how things happen, do not tell us why they happen. The phenomenon of the extreme instability of the magnetism of the field magnets remains unexplained. A more stable field could no doubt be attained by employing more massive magnets and a stronger field, which would at the same time greatly increase the efficiency of the arrangement.

*M. A. Witz, in *La Lumière Electrique.*

KENNEDY'S ALTERNATING ELECTRO-MOTOR.

The cut below is a sketch of Mr. Rankin Kennedy's new alternating electro motor. It consists of two ordinary dynamos, ring or drum armatures (drum armatures in drawing), and laminated field magnets; both armatures are on the same shaft, their coils being connected together. One of the machines acts as the motor, the other takes the place of the commutor; there are no brushes and no commutator, therefore no possibility of sparking.



KENNEDY'S ALTERNATING ELECTRIC MOTOR.

It requires two currents, one at a quarter of an alternation $\sim$ in advance of the other, but it does not require any synchronizing, and it can start with load on from rest; the two currents at different phases are obtained from a transformer or two line wires with a third for a common return, or from a coil wound on the field of one of the combined machines. Larger machines are made multipolar.—London *Electrical Review.*

ELECTROTECHNICAL COURSE IN NAPLES.—The Italian Minister of Public Instruction has just instituted a practical electrotechnical course in the practical school in Naples, the instruction in which will be given by Prof. Guido Grassi. The laboratory is provided with all the necessary machinery, and already contains a dynamo, a 10 horse-power motor, numerous measuring and other instruments. The programme comprises: Instruments and method of measuring electricity, primary and secondary batteries, dynamo and electric machines, distribution and transmission of electrical energy, and electric lighting.

THE TANGENT GALVANOMETER AND HOW TO USE IT.

BY A. P. WEAVER, ST. JOSEPH, MO.

If we compare two currents on a common detector galvanometer whose deflections have no known value, and one current gives a deflection of 25°, it by no means follows that the current is twice as strong which gives a deflection of 50°. The reason for this is that the separate convolutions of the coil cannot be placed at the same relative distance from the needle, consequently the magnetic force acting on the needle, which tends to place it at right angle to the coil, becomes less and less as the needle approaches 90°, or a right angle, where the effect of course becomes *nil*. Therefore the common galvanometer, although very useful for merely showing the presence and direction of a current, cannot be used for the measurement or quantitive comparison of currents of different degrees of strength. In order to overcome this difficulty several kinds of galvanometers have been constructed, among them being the Tangent Galvanometer, which is probably the best and most useful of any in use at the present time.

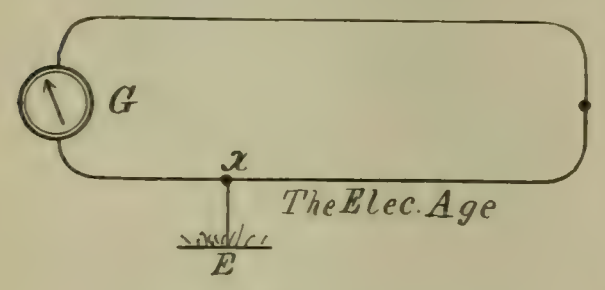


FIG. I.

The Tangent Galvanometer is constructed on the following principle: The strength of the current is proportional to the tangent of the angle of deflection when the length of the needle does not exceed a fifth part of the diameter of the circular coil.

It is to be remembered that the trigonometrical tangents of the angle of 0° to 45° of a circle whose radius is 1, increase from 0 to 1; and for the angles from 45° to 90° the tangents increase from 1 to ∞ (infinity).

Having thus briefly described the Tangent Galvanometer, we will now consider the various uses to which this valuable instrument may be put.

To measure resistance.—Before using the galvanometer you must take the constant of your instrument, *i. e*, ascertain the amount of deflection with a given battery through a known resistance.

Suppose we wish to measure the resistance of

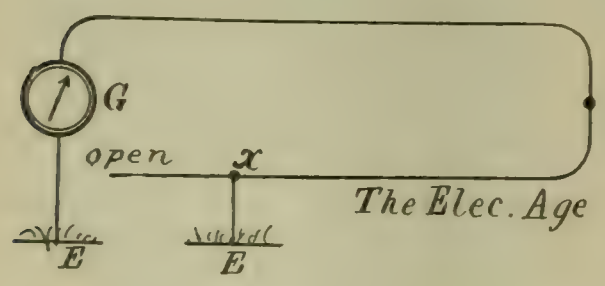


FIG. 2.

a coil of wire, or any similar object. Call this unknown resistance X. We connect the galvanometer in circuit with a rheostat and battery. Now unplug a known resistance (the amount of which depends upon the magnitude of the unknown resistance). Call this resistance R. Note the deflections and its tangent; call this tangent A. This is the constant of your instrument.

Now remove the rheostat and substitute the coil of wire, whose resistance we desire to measure. Again note the deflection. Call this tangent B. We now have data from which to calculate the unknown resistance, X. This is done by proportion, or the "rule of three."

X can be found by the following inverse proportion.

Tang. B : Tang. A :: R : X.

Example.—Assigning values to them,

Let R = 50 ohms.
" Tang. A (45°) = 1
" Tang. B (56.5°) = 1.510, then,

$$\frac{1.510 \times 50}{1} = 75.500.$$

which is the resistance of the coil of wire in ohms.

To measure the electro-motive force of a battery, connect the galvanometer in circuit with the battery whose E.M.F. we desire, note the tangent of the deflection, call this tangent A. Call the total resistance in circuit, including the internal resistance of the battery and the resistance of the galvanometer, Z, then,

Tang. A × Z = E.M.F.

Example.—Suppose the deflection to be 23°, the tangent of which is .4,245 and that Z = 10 ohms,

.4245 × 10 = 4.2450,

which is the electro-motive force in volts.

To measure the internal resistance of a battery, connect the galvanometer in circuit with a rheostat, and the battery whose internal resistance we wish to measure. Note the deflection and its tangent. Halve the tangent by introducing resistance in the rheostat, call this resistance R; the resistance of the galvanometer, G and the internal resistance of the battery H, then,

R — G = H.

Example.—Suppose the deflection to be 22°, the tangent of which is .4040. This, divided by 2, gives us .2020. Referring to a table of tangents we find the number of degrees which correspond most nearly to tangent .2020 is 11.5°. We now unplug resistance until 11.5° is reached. Suppose this requires 13 ohms and (using same letters as above) G = 8 ohms,

13 — 8 = 5,

which is the internal resistance of the battery in ohms.

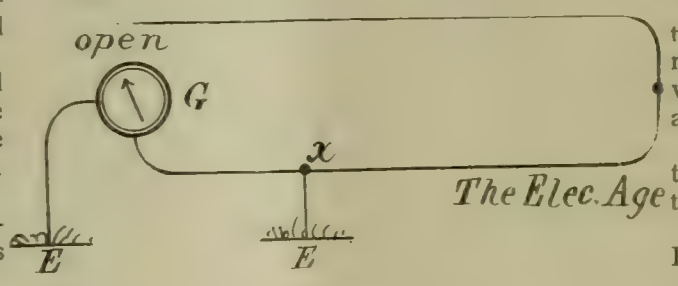


FIG. 3.

To measure the resistance of a galvanometer.—If we have two galvanometers, the most obvious way would be to use one to measure the other, regarding it as ordinary resistance. But if we have but one galvanometer and desire to ascertain its resistance, we proceed as follows:

Place the galvanometer in circuit with a rheostat and battery of very small internal resistance, unplug any resistance, say 200 ohms, and note the deflection. We will suppose it to be 20°. Now replace the plugs, and again withdraw resistance until the former deflection (20°) is doubled. Suppose it requires 125 ohms to produce this deflection. Now, multiply the two resistances by their respective deflections, subtract the smaller product from the larger and divide by the difference between the two deflections. The quotient is the resistance of the galvanometer.

Example.—Using the values as given above:

200 × 20 = 4,000;
125 × 40 = 5,000;
5,000 — 4,000 = 1,000;

$$\frac{1,000}{20} = 50,$$

which is the resistance of the galvanometer.

To locate a ground 1. Have the grounded wire looped to a perfect wire at distant end. Measure the loop disregarding the fault at X. Call this A, fig. 1

2. Take deflection of longest wire with shortest open at the testing office. Call this B, fig. 2.

3. Take deflection on shortest wire with longest poles at testing station. Call this C fig. 3.

Now add resistance to make C=B. Call this added resistance D, then

$$\frac{A - D}{2} = \text{distance from}$$

testing station to ground at X. This reduced to miles gives the distance to the fault, in miles and fractions of miles.

To test for a Cross.—Case 1. When the wires are very nearly equal in resistance or their resistance unknown,

Measure A to B (C and D open). Call it I.
Measure A to D (C and B open). Call it J.
Measure A to C (B and D open). Call it K.
J—I = L (Resistance of Cross itself), now,

$$\frac{K - L}{2} = \text{distance to X.}$$

Case 2. When resistance of wires are not alike make the following measurements (fig. 5)

1. A to B (C and D open). Call it J.
2. C to B (A and D open). Call it K.
3. A to C (B and D open). Call it L.

then,

$$\frac{J + L - K}{2} = \text{distance from}$$

testing office to cross at X on No. 1.

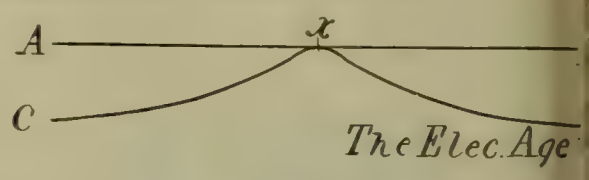


FIG. 4.

To test a terminal ground-plate. If we suspect a terminal ground-plate of being defective we may test it as follows:

Measure any two wires to ground through the suspected ground plate. Call the measurement of the first wire A: and that of the second wire B. Now connect the two wires in loop and measure the loop. Call this C. Now if

A + B = C,

the excess divided by 2 gives the resistance of the defective plate.

Example: To illustrate, suppose A = 88 ohms, B = 39 ohms and C = 99 ohms.

It is readily seen that the sums of 88 and 39 exceed 99 by 28. This excess, 28

$$\frac{28}{2} = 14,$$ which

is the resistance of the defective ground-plate.

To locate an escape or defective joint have the wire grounded about the middle of the line resistance (which should be obtained from previous measurements).

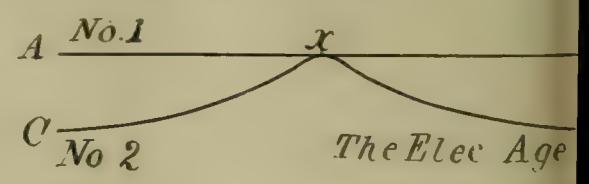


FIG. 5.

Now measure this section from the testing office to the ground with the distant end open. If it shows a higher resistance than half of the line normally possesses, the escape is between the testing office and the ground.

Now have the ground removed farther toward the testing office until the resistance makes a sudden fall from the last measurement. When this point has been reached the escape is located between the last two stations; on the contrary, should the measured resistance prove to be about what the line would normally possess, the escape is on the far side of the ground and it should be followed up as above.

The above is based on the supposition that the escape is concentrated in one point. Should it be diffused over the entire line, it is exceedingly difficult to locate.

UNDERGROUND WIRES.

In the January-February number of the *Annales Télégraphiques* says the London *Electrical Review*, M. J. Gidel describes his experiences during repairs effected by him in 1889 to some of the underground lines in the Lyon district.

The lines to which attention is particularly called are those laid in cement conduits—one between Grenoble and Gap, about 100 kilometres in length, composed of two cables; and the other between Tarare and Roanne, of about 40 kilometres, composed of three cables. Each of the cables contains three conductors, two of small diameter for short-distance signalling, and the third of a heavier type for working on long circuits. The conductors are of seven copper wires stranded and insulated with gutta-percha, and the cables have an outer protection of tanned, and in some cases tarred, tape. The cables were laid in 1884.

Great difficulty seems to have been experienced in repairing these lines as they were found to be in a very bad condition, no less than 25 faults being taken out of one section of 500 metres on the Tarare-Roanne system, while between Grenoble and Gap many sections were found to contain from 15 to 20 faults.

On the greater portion of the two lines under notice, the percha was found to be bare, the tapes having become perfectly rotten, and, in many cases, having altogether disappeared. This decay is attributed to the burning of the fibrous material by the caustic elements of the cement dissolved by water in the conduits. Under these conditions, it was found impossible to draw the cables through the conduit, for the purposes of repair, without still further injuring the gutta-percha covering.

All the faults were due to cracks in the percha. The conductor at these places was blackened, and generally very much damaged. A close examination showed that fusion of the metal had taken place, particles of copper had been separated, and on the percha in the vicinity of the faults, small particles of copper were noticed. Frequently two or three of the copper wires were found broken, and in some cases, all seven.

The routes followed by the lines are through districts subject to the most violent thunderstorms, and, in several instances, it was proved beyond question that lightning had struck the ground, or some object, in the neighborhood of the cables, at points were faults were discovered. In one case, the course of the lighting was marked by a passage burned through the sandy soil, large enough to admit a ram-rod; the conduit was blackened at the point struck, and an iron wire to the cement covers to the conduit was reduced to powder.

The majority of these faults, which the author describes as being due to lightning, were, however, not caused by a direct flash, but are attributed to inductive action. Some considerable portion of the lines was also found to suffer from a general weakness; the loss of current being so great in these localities, that it was necessary to renew the cores. The percha in these situations had been exposed to alternate wet and dry conditions, and had become of a yellow color to some depth.

At certain places, such as junction boxes, the percha wires are covered with India-rubber tubes. Whenever these tubes fitted the percha so tightly as to prevent the access of air or moisture the percha completely changed its appearance, turning to a light yellow color, and becoming quite pasty.

The author draws a comparison between the condition of the cables in cement conduits and those carried in iron pipes. Of the latter, there are several lines in the same district, and equally subject to the visitation of thunderstorms, but no faults have been discovered in them. He therefore comes to the conclusion that the only method which can be adopted to secure the safety of the underground lines is to abandon the present system, and to either lay the lines in iron pipes, or to give the cables an outer protection of iron sheathing wires.

CARDEW'S AUTOMATIC EARTHING DEVICE.

From a London contemporary we get the following description and illustrations of Cardew's automatic earthing device as modified and improved by Messrs. Drake and Gorham, of London. This pattern has been adopted by the London Electric Supply Corporation after an exhaustive series of tests, and will shortly be in use over all their London circuits. The necessity for apparatus of this class was foreseen by Major Cardew some time back and his patents cover devices which depend for their action on static attraction or made on the Geissler tube or similar principles.

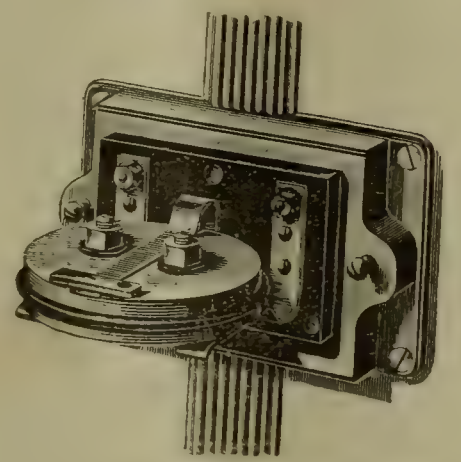


FIG. 1.—CARDEW'S EARTHING DEVICE.

The static arrangements have been found to give the best results, and have been adopted in the standard instrument as being less liable to derangement.

The action of the device is to connect the secondary circuit to earth automatically whenever a dangerous difference of potential is established between the lamp circuit and earth. This result is obtained by interposing some medium which will be of infinite resistance until a high voltage exists, when a free passage for the current is provided.

The static device illustrated consists of two brass plates placed near, but insulated from

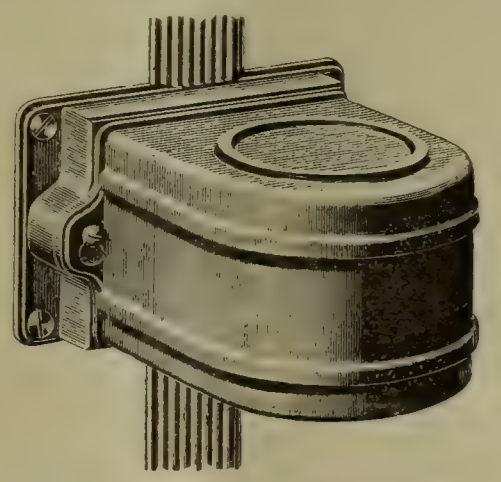


FIG. 2.—CARDEW'S EARTHING DEVICE.

each other. Between these lies a thin foil of aluminum which is retained in position by ebonite pegs, one plate being connected to earth and the other to the secondary circuit.

A flat projection is formed on the upper plate overone end of the foil, so that as soon as a difference of 400 volts is established, one end of the foil lifts by static attraction, and a metallic contact is made between the two plates. The main primary fuses are immediately severed by the increase of current, and the supply is cut off.

The two plates are insulated by ebonite rings, and are securely bolted together, so that after being tested at the central station, no skilled labor is required to fix them. It has been shown that the plates can be shaken or rolled about without affecting the voltage at which the foil will lift.

The plates are carried by brass springs to which the connections are permanently made at the back of a solid block of ebonite, so that the act of sliding in the plates makes the connections, and a slot on one side renders it impossible to put them in with the wrong side uppermost.

The plates are all made interchangeable, so that when the foil has acted it is merely necessary to slide in some fresh plates.

It has been suggested that the connecting of the secondary circuit permanently to earth will remove the necessity for this device; but there is no comparison, from a fire-risk point of view, for a strain is permanently put on the insulation of the conductors, and a slight leak, which with the automatic device would remain harmless for years, is liable to be developed at any time into a state of danger. This is especially the case in damp situations where the size of the conductor may be reduced by corrosion.

It is evident that the apparatus can be modified to act as a relay and cut off both poles of the circuit, or to ring a bell and drop a danger disc, as has been arranged for the Chelsea Electric Supply Company, where continuous currents are used.

In addition to the Deptford Company, the instruments have been supplied to the Newcastle Electric Supply Company, the Central Station at Lynmouth, Devon, the Shanghai Electric Company, etc.

To Regulate the Use of Electricity.—A bill has been introduced in the Massachusetts legislature to regulate the control and supervision of electric wires. Sections 1 and 2 contain the restrictions, and are as follows:

Sec. 1. Every person or corporation, private or municipal, owning or operating a line of wires over streets or buildings in a city, shall use only wires that are suitable and strong, shall suitably and safely attach them to strong and sufficient supports, and insulate them at all points of attachments, and shall remove all wires abandoned for use, shall suitably insulate every wire where it enters a building, and if such wire is other than a wire designated to carry an electric light current, shall attach to it at a suitable and convenient point near the place of entering the building, an appliance calculated to prevent at all times a current of electricity of such intensity or volume as to be capable of causing fire from entering the building by means of such wire beyond the point at which such appliance is attached, and shall suitably insulate every wire within a building when such wire is designed to carry an electric light current.

Sec. 2. Every such person and corporation shall in the several cities, within six months after the appointment of the officer hereinafter provided for affix at the points of support at which any such wire or cable containing wires is attached, a tag or mark distinctly designating the owner or user of such wire or cable. No such tag or mark shall be required for the wires of a street railway company used for the transmission of its motive power, or for the protection or support of such wires.

The bill also provides for the appointment of an inspector in each city to see that the law is enforced.

Telephone Wars.—Gen. C. H. Barney, Secretary of the National Telephone Exchange Association, in his news-letter of April 30th, says: There are strong indications of impending "telephone wars" in Philadelphia Chattanooga, and Salt Lake City. The local papers in each of these cities are filled with reports of the proceedings of subscribers' meetings, etc,

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE, ROOM 10, COOK BUILDING.

Boston, May 9, 1890.

The Brookline Gas Company have been granted locations for 14 poles in that town.

The business men of Flint village, Fall River, are demanding electric lights in that place.

The Randolph Power Company are to furnish power for a large manufacturing industry in that place.

Lightning burned out all but three of the lines at the Quincy Telephone Exchanges last Sunday night.

A large factory for the manufacture of electrical insulation is being built by the Johns-Pratt Company at Hartford, Conn.

The new 1,300 light T. H. alternating dynamo for the Malden Electric Company has arrived, and will be placed in position immediately.

Electric power in place of steam is to be used in the morocco factory of Eugene Barry, at Lynn.; a thirty horse-power motor is to be used.

The Lynn Belt Line Company has recorded a mortgage of $100,000 on its entire plant to secure the issue of first mortgage bonds at four per cent.

The engine at the new electric light station in Amherst, jars the building so much that steps will have to be taken to prevent this before it can be started for business.

A prominent manufacturer of Rockyville, part of Fitchburg, Mass. has promised an electric light plant for that place and the highways are to be lighted by electrtcity.

The West End Railway Company have petitioned the selectmen of Brookline for permission to, erect and maintain the overhead single trolley system for the propulsion of their cars by electricity.

During the past week the Lowell Electric Light Corporation have added to their plant a 200 h. p. Armington and Sims engine and a large sized generator to furnish power for the electric railway to Willow Dale.

The daily exhibitions of the Electrical Safety Company are largely attended by men prominently interested in electrical affairs. Two gentlemen from the West are negotiating for the territory in three of the Western States.

The Jordan Train Lighting Company have equipped a train on the Connecticut River R. R. with their couplers. It is understood that this is the only train that is now lighted by electricity in New England.

Gilbert G. McDuff, agent for the Fred H. Whipple Company, of Detroit, Mich., has been in Boston the past few weeks, compiling a list of names for "Whipple's National Electrical Directory" for 1890, which will be issued in June.

The Uxbridge and Northbridge Electric Co. has been organized in Uxbridge under the laws of Massachusetts. F. A. Wyman, of Boston, is president and J. R. Scott, of Uxbridge, is treasurer. The headquarters of the corporation will be in Boston.

The petition of the Board of Aldermen of the Suburban Light & Power Company for license to erect and use eight stationary steam engines of 1,000 aggregate horse-power on Hilton street, near East Chester Park, has been withdrawn by the company.

Mr. James H. Howard says the Inter-Continental Telephone Company has sold its telephonic rights government concession, good will and business in Venezuela to a strong syndicate of English. Amsterdam and Paris capitalists for about £30,000. The new company propose to extend the lines in Venezuela wherever they can be made to pay.

The Essex Electric Street Railway Company have notified the Salem Board of Aldermen that it was about to construct its road: that it considered the overhead trolley system as the best it could adopt, and petitioned for leave to erect poles and wires for same.

George F. Thaxter, who has carried on an electrical business at 33½ Beach street for a number of years past, died on Monday of last week of blood poisoning. Mr. Thaxter was the inventor of a number of electrical novelties, among which was an electric clock and an electric door lock.

The West End Street Railway Company has just placed an order with the Taunton Locomotive Works for thirty swivel trucks of a special design which it has furnished. These trucks are to be used under the new long open cars which are being built for the summer travel on the electric lines.

The Milford and Hopedale Street Railway Company, with capital of $60,000, was organized on Saturday last. President, E. P. Usher, of Grafton; Secretary, F. W. Morse, of Grafton; Directors, E. P. Usher, F. W. Morse, Gen. W. F. Draper, of Manchester. Work will be commenced immediately.

The new station of the Bangor Electric Light and Power Company at Veasie, Me., will, when completed, be the largest in New England. It will be 242 feet in length and 75 feet in width. Six large water wheels of 100 h. p. each, will furnish the power, in addition to this, there will be an auxiliary steam plant.

At the meeting of the Massachusetts Club last Saturday, the phonograph was used to reproduce speeches from Gov. Brackett, ex-Gov. Long, Collector Beard, Speaker Reed in Washington, and many other prominent gentlemen. The famous song "Breaking Waves Dashed High" which was sung into the phonograph by Hon. Samuel B. Noyes was also reproduced.

The Connecticut Motor Company, through its New England agent, have sold a 10, 5, 2 and two 1 horse-power motors to Boston parties. Mr. H. C. Roberts, special agent for the above company, who has been in town the past week, reports the sale of a 25 horse-power motor to the Kansas City Packing & Chase Refrigerating Company. The Boston office of the company has been moved to 32 Oliver street.

The Lawrence city government, with the chief of police, made a tour of inspection through the Boston police stations last Tuesday night. The party was in charge of President Wilson, of municipal police service, who showed the practical workings of the system. Lawrence is about to adopt a signal system for the police of that city, and the visit to Boston was for the purpose of seeing the system working.

The electric light question at Wakefield has not yet been settled by the gas commissioners, although the people are anxiously waiting for the improvements, especially as regards lighting the streets. The contest is between the Peoples' Company and the Wakefield Gas Company, and the commissioners appear to be unable to decide as to which of the two should have the franchise. The new street railway between Stoneham and Wakefield will be started as soon as a plant is put in by one of the companies.

At the meeting of the Boston Electric Club last Monday night, the revised constitution and by-laws submitted a month ago, were discussed at length, and amendments clearly defining the status of members were adopted The provision in the old code restricting membership to persons engaged in electrical pursuits was rejected. The regular monthly dinner of the Club, which was announced for Monday, the 19th, will be postponed to Wednesday, the 21st, as the American Institute of Electrical Engineers will hold their annual convention in Boston on the 21st and 22d of this month. This change will enable the Club to entertain the Institute as their guests at dinner.

The Nashua Light, Heat & Power Company have commenced the construction of a new station, and the work is to be pushed ahead rapidly. The building is to be of brick, and sufficiently large to accommodate a 1,000 horse-power plant.

The new brick station of the electric light company in Natick has been completed and is admirably adapted to accommodate the machinery and appliances necessary in a first class station. The plant consists of dynamos sufficient to furnish 4,500 incandescent and 150 arc lights, and 200 horse-power for motors, with two engines of 300 h. p. each. At present there are but two boilers, but provision has been made for four.

Judge Colt, of the United States Circuit Court, has ordered a decree for the complainant in the case of the Electric Gas Lighting Co. *vs.* Chas. E. Fuller, *et. al*, a bill in equity to restrain the infringement of a patent granted to Henry F. Packard and Frank V. Sanford, for improvements in electric gas lighting apparatus. The patents relate to that form of electric gas lighting where the burner is operated by hand and which does away with the use of matches.

STATE HOUSE.—On Monday the Committee on Mercantile Affairs reported inexpedient as to establishing a State Board of Electrical Control. The same committee reported a long bill regulating the control of electric wires.

The street railway committee recommended reference to the next General Court of the bill requiring protection for drivers of electric cars, limiting the number of passengers on cars, and prohibiting the carrying of passengers on platforms or steps of electric roads.

The bill to increase the capital stock of the Boston Electric Light Company from $1,000,000 to $3,000,000 passed the Senate last Wednesday.

The committee on manufactures, to whom was recommitted the Senate bill, providing for the inspection of electric lights and motors, reported the bill in a new draft. The only material change is in the second section, which provides that the amount which may be expended by the Board of Gas and Electric Light Commissioners, for incidental expenses shall be increased $1,000.

Mr. Heldreth, of Harvard, asked to amend the Senate bill, to authorize the consolidation of gas and electric light companies, so that such consolidation may take place only between companies in the same city or town, and so that the agreement for consolidation shall be approved by two-thirds in number, and interest of the stockholders of each of the consolidating companies.

The annual report of the New England Telephone and Telegraph Co. for 1889, shows: Earnings, $1,255,570, an increase of $128,263 over the previous year; expenses. $957,305, increase over previous year $100,724; net earnings, $298,265, increase of $27,538. Of the charges to new construction, $190,000 was expended for underground work. The amount of underground wire in use at the end of the year was 3,599 miles. No other city except New York has so much wire underground. The total amount paid for new construction was $318,169.

The report touches on the interference with the telephone service of the electric car lines and in the efforts to diminish the same. The management proposes to employ necessary means to obtain relief from disturbance and redress for injury suffered. The affairs of the company are declared to never have been more prosperous. At the meeting the following officers were chosen: President Thomas Sherwin; vice president, Henry S. Hyde; treasurer, William R. Driver; secretary, Fred. J. Boynton; general manager, J. N. Keller; board of directors, Fred. Ayer, Benjamin C. Dean, W. H. Forbes, John E. Hudson, Henry S. Hyde, A. O. Morgan, Moses G. Parker, Stephen Salisbury and Thomas Sherwin.

W. J. P.

WESTERN NOTES,

BRANCH OFFICE OF THE ELECTRIC AGE
35 COMMERCIAL BANK BUILDING.

CHICAGO, MAY 10, 1890.

THE CITIZENS' FUEL, GAS & LIGHTING CO., has been formed at Burlington, Iowa, with a capital stock of $300,000.

THE ROCKFORD ELECTRIC MANUFACTURING CO, Rockford, Ill, has filed a certificate of increase of capital stock to $100,000.

NEW OPERA HOUSE.—A permit was issued on the 5th inst. for the construction of the Metropolitan Opera House at St. Paul Minn., to cost $320,000.

THE ELGIN LIGHT & POWER CO., has been formed at Elgin, Ill., capital stock, $100,000; incorporators: I. C. Towner, William Fay, B. Hayelow.

THE STREET RAILWAY COMPANY at Minneapolis, Minn., has been granted permission by the city council to place its electric feed wires underground in conduits.

It is reported that the Muskegon, Mich., electric street railway is such a success that the company has been requested to extend its lines all over the city and choose its routes.

Mr. F. A. Wunder, western agent for the Schuyler Electric Co., and Mr. F. J. Baker, western agent for the Daft Electric Co., have removed to new and handsome offices in the Rookery, Chicago.

COUNCIL BLUFFS, IA., will soon have an electric fountain. The new fountain being erected in Bayliss Park is to be equipped with 32 C.P. incandescent lights placed under the flowing water.

MR. HARRY BAUM, of the Fidelity Carbon Company of St. Louis, has been in the city during the week pushing the interests of his company, and reports numerous sales of the Fidelity company's carbons.

THE CENTRAL GAS IMPROVEMENT CO., has been formed at Chicago, to manufacture gas and electricity for illumination; capital stock, $150,000; incorporators: Calvin Dickey, G. M. Trowbridge, and J. O. Morris.

THE STATE PHONOGRAPH COMPANY OF ILLINOIS has been formed at Chicago, to manufacture, lease and deal in phonographs, etc.; capital stock $230,000; incorporators: E. L. Lobdall, G. Farwell, E. H. Pearson.

THE GOOCH ELECTRIC COMPANY, Louisville, Ky., expect to increase their facilities shortly by the addition of two incandescent machines and two Sperry arc machines. This company is now operating two 650-light Mather incandescent machines, and are running both lights and motors on their circuits.

MR. M. M. SHIPE, of Abilene, Kan., has secured a franchise for an electric street railway, from the city of Austin, Tex., and a right of way for ten miles outside the city, from the county. Mr. Shipe represents Kansas City capitalists and will organize a company to be known as the Austin & Travis County Rapid Transit Co., with a capital of $200 000 He expects to commence laying track in about two months.

ELECTRIC RAILWAYS FOR EAST ST. LOUIS.—The city council of East St. Louis granted a franchise on the 5th inst. to the East St. Louis Electric Railway & Power Co., to construct a street railway. The company agrees to pay $5,000 cash into the city treasury, and will have the lines completed and in running order within sixty-five days from the completion of the viaduct over the railroads on Broadway.

CHICAGO ELECTRIC CLUB.—Handsome cases have been placed in the club rooms this week for the library recently received from the old American Electrical Society. Among visitors at the club this week were: D. T. Letter, Springfield, Ill.; G. M. Peters and C. M. Peck, Cincinnati, O.; T. B. Baum, Kansas City, Mo.; W. H. Lukins, Streator, Ill.; W. H. Gillett and James Cummings, New York; Ely E. Ware and Charles Ware, Cedar Rapids, Ia; and M. H. McCarthey, Minneapolis, Minn.

THE LEBANON, MO. CITY COUNCIL passed an ordinance on May 5th granting an exclusive electric light franchise for twenty years to B. F. Hobart of St. Louis, and has ordered an election to give the people an opportunity to ratify or reject the ordinance. The city will take 23 arc lights. The matter has created great enthusiasm on the part of the citizens and the city is enjoying something of a boom in consequence.

MILWAUKEE, WIS. The underground conduits and cables of the telephone company are now all in place. The service will be transferred to them before the last of this month, and the work of clearing the poles and overhead wires from the streets commenced at once. Great annoyance has been experienced by the telephone company from the proximity of the overhead street railway wires, and it is expected that this trouble will now be removed. The cost to the telephone company of making this change has been about $130,000.

STORAGE BATTERY CAR.—The directors of the Ft. Wayne & Elmwood Road, at Detroit, were given an opportunity on Tuesday last to examine the new storage battery car which has been running experimentally for some time in that city. A trip was made over the line of the Ft. Wayne company with the representatives of the road and a number of prominent citizens, and the general opinion seemed to be very favorable toward the car. This car, which is equipped by the Shawhan Motor Company, of Detroit, was run for six consecutive days last week, each day averaging 63 miles, on one charge of the battery.

MR. JAMES F. CUMMINGS, Superintendent of Construction of the Edison Electric Light Co., is in Milwaukee, Wis., to superintend the work on the Edison Company's plant in that city, which it is expected will be in operation by the end of July. Three hundred and eighty tons of underground tubing will be employed, and eight contractors are figuring on the work of laying the conduits, the contract for which will probably be awarded in a week or two. The underground work will take most of the time, and it is expected that by the time it is finished all else will be in readiness and the plant will be started at once.

THE WORLD'S EXPOSITION MANAGEMENT is moving into new and more permanent quarters this week, and the various committees are organizing and rapidly getting in working order. The director general has not yet been selected and it is understood that this appointment will be deferred until the National Commission has been organized, that they may consult with the board of directors in the matter. It is announced that the capital stock will be increased to $10,000,000, and steps are already being taken to secure subscriptions. The contribution of $275,000 by the Pennsylvania Railroad company to the Exposition fund is also announced. F. M. I.

THE CRANDALL ELECTRIC PROTECTOR.

It is a well-known fact that in the practical operation of most inventions or new industries the necessity for other inventions to meet the changed conditions is made apparent. Thus it is that inventions beget inventions. A case in point is found in electric light operations. When this method of lighting became a practical success everything worked smoothly for a while, and no one was conscious of any danger ahead. One day, however, a fire was started by an electric light current getting astray, and this accident was succeeded by many similar ones. Various methods were tried to avoid these dangers, but all were more or less deficient in important respects. It has finally come to be accepted as an unwritten law that in order to avoid the dangers due to abnormal currents getting into buildings over telephone or telegraph wires, means must be provided by which the current itself will by its own destructive powers render itself harmless before it can get into a building. To do this, many mechanical devices have been evolved, and many have died through inherent weak points. In this line as in all others, however, the fittest survive, and the fittest of this class of inventions is the one we are about to describe.

The Crandall Electric Protector is a little instrument designed to protect buildings from the dangers of stray electric light currents, or others of abnormal volume. It is as efficient as it is simple. There is no complicated mechanism to get out of order, and it is infallible in its operation. No better recommendation can be given of the value of this protecting device than reference to the fact that at a recent test in Boston the Crandall Protector was the only one that proved itself to be efficient and absolutely reliable under all conditions. So excellent was its performance that Mr. D. Killecutt, the Electrical Inspector of the Boston Fire Underwriter's Union, was constrained to acknowledge by letter, his extreme satisfaction with the result of the test of this instrument. Mr. Killecutt says, in concluding his letter: "I should recommend this device to be used on telephones, telegraphs and all grounded circuits of like nature, as I believe it a reliable and satisfactory protector for such lines."

Inspector Captain William Brophy in a separate report to the New England Insurance Exchange also endorses the Crandall Protector as affording ample protection against the dangers of surcharged electric wires.

The action of this protector is absolute and direct. There are no shunts, the instrument being connected directly in the main circuit. Essentially it may be described as follows:

One of the electric wires as they enter a building is connected through the proper means with an electro magnet, the other terminal of the magnet coil being connected with the armature. At the end of the armature farthest away from the magnet core is a back contact point which nominally remains in contact with a terminal to which is connected the telephone or telegraph instrument. Thus the circuit runs, as it enters from outside, to the magnet of the protector, then through the armature and its back contact to the telephone, or other instrument to be protected, then outside again by the other main wire. It requires a current of half an ampère at least to produce sufficient magnetism in the coil of the protector to draw the armature away from the back contact point. The currents used for telegraph or telephone purposes, however, are much weaker than this, hence the contact through the armature is never broken, so long as the operating current remains at its normal volume. The moment that the current is abnormally increased, by accidental contact with electric wires or otherwise, the magnetism in the coil is increased sufficiently to draw the armature towards it, thus breaking the connection with the telephone or other instrument to be protected. When this occurs the armature makes contact with a point placed at its front, to which a ground wire is attached. It will therefore be readily understood that so long as the abnormal current exists it has direct connection with the ground and is cut off entirely and absolutely from the telephone or other instrument. An additional precaution is taken in the use of a fuse wire, which is placed between the incoming wire and the protector itself. Thus, when the stray currents become too strong the fuse wire is melted; the current is opened, and all possibility of danger is entirely removed.

It is an absolute impossibility for an abnormal current to get inside of a building where one of these protectors intervenes, and there can be no reasonable excuse for higher insurance premiums on property thus protected.

The Crandall Electric Protector is manufactured by the United States Electric Safety Company, of this city, and is meeting with a very large sale. The increasing business necessitated the establishment of an Eastern company, with headquarters at Boston, brief notice of which we gave in a recent issue.

ELECTRIC LIGHTING AND TOWN AUTHORITIES.

The German *Building Times* (Bauzeitung), quoted by the *Journal für Gasbeleuchtung*, says the *Gas World* (London), gives a series of articles by Herr J. Baumann, Munich, on the above subject, which are of more than ordinary value, and of which we briefly jot down the main heads.

The discussions at Frankfort, Leipzig, Halle, Madeburg and elsewhere having been noted, the author proceeds to compare electric and gas lighting. One difference is that in gas supply the technical difficulties are much the same in small and large towns; in electric the problem has for small districts been solved, while for large it is still practically unsolved, and large districts going in for electric light take a step in the dark. As to the question whether it is advisable in the present state of things for the authorities in large towns to take up the electric light, he says, that to answer it is not so simple a task as at first appears. The tendency is for local authorities to get into their hands all the means of collective life, such as water, drainage, tramways, telephones, and gas; private electric lighting belongs to this category, and it might be best for them to take up electric lighting without its going, in the first place, into the possession of private enterprise. There is another important difference between gas and electric lighting, too often neglected; gas answers the demands of open-air lighting and of within-door lighting. So does electricity; but the advantages of electricity—coolness, safety, purity of the air—disappear entirely in the former. But it is the former, the open-air lighting, which entails the greatest difficulty and expense, and weighs down the within-doors lighting; this does not occur with gas. Another difference is the ease of putting up independent small electric installations for houses, theatres, places of amusement, etc., as contrasted with gas. The question, therefore, becomes one of the possibility of fitting in the new light in such a way as, by earning a fair profit, to do justice, amid the existing relations, to that portion of the community which cannot avail itself of the new system. From this point of view the conclusion would appear adverse to large schemes of supply for all purposes, and favorable to the supply of electric light as a special light suitable to and remuneratively saleable in certain special districts. The risk is thus minimized, for small special districts can and do pay; and the technical difficulties are brought within manageable compass; and have by this time been ascertained and can be provided for. And such small districts had better be managed by the local authorities, who can systematize the electric wires along with all other underground systems, such as heating and compressed air pipes, and telephone and telegraph wires, and thus cheapen each system.

As to the question of alternate *versus* direct current: the author does not think the dispute is one about fundamentals; but it is still one of considerable importance in view of future development. We have to do with a machine house and an insulated network of wires: the latter consists of main trunks and supply branches, so far somewhat resembling a gas system; but the manufacture and the supply are, in gas, independent, while in electricity they are not, and the central station must keep going, while the consumption varies enormously from hour to hour, the conditions being, therefore, uneconomical. The two systems to be compared, as being those in use up to this, are low tension direct and high tension alternating currents. In the former the current goes directly to the lamps, in the latter the circuit is closed, and currents of less tension induced by it in transformers are used in the lamps.

The energy required is the same in both cases; in the former it is supplied at low tension and high in quantity: in the latter it is supplied at high tension and low in quantity; and as the loss on the way is proportional, first, to the resistance, and, secondly, to the *square* of the *quantity*, it follows that the low-quantity system—that is the high tension system—suffers less loss in transit, and can bear either thinner cables or a longer conducting cable, or both, and can therefore be worked with light cables at greater distances than the low tension system can; and it therefore renders possible the establishment of stations at a distance instead of close to the supply, and, accordingly, the supply of larger areas; and the advantage of cheapness of cables tells best when the areas to be covered are very large. Hence the system is advocated for town supply, and is most advantageous in that particular respect in which electric lighting is itself least, or not at all, so—namely, in street lighting. In the meantime, at the present stage of electrical progress, the alternate system presents advantages in respect of simple machinery, easier regulation of tension, and smaller cost per unit of electrical energy. Laying and maintaining mains are much the same in both systems; but it is more difficult in the high tension to insure and maintain due insulation. In both cases the wires must be laid underground; this imposes a heavier strain on the high tension canalization, when it conveys energy to larger districts—a circumstance which goes far to neutralize the primary economy in copper; unless, indeed, a part of the system be laid overhead. The high tension wires have therefore to be laid in solidly-constructed beds, unless they can be accommodated in sewers, etc., as in Paris. The constancy of supply depends on the good condition of the greater length of high tension cable; and the high tension is dangerous to workmen looking for faults or effecting repairs, either in the cables or about the transformers. For glow lamps both systems are equally suitable; for arc lamps both use an equal amount of energy, but the alternating current affects the carbons so as to throw more light up, an effect which can only be partly obviated by reflectors; and the alternating current in an arc lamp is noisy and produces less agreeable colors.

The comparison has hitherto run between high tension alternating and low tension direct. What about high tension direct? There are no transformers for this as simple and efficient as those for alternating currents, which give a return of 90 per cent. But high tension direct currents might be advantageously used with accumulators, which would give off at lower tensions, and would keep up the supply in case of a breakdown, or so as to enable a more economical working of the engines in respect of time. Unfortunately the sub-station, where the accumulators are, must occupy a good deal of space; very attentive supervision is necessary, accumulators are so dear that the advantage of cheaper cable disappears; yet in every town there are circumstances under which the use of accumulators would present advantages. Perhaps these circumstances may not be sufficient in themselves to call for a huge direct current station, but would lend themselves well to a small district arrangement. Such circumstances are theatre and concert hall lighting, for which all known precautions are necessary, and the use of accumulators in which ought not to be limited to the mere supply of an emergency light; though, on the other hand, the friends of an alternate current urge that the run of an alternate station is as steady as that of a gasworks. Electro-plating, chemical laboratories, electro-chemical industries call for direct, not for alternating currents; and as to the use of current for motors, it may be said that while the conditions are variable, and are most favorable where small powers are used in an industrial town, it does not at present appear that there is a pressing call for electricity for motors, to be put in place of the existing arrangements. At present the advantages are fairly balanced; and the establishment of power buildings is outside the sphere of an electric supply station. Electricity for motors, then, can scarcely be one of the hopes of a local authority proposing to put up an electric station. At present there are no alternate current motors to compare with direct current motors in efficiency, price, or management.

As to the dangers to life, health, and property; the peculiarity of the individual has a great deal to do with the result; but alternate currents, even the small ones used by medical men, are physiologically far more powerful than constant currents; the high tension alternating current of a central station is in the highest degree dangerous to life, the constant current of a small district installation is safe. The numerous fatal accidents and permanent injuries caused by alternate currents in America are sufficient to show this; but their number is mainly due to overhead working, which, in the author's view, is wholly inadmissible; still there always remains danger in the machine house and at the transformers. With direct currents there is no such danger to the consumer; and with alternate there is also none, so long as all works well at the transformers; but let the supply wires and the house wires come somehow into communication; then the house wires are more dangerous than the mains themselves, because they have not been calculated to stand the new strain, or fitted up so as to do so: and the dwellers in the house are not experts in self-protection. So, also, if the insulation in the transformers breaks down; and Dubraoa has quite recently called attention to the high tension developed in the wire supplied by a transformer at the first switching on, if that wire have any considerable capacity, a tension which may quite easily result in a dangerous spark, and to which there is nothing analogous in direct current lighting. The danger of fire from direct heating of the wires is about the same in both systems.

As to electric tramways, there is no doubt that electricity will be much used for this purpose, whether from central stations or in accumulators carried in the vehicle. The use of the direct current is preferable in the former case, and also possible in the latter, which seems to have the greater future.

The author's conclusions are: 1. Local authorities should not try, electrically, to cover the whole ground. 2. They should introduce the electric light without delay. 3. In small districts by direct currents. 4. On public account.

THE INSURANCE QUESTION.—The 24th annual meeting of the National Board of Fire Underwriters was held in this city on May 8th. The most interesting report of the meeting came from the Committee on Lighting and Heating, read by Chairman John H. Washburn. "The great problem before us to-day," he said "is the management of the various systems of electric lighting, which is not the harmless thing we had imagined, but a most prolific source of danger. It has come to stay, however, and in time it will probably be as safe as any light in use." With the report a graphic diagram was handed in, which showed that, while electric wires and lights were responsible for losses of only $460,000 in 1886, the value of property injured by fire which could be traced to the same sources in 1889 was $5,533,000. The Board agreed to adopt the rules of the New York Board in the regulation of electric light equipments, and appointed W. A. Anderson, Superintendent of Surveys of the New York Board, to meet a committee of experts at the invitation of the National Electric Light Association, to recommend rules which will make electric lighting safer all over the country.

LOW HANGING LAMPS.—Complaint continues to be made by the Boston papers of the manner in which some arc lamps in that city are hung. They are so low that a person of medium height can touch them.

THE DIATHERMANCY OF AIR IN RELATION TO THE EFFICIENCY OF INCANDESCENT LAMPS.

(F. Higgins, before the English Institute of Electrical Engineers.)

It is occasionally useful to know something of the state of the vacuum in incandescent lamps without injuring them by perforating the bulb with electric discharges. The property which air possesses of transmitting radiant heat in proportion to its density, affords a means for obtaining this information. I have not seen any mention of this property in works on the subject which I have consulted, and do not know whether my results agree with others which may have been obtained.

In order to make some comparative tests, I obtained, through the kindness of Major Flood Page, a number of lamp bulbs fitted with similar filaments of platinum iridium, as nearly as possible alike in length. Some of these bulbs were exhausted to the highest possible degree, some left open to the air, and others exhausted to a pressure equal to 1-10th inch of mercury. With a sensitive thermoscope the different qualifications of the three descriptions can be made apparent. The lamps of each class being very similar in their behavior, it is only necessary to give the results obtained with one of each type. The highest possible exhaustion is that which is supposed to be the condition of the electric lighting bulbs; the 1-10th inch gives a vacuum like that necessary for the Geissler tubes; the air-bulb, as before mentioned, open to the air.

By means of adjustable resistances and batteries, the three lamps were brought to the same degree of red heat, as nearly as could be judged. The potential at the filament terminals and the volume of current flowing were measured in each case, with the result that the air-bulb required to produce the red heat, 7·02 watts; the 1-10th inch vacuum, 5·336 watts; and the highest possible, 0·646 watts only. With the same lamps in series the highest possible becomes white hot with a current which scarcely causes visible redness in the air-bulb filament, and only dull redness in the 1-10th inch vacuum. The relative conductibility of the three bulbs, as measured by radiation upon a sensitive thermoscope, was—

Air, 325°.
1-10th inch vacuum, 250°.
Highest possible, 35°.

When the same filaments were raised to incandescence, that in the air-bulb required 31·2 watts per candle; the 1-10th vacuum, 15·20 watts per candle; and the highest possible vacuum, 4 watts only per candle.

These results show that of two similar lamps, one, merely from imperfect vacuum, may require double the current that is necessary in the other to produce the same amount of light, and at the same time become dangerously hot. The two extremes of my scale show, for example, the absorption of nearly eight times the force in the case of the air-bulb that is necessary to produce the same effect in the most efficient lamp with a higher vacuum. It is possible that vacua produced by chemical absorption of carbonic gas may be more perfect even than this, and advantageous to use. There is always some air left in a vacuum produced by a pump; but it is possible to imagine that no gas will be left unabsorbed in the case of caustic potash and carbonic acid gas being employed. Lamps which differ much in the state of their surrounding medium differ also in their behavior when current is applied. Those which have a very perfect vacuum attain incandescence slowly, and lose it in the same way; while those which are imperfect start suddenly into incandescence, and as suddenly lose it.

Personal.—Mr. Theodore F. Taylor, the well-known electrical expert of this city, is now with the Cross Primary Battery, Electric Light, Power and Manufacturing Company, of Chicago, as their electrician.

WHAT THE BEST JUDGES DECLARE AN INVENTION TO BE.*

The late Judge Hall, of the United States Circuit Court, says:

"An invention, in the sense of the patent law, means the finding out, the contriving, the creating, of something which did not exist and was not known before, and which can be made useful and advantageous in the pursuits of life, or which can add to the enjoyment of mankind.

"In other words, the thing patented must be new; and it must be useful to an appreciable extent, though the measure of that usefulness is not material. Any degree of utility appreciable by a jury is sufficient, upon the question of utility, to sustain a patent." (Conover *vs.* Roach, vol. iv. Fisher's Patent Cases, p 16.)

And Judge Sawyer, late of the Supreme Court of the United States, defines invention in the following language:

"Invention is the work of the brain, and not of the hand. If the conception is practically complete, the artisan who gives it reflex and embodiment in a machine is no more the inventor than the tools with which he works. Both are instruments in the hands of him who sets them in motion and prescribes the work to be done. Mere mechanical skill can never rise to the sphere of invention. The latter involves higher thought, and brings into activity a higher faculty. Their domains are distinct. The line which separates them is sometimes difficult to trace; nevertheless, in the eye of the law, it always subsists. The mechanic may greatly aid the inventor, but cannot usurp his place." (Blandy *vs.* Griffith, vol. iii. Fisher's Patent Cases, p. 616).

But while, as Judge Sawyer asserts, the boundary line between the domain of invention and mere mechanical skill is strictly drawn, yet some of the most valuable inventions have been so simple as to lead one to think that they were obvious, and did not rise to the dignity of invention.

Concerning the simplicity of invention, the late Judge Story, of the Supreme Court of the United States remarks:

"The simplicity of an invention, so far as being an objection to it, may constitute its great excellence and value.

"Indeed, to produce a great result by very simple means, before unknown or unthought of, is not infrequently the peculiar characteristic of the very highest class of minds." (Ryan *vs.* Goodwin, vol. i. Robb's Patent Cases, p. 729).

It not infrequently happens that a sudden lucky thought gives a man a small (sometimes a large) fortune—the outgrowth of an important invention.

More than a quarter of a century ago, the late Judge Shipman, of the United States Circuit Court of New York, embodied the idea in one of his decisions:

"A subject matter to be patentable must require invention; but it is not necessarily the result of long and painful study, or embodied alone in complex mechanism. A single flash of thought may reveal to the mind of the inventor the new idea, and a frail and simple contrivance may embody it. Some inventions are the result of long and weary years of study and labor, pursued in the face of abortive experiments, baffled attempts, and finally reached after the severest struggles; while others are the fruit of a single happy thought." (Magic Ruffle Company *vs.* Douglas, vol. ii. Fisher's Patent Cases, p. 338).

Other opinions, similar in purport, might be added; but these are sufficient to define what constitutes a patentable invention, which is important imformation for every inventor to know.

**Scientific American.*

ELECTRIC TRACTION.

The London *Electrician*, in discussing the development of electric traction, says: A perusal of some of the more recent American papers dealing with the subject of electric traction cannot fail to cause English readers to reflect on the unsatisfactory rate of British progress in this direction when compared with the very rapid development on the other side of the Atlantic. The electric railway, although of European birth, seems to have emigrated. Whilst in England there are scarcely twenty miles of road operated by electricity, in America we are informed, on Mr. Sprague's authority, that 1,500 miles are actually constructed or under contract. In this country there are only about ten electric railways to boast of, while in the States there are no less than 130 towns possessing one or more such roads; and these require for their operation 1,700 motor cars and 3,000 motors, with an aggregate capacity of 45,000 horse power. This remarkable development has, moreover, taken place within the last two or three years; for in 1885 the Americans were no further advanced than ourselves, and possessed no more than three railways, whose aggregate length did not amount to as much as eight miles.

The comparatively slow advance in this country certainly cannot be attributed in any degree to lack of skill among our own electrical engineers. The causes of it are the same as those which have retarded the development of other applications of the electric motor, and are to be sought in the cheapness of coal and in the absence of water power. Wherever natural sources of power are available, the transmission and distribution of energy by electricity has followed as a matter of course, and the familiarity with electric motors thus brought about has not only been of direct service in increasing the experience of engineers, but also, by familiarizing the public with their use, has led them to expect further successful applications. The great difficulty in England has, indeed, been to induce an over-cautious public to believe in their commercial success; and this difficulty would be to a great extent removed if the actual working powers of existing motors were more generally known.

* * * * * * * * *

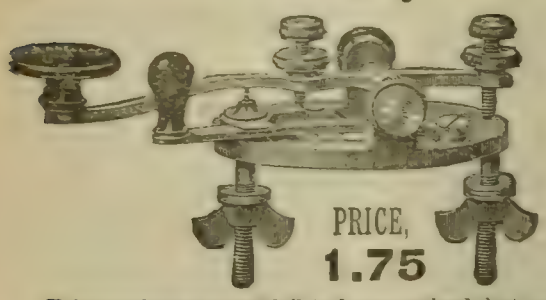
The cheapness of coal, the absence of water power, and the high state of development of other competing industries have, in this country, rendered profitable applications of motors hard to find; and the attention of electrical engineers has been so much concentrated on the commercial development of the dynamo for purposes of electric lighting that the possibilities in store for the electric motor have been somewhat neglected.

The *Electrician* calls attention to the fact that what few electric railways there are in England are nearly all commercially successful, but acknowledges that development has taken place with greater rapidity in America than in England, although in the latter country the subject of electric railways has been exploited as much, if not more than in America.

Lumber Journalism.—The *Southern Lumberman* published at Nashville, Tenn., is a very attractive journal. It is devoted to saw mill, lumber and wood-working interests, and contains much information of value in that line. It is published semi-monthly and has sixty-four pages.

Zig-Zag Lightning.—The thunder storm committee of the Royal Meteorological Society says, in a report, that there is not the slightest evidence, in the photographs taken of lightning, of the angular, zig-zag or forked forms commonly seen in pictures. A later report says, however, that these appearances are optical realities, as the cloud on which the projection of the flash is seen is often of the cumulus type, which affords an angular surface.

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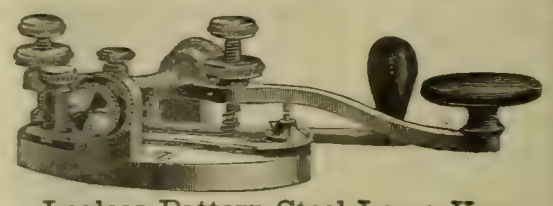


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ELECTRICAL POSSIBILITIES.

Prof. Elihu Thomson's remarks before the Thomson Scientific Club, Lynn, Mass., at last week's meeting of the Society, were fraught with significance. The opinion that the production of electric power direct from fuel without the intervention of steam will be solved, coming from such high authority, is not vain talk. Prof. Thomson does not venture statements of this character without good reason for them, and it is more than likely that he, himself, will be able to announce to the world some of these days his successful and practical accomplishment of this important result. His welding process is a sample of his genius, and it is to such men as he that the world looks for great electrical inventions and developments. His prediction, on the same occasion, that electric railroading at a speed of 100 or 150 miles an hour, with safety, would also be a future accomplishment, may seem rather startling. But when the source of this statement is considered it must be a admitted that there must be a possibility of such results. A few years ago sixty miles an hour on a railroad was regarded as simply suicidal—in fact, impossible. Now-a-days, however, speeds of sixty miles an hour are of common occurence in railway practice, and it may be that in a few years hence this speed will be a snail's pace compared with the speeds attained then on electric railways.

THOMSON-HOUSTON LIGHTS IN LONDON.—The Royal Military Exhibition was opened on May 7th, in London. The buildings and grounds are brilianty illuminated with the electric light. The lamps used are Thomson-Houston arcs, fed from the same company's dynamos.

THE ELECTRIC LIGHT IN SOUTH AMERICA.

The maintenance of electric light plants in South American countries is a lively occupation, as will be seen by the report of a correspondent printed on another page. Our South American friends, however, show considerable pluck in protecting the electric light interests in the manner they do, even if it does savor of cow-boy life. The idea of special guards, armed with knives and revolvers, patroling electric light lines to protect them from damage by employés of rival gas companies is somewhat new in our country. Even on the borders of our Western wilds we would hardly expect to find such extreme precautions necessary. But in sub-tropical countries, things are different. The Spanish mind is not built on the plan of submission to an innovation; hence the resort to daggers and bullets. It seems to us however that the electric light people are giving themselves unnecessary uneasiness. Why don't they let the gas companies' men fool with the electric light wires a few times. They would be dispatched more expeditiously than by bullets or knife thrusts. A few good whole-souled shocks would have excellent effect, and the meddlers would likely keep away from the live wires.

By the way, why is it that American systems are not more represented in South American countries than they are? There is a great field there for enterprise The Westinghouse Company, we believe, have several machines there, but these are a mere drop in the bucket. The English seem to have the inside track, but the American systems would certainly be more preferable to our Southern neighbors. That the South Americans will have the electric light at all hazards is quite evident.

Any company which will use a locomotive—and an antique specimen probably—to supply the power for running their dynamos, means business. There are no discriminating duties in the South American countries against American goods of this class, so here is an excellent field for enterprising American concerns to explore.

FATALLY SHOCKED.—On Saturday afternoon, May 19th, Bastiano Ipaldo, an Italian, while washing the front windows of the Inter-State National Bank, 167 Broadway, came in contact with an electric light wire, and received a fatal shock. Just how the contact was made is not exactly known, but it is supposed the unfortunate man for some reason took hold of the wire with his hand. As usual in a case of this kind the accounts of the accident printed in the daily papers are wonderful productions of imaginative art. It takes the average daily newspaper reporter to describe the detai'ls of an accident of this chaarcter. It is quite evident that no one but the victim himself can be blamed for the accident, but of course the electric light companies in general will receive the blessings of the daily press, and be charged with accidents due entirely to individual carelessness.

VOLTMETERS AND AMMETERS.—When a strip of material has been given a permanent twist and when it is acted upon by axial forces, there is a relative rotation of the ends; in other words, the twist gets less. Advantage of this fact has been taken by Messrs. Ayrton and Perry, the well-known English Electrical Engineers, in the new voltmeter made by this firm, which is described and illustrated on another page of this issue. Voltmeters and Ammeters constructed on this principle have been thoroughly tested and have proved to be very reliable instruments. It may be mentioned that the results indicated in the article have been completely verified by practical tests for several months, and the data are reliable. The fact that the principle of torsion has been applied to instruments of such a delicate nature as barometers seems to warrant the claim that the same idea applied to electrical measuring instruments will give quite as accurate results.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

As this issue is on the press, the annual meeting of the American Institute of Electrical Engineers is being held at the rooms of the American Society of Civil Engineers, 127 East 23d street. Officers are to be elected for the ensuing year and a paper is to be read by Gilbert Wilkes, late of the U. S. Navy, on the subject of "Electricity in the Navy." The meeting will then adjourn to meet in Boston on the following day, Wednesday, at the corner of Boylston and Clarenden streets The proceedings are to be opened at 10 a m., with an address of welcome by Gen. Francis A. Walker, Ph. D., L.L. D., president of the Massachusetts Institute of Technology. After a response by President Elihu Thomson, the following papers, according to the programme, are to be read:

"Electric Lighting in the Tropics," by Wilfrid H. Fleming of New York City.

"Magnetic Data of the Sprague Street Car Motor," by H. F. Parshall of New York City.

"Note on a New Photometer," by Dr. Edward L. Nicholas of Ithaca, N. Y.

"The Limitations of Steam and Electric Transportation," by Oscar T. Crosby of New York City.

At the afternoon session the following papers will be read:

"The Industrial Utilization of the Counter Electromotive Force of Self Induction," by Thomas D. Lockwood of Boston.

"A Study of Arc Light Carbons," by Louis B. Marks of Cornell University.

"The Practical Aspects of Alternating Current Theory," by Dr. Michael I. Pupin of New York.

"Automatic Electric Welding Machines" (with experimental demonstrations), by Hermann Lemp, Jr., of Lynn, Mass.

In the evening the members of the institute will be the guests of the Boston Electric Club at a dinner, after which a paper will be read under the auspices of the club, by Stephen E. Barton of Boston, on "Central Station Insurance."

ELECTRICAL AFFAIRS IN NEW ENGLAND.—Our New England letter in this issue covers pretty throughly the electrical field in that section for the past week. There is considerable activity in electrical matters in the East, and what they do there is done well. The East seems to be a good field for electric railway enterprise, as every letter records several new creations in that line. Boston itself seems to be leading the other large cities in this respect, and considering the narrowness and crookedness of its streets the managers of the electric roads deserve a good deal of credit for their enterprise and success. If electric roads can be successfully operated in Boston they certainly can elsewhere.

ELECTRICAL PATENTS.—Last week there were no less than 54 patents granted on inventions pertaining to or involving the use of electricity. This is a large number, and is indicative of the activity in the electrical field. It can be said of electrical patents that there are fewer worthless or unpractical inventions patented than in any other line of invention. This of course, is due to the fact that the number of persons who understand electricity are comparatively few, and, as a rule, those who do apply for patents have invented something to supply a need.

INTERNATIONAL TELEGRAPH CONFERENCE.—The International Telegraph Conference opened in Paris on May 16th. One hundred and seventeen delegates are present. M. Roche, Minister of Commerce, made the address of welcome. He reviewed the developments in telegraphy and telephony, and predicted that the deliberations of the conference would result in further improvements, and, would serve to draw closer and tighter the bonds of peace between nations.

AYRTON AND PERRY'S TWISTED STRIP VOLTMETER.

A paper read by Prof. PERRY at the British Association meeting at Newcastle, 1889.

At the Physical Society, some years ago, I announced that a strip of material, to which a permanent twist had been given, behaved in much the same way as one of our now well-known springs; that is, when it was acted upon by axial forces, there was a relative rotation of the ends; in fact, the twist gets less. As some people have a difficulty in understanding what I mean by a twisted strip, I have prepared fig. 1 to illustrate my meaning. The relative rotation is perhaps better seen in a strip whose permanent twist is right-handed at one end and left-handed at the other. If a pointer be attached to the middle, as shown at A, Q, B, fig. 2, and the ends are pulled out, the pointer rotates. This double twisted strip we have applied to weighing machines aneroid barometers, and



FIG. 1.—TWISTED STRIP.

many other instruments, such as wire-testing machines, and I can recommend its use in all cases where a force has to be measured, and where it is not advisable that there should be a considerable amount of yielding. For example, spring balances are sometimes used acting directly on specimens as testing machines; but when the specimen breaks, the recoil of the balance is likely to cause it to get out of order. Again, if a double twisted strip is used as a tension piece in a jointed structure, a pointer set at its middle will indicate the pull at any time.

The only likely suppositions I could make in thinking of what occurs in a twisted strip were, 1st, that two spiral filaments symmetrically disposed relatively to the axis resembled the two threads in a bifilar suspension, if a sufficiently short length of strip was considered; 2d, that the tensile stress was uniform over a cross-section of the strip at right angles to the axis; 3d, that the resisting couple was due to the torsional

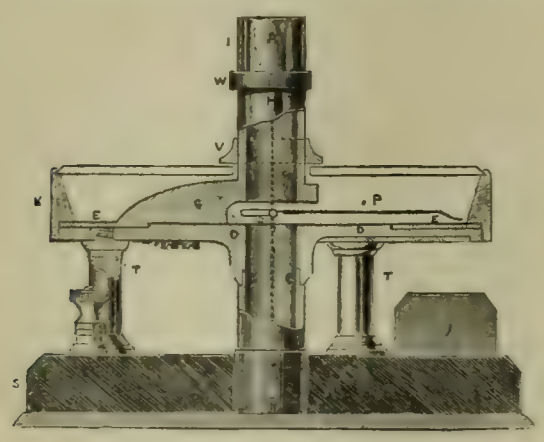


FIG. 2—SECTIONAL VIEW OF VOLTMETER.

rigidity of the section of the strip, still taken as rectangular. These suppositions lead to the result

$$\theta \propto \frac{w\, l\, n\, b}{t^3},$$

where w is the axial force, l the length of the strip, n the number of complete spires given by permanent set to unit length of the strip, b the breadth of the strip, and t its thickness, θ being the small rotation produced by the small load, w.

Now such experiments as I have hitherto made on steel strips point rather to some such law as the following being roughly correct:

$$\theta \propto \frac{w\, l}{b\, t^3}.$$

That is, the rotation seems to be independent of the amount of twist originally in the strip, and instead of increasing as the breadth of the strip increases, it diminishes. It is evident that the motion is a much more complicated one than I had imagined. Now, I found that if a double-twisted strip was placed in tension and its ends were fixed, the pointer rotated if the temperature was altered, so that its use as a pyrometer or thermometer was possible.

In this instrument before you (figs. 2 and 3), we have a tube, A, H, D, C, B, about two-thirds of whose length, A, H, D, is brass, and about one-third, C, B, is iron. A double-twisted strip of platinum silver is in tension in the axis of the tube, with its ends fastened to the ends of the tube, but one of them electrically insulated from



FIG. 3—VOLTMETER.

the tube. The tube, just at the middle of its length, D, G, becomes a strong thin bracket, which enables a pointer, Q, P, attached to the strip to make a rotation of nearly 360°, and the arrangement of the bezel and dial will readily be understood without any further description. A and B are caps to the ends of the tube; when the cap, A, is turned the initial pull in the strip is altered, and this furnishes a zero adjustment.

When the various parts of this instrument are all at the same temperature the pointer remains in the same position, whatever that temperature may be. When a current is passed through the strip the pointer records the difference of temperature between the strip and its case, and

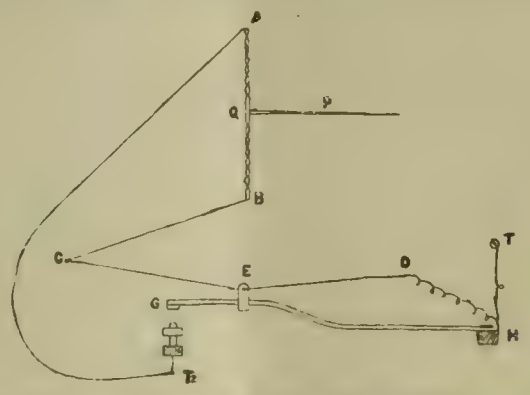


FIG. 4—SHOWING FUSE ARRANGEMENT.

hence the readings on the dial may be made in ampères. Again, the readings may be in volts for the potential difference between the ends of the strip or the terminals of the instrument. These instruments before you read to 2½ volts, they waste almost exactly *one watt* at their highest reading.

By inserting resistance of platinoid or of German silver we can increase the range of the instrument, but of course we expend more energy in such a case.

That there may be no creeping or permanent set or hysteresis, we find it sufficient before graduation of the instrument to keep sending a current greater than the hightest which is to be used on the instrument for 72 hours, breaking and making the current once in every minute. This process is performed by the second's hand of a clock passing into and out of a bath of mercury in every revolution.

It is quite wonderful to observe the complete change in elasticity produced in a strip by this kind of fatigue. The strip seems to undergo no alteration afterwards by mere use or disuse, but it is my intention to test this by many months' experience before allowing these instruments to be manufactured. The two instruments before you are the only two yet made.

I had hoped to be able to show you one in which the strip is of flashed carbon. Here are specimens of twisted carbon strips, but unfortunately they are all too coarse for a 50-volt instrument, which is what I intended them for.

For accumulator work the 2½ volt instrument is greatly needed and I prefer this form to our hot wire instrument, because of its great simplicity and its needing so very little adjustment in manufacture.

For alternating currents this 2½ volt instrument may be used through any range whatever by placing a small transformer on the base of the instrument. The little transformer before you transforms in the proportion of 50 volts to 1, so that the instrument may be used on the ordinary 100 or 110 volt circuits. By using a different winding on the transformer the same instrument may be graduated for a 1,000 volt circuit. I find that this transformer maintains the same proportionate transformation of voltage, whether the frequency of alternation of current is 50 or 100 per second.

This pleasing result was not altogether unexpected, but it certainly was unexpected to find that if a sufficient quantity of iron is used in the transformer there is a constant ratio of transformation of current for quite different frequencies of alternation. Hence I find that this 2½ volt instrument may be graduated as an ammeter up to 1,000 ampères or more, or a voltmeter up to 1,000 volts or more, the transformer being the only variable thing about it. I need hardly say that with several transformers and resistance coils at the side of this instrument we may almost call it a universal instrument.

Fig. 4 shows our fuse arrangement—T_1 and T_2, are the terminals of the instrument; current flows from T_1, through the short thin copper wire, T_1, H, then through the adjustable resistance coil, H, D, then through the tightened platinum silver wire, D, E, C, whose ends are fixed, and which is kept sagged and tight by the metal spring, H, G; then through the twisted strip, B A, to the terminal, T_2. But should the voltage between T_1 and T_2 be so great as to be liable to hurt the instrument, the wire, D, E, C, sags so much that the end, G, of the spring short circuits the instrument through G, H, and the thin copper wire, H, E, the copper wire being instantly melted.

NESTING IN ELECTRIC LIGHT GLOBES.—"A new use has been discovered for electric light globes," says a Boston paper. "The spring birds have found that they make excellent places in which to build their nests, shelt red as is the inner space from the winds and storms, and many a lively and lovely courtship may be seen almost any day by glancing at the top of the tall poles. The newcomers perch upon the edges of the globes and peep and twitter to one another as they make their connubial arrangements. Then they may be seen bringing their twigs and bits of straw and twine preparatory to beginning housekeeping.

A day or two later and the domicile is all ready for occupancy. One may see the nests from below through the glass. The dear little fellows seem happy and contented, although they live in the full glare of light by day and by night. A bird's nest one expects to find hidden beneath a branch in some cool, shady spot, and not in so conspicuous a place as this. But if the birds are happy there it is to be hoped that the faithful employés of the electric light companies will not interfere with them."

ELECTRICAL INDUSTRY IN THE SOUTH.—The Voltal Electrical Manufacturing and Supply Company, to manufacture electrical supplies, with a capital of $1,000,000, has been organized at Memphis, Tenn.

THE ACME LINK BELT.

The Acme Link Belt, manufactured by the Page Belting Company, of Concord, N. H., has many points of value which merit particular notice.

These belts are valuable for a variety of purposes, and especially for damp places, as they are the only leather belts that are absolutely waterproof, there being no cemented joints to give way by contact with dampness. For quarter turn belts they are unquestionably superior to any others made, as their joints enable the belts to adjust themselves to the pulleys more completely than solid leather belts. By virtue of their weight they are capable of transmitting a considerable amount of power without great width of belt and pulleys. When made with a center hinge joint they fit laterally to the pulley more completely than solid leather belts, and this quality assists them in the transmission of power.



FIG. 1—ACME LINK BELT.

The Acme Link Belts are constructed upon an entirely new principle, by which the defects heretofore existing in link belts are completely avoided. This belt presents absolute contact both laterally and around the pulley, thus utilizing 100 per cent. of the apparent transmitting power of the belt as compared with only a fraction of utility found in other link belts.

Fig. 1 illustrates the proper manner of running link belt. Here the belt is drawn taut upon the under side, allowing the upper side to sag and gnb the driven pulley so as to bring the belt in contact with a large portion of its circumference. This large arc of circumference in contact, and the weight of the belt, result in the largest possible amount of power transmitted. In link belts as ordinarily constructed, this way of running upon the pulleys is a necessity, because they do not possess the ability of complete contact with the pulley.

While it is desirable to run the Acme belt in this manner for obvious reasons, it is not absolutely necessary. It may be run with the upper side taut with the under side slack. The results, however are not quite so good.

The three center links of the Acme belt, which lie on the highest part of the pulley, are V-shape. These form the centre hinge, giving flexibility and adjustability to the belt. The V-shaped links throw the edges of the belt *down*, so that the belt tends to hug the pulley tighter at its edges than in the centre. Belts without centre hinge joints cannot hug the edges of crowning pulleys at all. This belt also prevents cushioning which is, as is well-known, detrimental to full transmission of power.

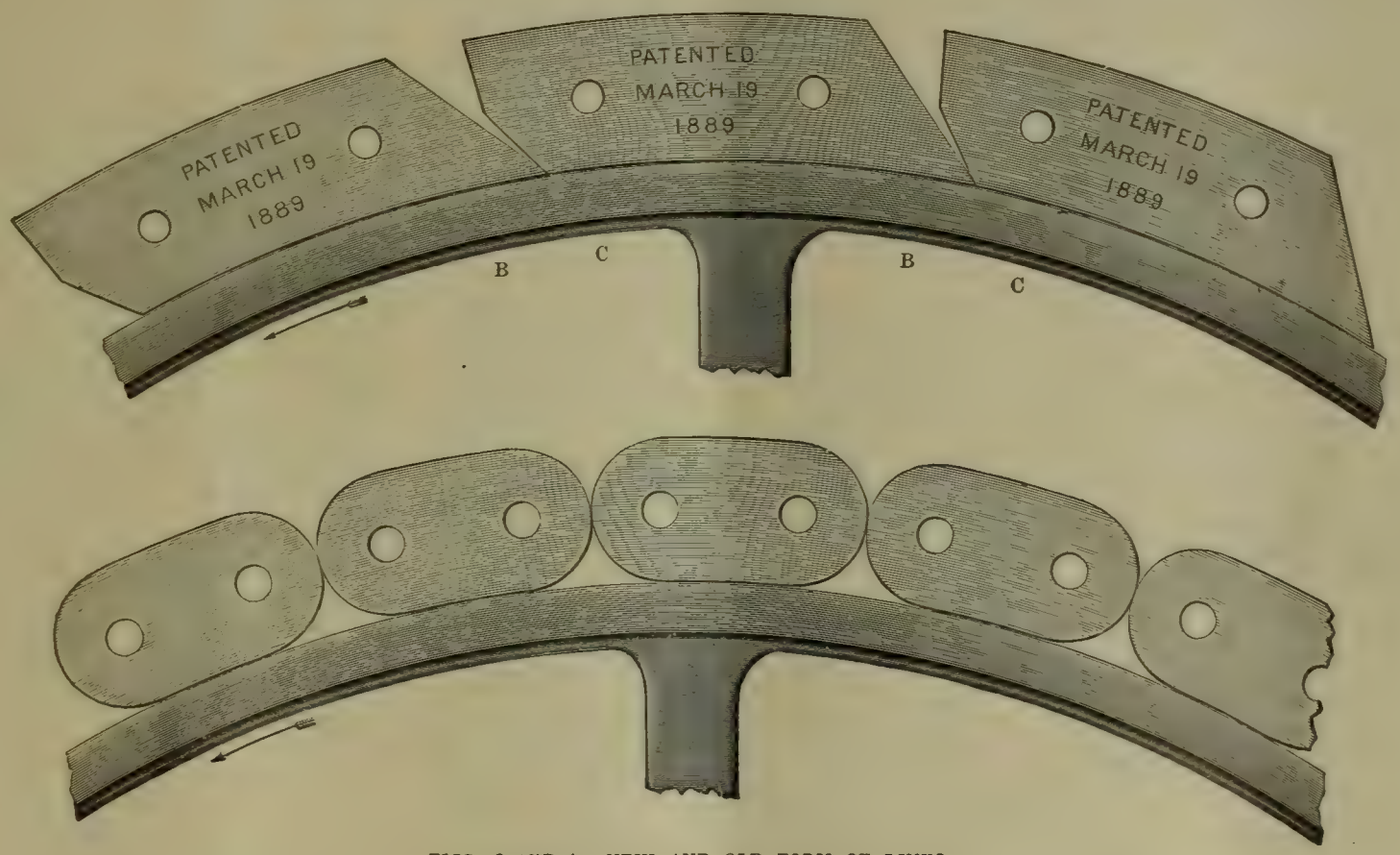
Fig. 2 shows how the Acme belt may be run from one shaft to another on a "quarter turn." These belts are especially adapted to this work.

Figs. 3 and 4 represent (in full size) an Acme belt passing over a pulley 12 inches in diameter. The links shown in fig. 4 are of the shape heretofore constructed, while those shown in fig. 3 are of the new form. Owing to the construction of the latter, they are brought into absolute contact with each other as the belt passes around the pulley, so that no space exists between them. This form of link also enables it to adjust itself, within a limited range, to different sizes of pulleys. Whether the circle be large or small the gaps between the links are always closed. By comparing figs. 3 and 4 the difference in construction and contact is apparent. In fig. 3 there is no waste space as seen in fig 4, and owing to the length of links in the former the number of bolts is reduced (about one-third) thereby reducing the liability, by that amount, of the belt getting out of repair.

The Acme belts, on account of the large power they are capable of transmitting, are adapted to main driving work. They are made of the very best material, and by means of special coupling joints can be easily put together or taken apart.



FIG. 2—QUARTER TURN.



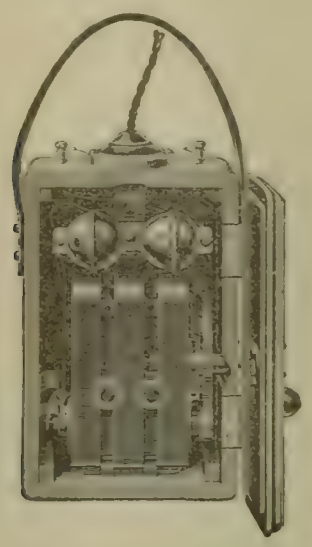
FIGS. 3 AND 4—NEW AND OLD FORM OF LINKS.

ELECTRIC TRACTION IN MEXICO.—*The Courrier du Mexique* is authority for the statement that the first Electric Railway in Mexico has recently gone into practical operation. The line connects Laredo with Nuevo-Laredo, and runs across the Rio Bravo.

ELECTRIC STORAGE.—When water is decomposed by an electric current, and the gases collected in separate receptacles, if the connection with the battery be severed, and the wires leading to the gas receptacles brought into contact, a current of electricity will flow through them in a direction reverse to that of the original current, the gases at the same time recombining to form water. Platinum terminals are required to accomplish this result. This is a storage battery in its simplest form.

A NEW AND IMPROVED FORM OF TESTING GENERATOR.

We illustrate a new and improved form of Testting Generator designed to meet all the requirements of a perfectly reliable testing magneto, combined with compactness, durability and reliability. This instrument is made to ring through a resistance of from 20,000 to 25 000 ohms, and is guaranteed to ring through 20,000 ohms. The bells inside the box are of very loud and clear tone, and can be plainly heard even when the door is closed. The parts are all selected with care and nicely adjusted, each and every part being throughly tested before the Generator is put together. A strap at the top makes it portable and the connections and rosette for the cord, finishes the instrument, and makes it as complete as can be desired. The Holtzer-Cabot Electric Company of Boston are making a specialty of these instruments, and they have already secured an enviable reputation.



NEW TESTING GENERATOR.

These Generators are invaluable for the use of Central stations and wire men, and should be in the possession of every one using such instruments.

New Incandescent Lamp.—In a new incandescent lamp the carbon filaments are made of raw silk, and a needle is fitted inside from the socket to the glass tips, which prevents the filament from shaking, and also attracts the particles of carbon to it. The arrangement is claimed to prevent discoloration.

Insulating Compound.—A new insulating compound consists of a mixture of carbolic acid and shellac. The acid is heated to the boiling point and the shellac added, the product being a semi-plastic mass of great toughness and tenaciousness and impervious to changes of temperature and to moisture.

The Westinghouse Company.—The Westinghouse Electric Company of Pittsburgh, Pa., have just issued a very handsome pamphlet descriptive of their system of arc-lighting by the alternating current. The pamphlet is truly a work of art, both typographically and in design. The engravings are of fine workmanship, and the descriptive pages are beautifully illuminated. The Westinghouse Company is an enterprising concern, and this pamphlet shows that they know how to blend the beautiful with bu siness.

Phonographs.—The waxen cylinders of the phonograph, containing the words of great men and women, will after the lapse of time become valuable, says an exchange, more so than their autographs. The autograph is a mere sign, and only reminds you that such a person once lived, but with the phonograph cylinder the case is different. Place it in the instrument and the person is with you. It is his own voice, so to speak, though he has been dead a hundred years.

A THEORY OF PERMANENT MAGNETISM.

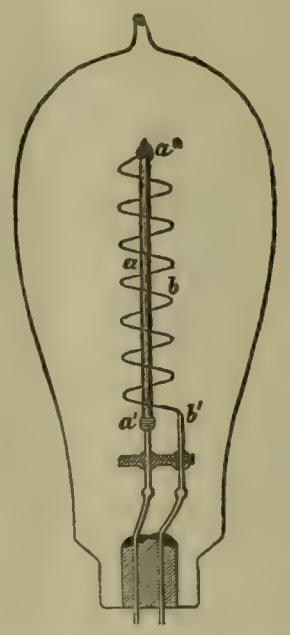
At a recent meeting of the Physical Society in London a paper prepared by M. Osmond was read by the secretary. The author pointed out that iron exists in at least two molecular states —soft iron, annealed and slowly cooled, which he has called *a* iron ; and this, when raised to a certain critical temperature, passes into the second form, which he has called β-iron, and the latter state is partially retained on cooling, especially if the cooling is rapid and the iron contains a considerable proportion of carbon and manganese. Electrolytically-deposited iron is of the β variety, which may also be produced by cold hammering. The author then regards a bar of steel, after allowing for the carbides, phosphides, and sulphides which may be mixed with it, as consisting of an intimate mixture of the two varieties in proportions which are determinate at any one point, but may vary from point to point. He supposes the β-iron to form a sort of porous non-magnetizable framework, interlaced with polarizable and mobile particles of *a*-iron. These particles after displacement, caused by placing the mass in a magnetic field, will be prevented from returning completely to their original positions by the presence of the rigid framework of β-iron, and so a permanent magnet will be formed.

The paper was accompanied by a diagram in which the author attempted to depict his theory graphically. He thought it explained the fact that expansion, shocks, or vibration tend to diminish the permanent magnetism of a bar, as any of those would tend to make the framework more open, and, therefore, allow the polarizable particles to move more freely. The magnetizing force required to produce saturation would increase with the proportion of β-iron, which was in agreement with the experimental fact that iron containing a large proportion of carbon or of manganese—Speigel iron, for example, which contains 25 per cent. of manganese—is non-magnetic. The theory also explains the difficulty, after a bar has been magnetized to saturation, of magnetizing it to the same extent in the opposite direction; this being due, on the author's theory, to some of the particles of the *a*-iron being immovably entangled within the framework of β-iron.

Lighting of the Eastern Railway Station in Paris.—An important electric light installation has been completed at the Eastern Railway Station in Paris. The three-wire system of distribution is employed both for the incandescent and arc lamps. The machinery comprises a set of Belleville boilers, and three groups of Weyher and Richemond engines and Sautter-Lemonnier dynamos. Two of these groups supply the necessary current, whilst the third is kept in reserve. The dynamos are series wound, of the two-pole type, and have a capacity of 100 h. p. each whilst running at 300 revolutions. There are in daily use 130 arc lamps requiring 860 ampères, and 1,500 glow lamps taking 1,180 ampères. At this rate of consumption the dynamos are not worked at their full output, and including the third group, the total reserve plant amounts to 20 per cent. The switchboard has been so arranged that one dynamo can easily be replaced by another without any variation in the E.M.F. taking place in the circuit at the moment when the one machine is withdrawn and the other started. An arrangement has been adopted whereby the working of the dynamos may, if desired, be changed from the three-wire to the two-wire system. A noteworthy feature in this installation is, that the railway company's engineers obtained the whole of the plant from French firms, possibly in view of the agitation of the Paris electricians against the employment of foreign machinery in the central stations in that city. The arc lamps used in this installation are of the Cance, Bardon and Henrion types.

A NEW INCANDESCENT LAMP.

Langham & Co., of Berlin, have just patented a new lamp (see fig.), the principal feature of which is the vertical prop, *a*, supporting the incandescent spiral, *b*. This prop is connected at a^1 with one of the two electrodes, and at a^2 with the spiral which joins the electrode at b^1. It consists of a core and envelope, the latter being formed of two metals or alloys, whose coefficient of expansion differs. The heat caused by radiation occasions a difference in expansion between the core and envelope and the internal tensions, the result being the suppression of all lateral flexion.



NEW INCANDESCENT LAMP.

An Enormous Leather Belt.—What is declared to be the largest leather belt in the world is in process of manufacture at the establishment of Charles A. Schioren & Co., in Ferry street, this city. This enormous belt is 160 feet long and 72 inches wide. It is being made of two thicknesses of hide, and contains the hides of 175 animals. The total weight of the belt when finished will be two tons. It will require the work of twenty men for a period of two months to complete it. The fly-wheel which the belt is to encircle is part of the machinery of a Louisiana electric light firm, and is 28 feet in diameter and 74 inches in width. A special hydraulic press of 400,000 pounds pressure has been erected by the makers of the belt in order to squeeze it together. When properly glued and riveted the services of twenty-five men will be required to put the belt in position, and one week will be consumed in the job. The total cost of the belt will be about $10,000, as it is valued at $10 a square foot.

Electrical Apparatus Burned.—By fire at Willetts Point, N. Y., on May 10, the Government lost property valued at one million of dollars. Among the property destroyed was all the electrical apparatus belonging to the station. These included nine Fish torpedoes, valued at $8,000 each, and the Sims-Edison torpedo apparatus valued, it is said, at many thousands of dollars.

Igniting Gas By Electricity.—For igniting gas by electricity the spark from an induction coil is more reliable than heating platinum wires to incandescence. The latter method has been almost entirely abandoned.

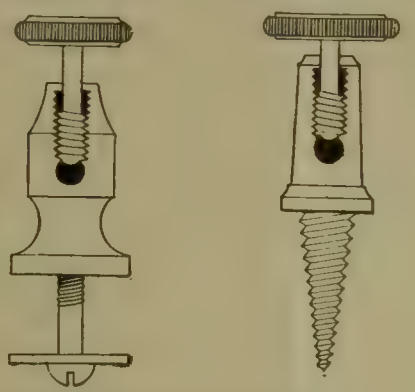
Alternating Magnetic Fields.—If two or more closed circuits are similarly affected inductively by an alternating magnetic field, they will attract one another, and tend to move in parallelism.

Electric Welding.—In electric welding the current from an alternating current dynamo is transformed into one of low potential but of large volume.

THE DELANY SECURITY BINDING POST.

It is always a pleasure to notice an improvement, even in small things, which fosters advantages manifestly important and at the same time so apparent at the first glance as to cause the mental inquiry "why was that not thought of before?" The accompanying cuts illustrate an improvement of this character—The Delany Security Binding Post.

That necessity is the mother of invention we all know, but it is the appreciation of this necessity which impels the practical observer to find remedies for defects and vexations as he meets them Everybody who has had anything to do with electrical instruments knows the trouble and annoyance arising from loss of binding post screws. They disappear in shipment of instruments. They fall out of moving parts. They are worked out by vibration and get lost in various other ways, plain and mysterious, frequently impairing the usefulness of important instruments and sometimes causing serious trouble. All this need no longer be. The screw of the new binding post cannot come out. It backs out just far enough to clear the hole, but no further. The thread of the screw is on a shoulder larger than the stem, and as the neck of the cup is turned over tight up to the stem, the screw part cannot pass. The operation is plain and perfect. The binding posts are made in all sizes and shapes. They look just like the



DELANY'S SECURITY BINDING POST.

ordinary binding posts. It will be strange indeed if they do not supplant the ordinary binding posts altogether, not only for telegraph and telephone instruments and switches, but for all kinds of electrical machinery, including dynamos and electric motors. One great advantage of the new post is that when wiring has to be done in dark and difficult places it can be known with certainty that the wire-hole is clear when the screw is withdrawn to the limit.

The E. S. Greeley & Company have the exclusive right of manufacture and sale and will supply all dealers.

ELECTRIC HEATING.—In an electrical exhibition in San Francisco an illustration was given of the saving that was effected when gas is used as a fuel instead of an illuminant. During the evening's run the gas engine, which works the electric plant, consumes 300 cubic feet of gas, and furnishes 53 sixteen-candle power incandescent lamps, while 53 sixteen-candle gas lights, with five-foot burners, would require 618 feet for the same length of time. This is a saving of over 50 per cent.

SAFETY APPLIANCE.—A recent invention consists of a fender for street railway cars run by electricity. It presents a platform capacious enough to receive a victim so unfortunate as to be caught upon the track before a car. At a slope before it is a heavy four-ply rubber belting, pliable enough to pass over paving stones and similar objects but sufficiently rigid to prevent an arm or leg from being drawn under the fender.

ELECTRIC LIGHT WORKS BURNED.—The buildings of the Taunton Electric Light Company, Taunton, Mass., were partially destroyed by fire May 13th, causing a loss of $10,000.

EASTERN NOTES

BRANCH OFFICE OF THE ELECTRIC AGE, ROOM 10, COOK BUILDING.

BOSTON, May 16, 1890.

The Framingham Electric Street Railway Co., will petition the council for a franchise at their next meeting.

The West End Railway Company commenced running open cars on their electric lines on Thursday last.

The American Institute of Electrical Engineers will hold a meeting at the Institute of Technology on Wednesday, May 21st.

The Fall Mountain Paper Co., of Bellows Falls, Vermont, have secured the contract to light that town with 30 arc lights of 2,000 C. P. each.

The Standard Electric Company, have just installed a 300 light plant on the Steamer Winthrop running between New York and Bar Harbor.

The armature of a 1000 light alternating current dynamo was burned by lightning at the station of the Malden Electric Company, last Wednesday night.

The Washburn and Moen Manufacturing Co., of Worcester, have petitioned the Legislature for permission to increase their capital from $1,500,000 to $2,500,000.

The United Electric Light Company, of Springfield has begun extensive additions to their already large plant which, when completed, will double its capacity.

The Randolph Power Company, will furnish power to Messrs. Strickland & Pierce of that city who are to engage in the manufacture of bicycle shoes and gymnasium goods.

The code of signals based upon the Morse alphabet which was recently adopted by the Navy Department for signalling between ships at sea, is practiced daily at the Charlestown Navy Yard.

The Black Rocks and Salisbury Beach Railway Co., have purchased the franchise of the Plum Island Street Railway Company and will at once commence the extension and equipment of the lines.

George E. Honnors, who has been connected with the Gloucester Exchange of the New England Telephone and Telegraph Companies, as supervisor, has been appointed manager, Geo. O. Stacey having resigned from that position.

George W. and Belle Harmon have brought suit against the Newport Street Railway Company for $5,000 damages for injuries alleged to have been received by Miss Harmon by an accident on one of the company's electric cars last August.

It is understood that the proposed syndicate deal for the possession of the existing lines of street railway in and out of Salem will undoubtedly be consummated in a few days. It is possible that the entire system will be running by the first of June.

Bird & Sloane is the style of a new firm who have just started for themselves in the electrical field. Both are young men, thoroughly acquainted with the business, and will no doubt attain success. They will make a specialty of electric light wiring.

The Atlantic Works at East Boston are building radial steel trucks for the Robinson Radial Car Truck Co., and the Bemis Car Box Co. of Springfield is building fourteen trucks of the same description to be used on the West End Railway under open cars which are now being built.

Work has been commenced on the Union Electric Street R. R., which is to run between Sawyer's Mills, in Dover, N. H., to Salmon Falls River, in Great Falls, a distance of six miles. Poles for two miles are set, and it is expected to have the work completed and the road in running order July 1.

A new concern has been organized in Holyoke, Mass. under the title of the Holyoke Electric Company. The capital stock is $10,000 and the number of shares 100, valued at $100 each. The company is organized for the purpose of generating, distributing and selling electricity for light, heat and power.

The machines of Lieut. Wood, U. S. N., for welding shells, which have been in course of construction for some time at the works of the Thomson Electric Welding Company, is now an assured success. The prospect is that the new company, which has been planning, will soon be formed.

A. Jarratt Lewis, manager of the Long-Distance Telephone, was married in Malden, on the afternoon of May 14th, to Miss Selina W. Bailey. Rev. B. H. Bailey, the father of the bride, performed the ceremony. The happy couple will take a short wedding trip, after which they will reside in Malden.

The Essick Printing Telegraph Company, have leased a line form the W. U. Telegraph Co., between Boston and Washington and will give exhibitions daily between these two points. Jas. H. Howard of the Inter-Continental Telephone Company, is negotiating with R. D. Wilson & Co., for the right to introduce the system of telegraphy in South America.

The New York parties who are expected to put capital into the electric railway at Athol have been negotiating for a location for a central station. It is not certain whether Athol or Orange will be chosen. The road was to be started July 15th, but work is delayed because of the inability of the company to get the orders for electrical machinery filled quickly. It is not improbable that the plant will be located at Orange and that the railroad company will do the town lighting.

The Thomson Scientific Club held their first annual banquet at Exchange Hall, in Lynn, last Wednesday night. Prof. Elihu Thomson was the principal speaker, his subject being the electrical engineering problem of the future. He predicted that sooner or later the problem of getting electrical power direct from fuel, without the intervention of steam, would be solved, and that some time electrical railroading would be so perfected that a speed of 100 or 150 miles an hour would be secured with safety. Other speakers were Rev. Dr. Hazlewood, J. F. Much, A. K. Rohrer and J. F. Randall.

The Thomson-Houston Co. are tearing down the old carpenter and paint shop in their yard to make more room, the carpenter work having been transferred to Factory G, in Centre street. The new office building of the Company on Centre street will be occupied in a few days. The basement will be used for testing and calibrating instruments and testing raw materials; also, for storage of models. The reception room and the office of C. J. Van Depoele, railway electrician, D. M. Banton and clerks in charge of the order department, and Lieut. Spencer, local purchasing agent, will be upon the first floor.

Articles of association have been prepared and the necessary subscriptions secured for a new street railway corporation to be known as the Newton Central Street Railway Co. The capital stock is $30,000, and it is expected that the overhead system will be used, as many of the principal subscribers to the stock are also interested in the Newton street railroad now constructing a line between Newton and Waltham. The location to be asked for is between Newtonville and Newton Centre. A corporation is forming for a storage battery line on the same location but the articles of association have not as yet received the necessary signatures.

W. J. P.

ANSWERS TO INQUIRIES.

Editor of the ELECTRIC AGE.—Will you kindly inform a student what is the difference between closed circuit and open circuit dynamo armatures, and oblige,

R. H. G.

Walla Walla, Wash.

Answer.—A closed circuit armature is one in which all of the armature coils connect with each other, while each coil also connects with a separate segment of the commutator. An open circuit armature is one in which terminals of the coils are connected directly with commutator segments. The coils have no electrical connection with each other as in the former case. The Gramme ring is an example of the first type of armature. The armatures used on Edison dynamos are examples of the second type.—[Ed. ELECTRIC AGE.]

J. R. M. asks if Mr. Edison has always used bamboo fibre for the filaments of his lamps. No. Under his first patent, in 1879, Mr. Edison made the filaments from brown paper or cardboard. These were too fragile for practical use and were soon abandoned. In 1880 he took out a patent which practically covers his present method of preparing filaments.

Editor ELECTRIC AGE.—What is the cause of the cloudy appearance of incandescent light globes after some use? ARTHUR McD.

Taunton, Mass.

Answer.—The blackening or clouding of the interior of direct current incandescent light globes is due to the wastage of the material of the fila ment. Infinitesimal particles of carbon are driven off, probably in the form of vapor, and adhere to the sides of the glass. During his investigations into the cause of this, Mr. Edison observed that the wastage is greater in one-half of the filament than in the other. The reason for this is supposed to be the same as that for the unequal consumption of the carbons in the direct current arc lamp.—[Ed. ELECTRIC AGE.]

HAYWARD, Quebec.—No; an alternating current will not do for electro-plating purposes. A direct or continuous current must be used. An alternating current would not do for the reason that work done in the electrolyte by the one current would be undone or neutralized by the other.

Ed. ELECTRIC AGE.—Please explain the principle of operation of the Edison current meter, and oblige, WM. H. J.

Muscatel, Iowa.

ANSWER.—The Edison current meter is constructed on the principle that the quantity of current consumed on a lamp circuit is in direct proportion to the quantity of metal deposited by electrolysis by a small portion of the current from the same source, passing at the same time through a shunt.—[Ed. ELECTRIC AGE.]

THE ELECTRIC TORCH IN "ASCANIO."—An interesting application of electricity to theatrical purposes was made in connection with the ballet in *Ascanio*, M. Saint-Saën's new work at the Paris Opera. This was the torch carried by the genii and constructed by M. Trouvé. The torch, which was of very limited dimensions, had to be kept alight for a quarter of an hour each evening. An incandescent lamp was concealed beneath the "jewelled" torch-head and a battery of six accumulators was placed in the staff. The accumulators were of the Plantè pattern composed of leaden plates 5 centimetres high and 7 centimetres broad, rolled upon each other.

The total active surface was about a square decimetre per element. Each accumulator had a casing of thin glass enveloped in gutta-percha and measuring 7 centimetres in height and two centimetres in diameter. The batteries were divided in two superposed groups, and the elements were all mounted in series with an intervening space of 1½ millimetres between the plates. The accumulators were capable of holding out for 30 minutes, *i e.*, two performances. They supplied a 10 volt 3 ampères current during 20 minutes In lighting the torch, the actress who took the part of Phœbus and carried the genii's torch, applied thumb pressure to a spring situated in the handle, when the connections were formed and the lamp was lighted. The accumulators were daily charged at the electric station attached to the opera.

AN INSULATING PAINT.—The greatest natural enemy of electrical insulation is moisture. Anything that will prevent absorption of moisture in an insulating substance will, therefore, necessarily preserve its insulating qualities. One of the best articles in the market for this purpose seems to be Gould's Elastic and Fireproof Paint. This paint is absolutely impervious to the elements or acids. It is entirely devoid of oil, which, as is well known will, on account of the evaporation of the oil, corrode and crack in a short time. The Gould paint, however, becomes harder and more durable the longer it has been used. The insulation of electric wires coated with this paint is prolonged indefinitely. Some tests have recently been applied to this paint to determine its mechanical resisting qualities, and the results were remarkable. In order to make the tests tin plates and other metals were coated with the paint. A fire test was made by applying heat to the painted surface of 250 degrees, F. The paint showed no signs whatever that such heat had been applied to it. Muriatic acid was then put on the surface of the paint on the tin and 300 degrees of heat applied underneath without any injurious effect whatever to the paint. A piece of painted tin was bent and the fold hammered flat. It was then straightened out and the paint was found to be uninjured in the least. Other severe tests were applied but the paint in each case was unyielding. The paint was submitted to various tests by the Advisory Board of the Navy Department with the result that it was recommended by the board as being the best paint adapted for naval use. Very thorough tests are now being made of the paint by a prominent electric wire manufacturer to determine exactly its value as an insulating material, and in a couple of weeks we will be able to report the result of these tests. Mr. W. W. Kughler, of 250 St. Nicholas avenue, New York, is the sole agent for the paint.

AGE OF ELECTRICITY.—The voltaic battery is ninety years old. In the year 1800 Volta invented the famous Voltaic Pile, which is the parent of all primary batteries. Electricity has, of course, existed ever since the creation of the world, and possibly before, but it was not until 600 B. C., 2,490 years ago, that its manifestations were observed by a human being. In that year Thales, of Milete, discovered the peculiar power produced by rubbing a piece of amber. Hence frictional electricity, as far as our knowledge of it is concerned, is 2,490 years old.

TRANSFORMERS.—The relation which exists between a primary inducing coil and a secondary coil in an inductive apparatus or transformer, says Prof. Elihu Thomson, is of the same nature. The secondary coil is merely a conductor immersed in the medium which surrounds the primary coil. The latter, and the wire leading to it from the source of current, is but the core of a set of disturbances or strains in the ether surrounding it, and in which the secondary coil is immersed. Hence the coils, though insulated from each other, are yet both immersed in the medium whose transmitted strains are the real expression of electrical energy transmitted. The result of this relation is, that, were it not for the fact that the coils must necessarily be made of imperfect conductors, the amount of energy transmitted to a secondary coil from its primary could be unlimited—it might be thousands of horse power, and the iron core of the transformer be only of such size as to be easily lifted in the hand.

PERSONAL.—Mr. T. F. Clohesey of Kansas City, the well-known electrical expert, was a recent visitor to the commercial metropolis. He returned home with a deep-rooted conviction that New York s a great place.

CARE OF COMMUTATORS.—It is very important and necessary that dynamo commutators should be kept true and clean; otherwise trouble will result. Never use a file on a commutator.

CAUSE OF CURRENTS IN DYNAMO ARMATURES.—The current developed in the armature coils of a dynamo is due to the cutting of the lines of magnetic force of the field by the armature coils during their rotation.

CELLULOID.—The Deutsche Celluloid Fabrik has recently introduced perforated celluloid plates for holding the active material of accumulator plates. It has been found to satisfactorily resist the action of sulphuric acid

AN ELECTRICAL COMPETITION.—The Société Belge d'Electriciens announces that a prize of 500fr. will be awarded to the author of the best manual of electricity suitable for foremen and electrical artisans. The works, which must be in French, are to reach the secretary of the society not later than May 1, 1891.

FELLING TREES BY ELECTRICITY.—The forest trees may be felled by a wire heated to a white heat by electricity, and drawn through it, and it may afterward be cut into boards by the same means, thus doing the work of a circular saw. The only drawback would be in the fact that the wood would necessarily be charred by the passage of the hot wire.

PROTECTING MEN-OF-WAR.—The latest scheme to protect men of-war at anchor from the sudden attack of torpedo boats at night is to surround the vessel at the proper distance with a wire, through which an electric current is sent. This wire may be supported at intervals by buoys. When a vessel or any body touches the wire, a light blazes up and discovers them to the assailed.

THE PROTECTION OF IRON FROM RUST.—Herr Haswell, of Vienna, proposes to protect iron from rust by coating it with a layer of electrolytically deposited manganese dioxide. The iron is made the anode of an electrolytic bath, containing a .05 to .5 per cent. solution of chloride or sulphate of manganese, and from 5 to 20 per cent of ammonium nitrate. Carbon is used for the cathode. On passing the current the iron becomes coated with a firmly adherent and inoxidizable film manganese dioxide.

ELECTRICAL CURRENT.—There is a growing tendency among electricians to regard the effects of what is called an electrical current in a conductor to be due, in large part at least, to a movement of particles or to a transmitted strain which has its place entirely outside the wire or conductor, and in the space around such conductor. The wire and current in it are regarded simply as the central core of a set of disturbances in the medium surrounding it, by which medium the energy of the current is actually transmitted, if the current itself is not merely an effect of such a set of disturbances in the surrounding medium.

DIVISION OF APPLICATIONS FOR PATENTS.—Under the rules of the Patent Office two or more independent inventions cannot be claimed in one application, but where several distinct inventions are dependent upon each other and mutually contribute to produce a single result they may be claimed in one application and under one fee. If several inventions claimed in a single application be of such a nature that a single patent may not be issued to cover them, the inventor will be required to limit the description, drawing and claim of the pending application to whichever invention he may elect. The other inventions may be made the subject of separate applications, which must conform to the rules applicable to original applications.

SOME RECENT ELECTRICAL PUBLICATIONS.

ELECTRIC LIGHT INSTALLATIONS AND MANAGEMENT OF ACCUMULATORS. — A Practical Handbook. By Sir David Salomons, Bart., M. A. Fifth Edition; revised and enlarged, with 100 illustrations. $1.50.

This book is the best ever published, giving details on the subjects named in its title. The management of accumulators is a subject that is not very well understood, and this book gives all the information possible. Electric light installations is a very practical subject these days and too much knowledge concerning them cannot be had. This book is a practical one, and every one interested in electricity should possess a copy.

ELECTRIC TRANSMISSION OF ENERGY, AND ITS TRANSFORMATION, SUBDIVISION AND DISTRIBUTION. — A Practical Handbook. By Gisbert Kapp, C. E. Second edition; pp. 348; 124 illustrations. $3 00.

This book brings the subjects covered by it up to date, and is full of valuable information on these important topics. It is particularly valuable to every one interested in electric power.

ELECTRICAL INSTRUMENT-MAKING FOR AMATEURS. —A Practical Handbook. By S. R. Bottone, author of "The Dynamo," etc. With 60 illustrations. Second edition. Cloth. $1.20.

In studying electricity nothing is so instructive as the making of the instruments for practical use. This book gives full directions for making apparatus.

EXPERIMENTAL SCIENCE. By George M. Hopkins. pp. 740, with 680 illustrations. $4.00.

This book treats of the various topics of Physics in a popular and practical way. It describes the apparatus in detail, and explains the experiments in full, so that teachers, students and others interested in physics may readily make the apparatus, and perform the experiments without difficulty. The amateur electrician will here find simple instructions in the measurement of resistance, and of electro-motive force and current strength; the best arrangement of batteries; the construction of dynamos and motors. He will also find the principle of the dynamo, the telephone, and other electrical machines and apparatus fully explained.

THE ELEMENTS OF ELECTRIC LIGHTING, including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson, A. M., Ph. D., author of "Elements of Static Electricity." Fifth revised edition; pp. 255, with 104 illustrations. $1.50.

This is a valuable book for beginners in the study of this interesting subject, and, having mastered the principles of electric lighting as set forth in this work one is quite well prepared to solve many of the difficulties that beset the path of the practical electric light man.

All of the above named books are for sale by THE ELECTRIC AGE, No. 5 Dey street, New York. Send for our catalogue of books.

THE MOON'S HEAT MEASURED—The problem of measuring the moon's heat has been solved at last by Mr. C. V. Boys, one of the professors at South Kensington. By means of quartz filaments he has produced a thermopile of almost incredible delicacy. By this remarkable apparatus he can render sensible the heat of a candle up to the distance of a mile and three-quarters, and by directing the minute disk of the instrument to the moon he has shown that the warmth received from its reflected light is equal to that given out by a candle at twenty-one feet distant. Observation seems to show that, although the moon's face is under the blaze of an unclouded sun for fourteen days, it remains comparatively cool, and that whatever heating it does ultimately receive is rapidly gained and as rapidly lost.—*St. James's Gazette.*

THE TELEPHONE IN VENEZUELA.

In our Boston letter in last week's issue brief mention was made of the sale by the Inter-Continental Telephone Company, of its telephonic rights, government concessions, etc., in Venezuela to a European Syndicate. We have been enabled since to obtain more facts concerning the deal. The company has over 1250 paying subscribers, and earns 7 per cent. net on $200,000, which is its capital at par. The concession and business have been transferred, with the approval of the Venezuela government, and the new company, the Venezuela Telephone & Electrical Appliances Company (limited) of London undertakes to extend the business throughout the country, wherever a paying system can be established, and for that purpose has taken over the Tropical American Telephone Company's contract, and already purchased about £7,500 of new supplies, instruments and apparatus, including multiple switchboards, iron poles, Bell and Blake telephones and transmitters, and expects to expend about £10,000 more during the present year. All this business comes to the Tropical American Telephone Company, the assignee of the inventors in South and Central America. This is the field where the American Telephone Company Consolidated, so called, attempted to do a business in competition with the Inter-Continental Telephone Company, under an alleged concession from the Venezuela government, and which company raised something like $100,000, under a prospectus, with Hon. Benjamin Butterworth as president. When the true facts were shown during a newspaper exposé, all the money was refunded and Mr. Butterworth resigned. The stockholders will now realize how small a chance they had to succeed, and those who reinvested their money, will undoubtly lose it as the new English company will brook no competition or interference, and the English government will allow no injustice through "duplicate" concessions. Mr. Derrom, the old manager for the Boston concern, takes charge of the business for the new English company. The Inter-Continental company expended about $125,000 in its Venezuela plant its shares are held by a very few, mostly officers of the Tropical American Telephone Company, which company is a large shareholder and will realize handsomely from the sale, besides retaining a good customer in the English company. Mr. Howard further says the Tropical Company can now resume its dividends, if it chooses, out of its released funds from the proceeds of this sale It will get something like $40,000 cash by June 1.

PROTECTION AGAINST ABNORMAL ELECTRIC CURRENTS.

To the Editor of The Electric Age:

In the last issue of your interesting paper I saw an article headed "The Crandall Electric Protector" you truly stated "many mechanical devices have been evolved, and many have died through inherent weak points. In this line as in all others, however, the fittest survive, and the *fittest* of this class of inventions is the one we are about to describe." I ask in justice to other devices of this class that a few facts may be put before the public that do not appear in your article. I was a spectator at the recent tests made under the auspices of the Boston Board of Fire Underwriters, and saw a Crandall Protector destoryed also coils same as used in telephones burnt up which were supposed to be protected by one of the instrumeuts. I ask is this protection? The Crandall Instrument is limited to telephone or other ground lines and can not be used on a fire alarm or other metallic circuits. When connected to a telephone if the abnormal current is 4½ amperes and 100 V. with the telephone off the hook the telephone is *not protected* and will burn out. The breaking of the circuit is not a desirable feature as the armature will vibrate on back contact causing a miniature electric light on the protector. As far as meeting all the requirements it is false.

Boston, May 17. "FAIR PLAY."

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE
35 COMMERCIAL BANK BUILDING.
CHICAGO, May 17, 1890.

THE EAST AND WEST RAILWAY CO. has been formed at Pittsburg, Kansas, with a capital stock of $20,000.

ST. CHARLES, Mo., is agitating the question of an electric light plant for commercial purposes, to be under city control.

MANAWA, Iowa, will have electric lights, the Council Bluffs City Council having decided to extend the city plant to that town.

MICHIGAN FUEL COMPANY has been formed at Chicago to manufacture gas and electricity. Capital stock, $2,000,000; incorporators, George B. Kedder, Thomas S. Porter, C. C. March.

THE ATCHISON (KANSAS) STREET RAILWAY is reported to have changed hands, H. J. Ransom of Des Moines, Ia., and some Boston parties having purchased a three-quarter interest in the road. The line will be equipped with electricity, the Sprague system being employed.

THE ILLINOIS ANGLO-AMERICAN STORAGE BATTERY CO. recently moved into new quarters at 177 La Salle street, and report much business on hand and many orders coming in They claim that their battery has passed the experimental stage and has gained the confidence of the public, and they look forward to great results during the year.

THE JOPLIN (Mo.) Electric Light Plant has been sold to an eastern syndicate who propose to build an immense electric light and power plant and furnish power for running mining machinery as well as furnish light. Ample water power has been secured to drive the electrical machinery, and the new company will invest $200,000 in the enterprise.

W. P. ADAMS & COMPANY will now take care of the Western agency for the McIntosh-Seymour engine, that firm succeeding J. A. Grant & Company in this city. Mr. Adams is well known in electrical circles, having been connected with the International Thomson-Houston Company. Mr. J. E. Wilson, the other member of the company, has been for some years in the engine business and has been in the Chicago office of the McIntosh-Seymour since it was first established. The office of the company is, as before, 103 Adams street.

NEW RAILWAY SYSTEM.—The rapid transit problem which has been absorbing the attention of Detroit, Mich., for some time has resulted in the offering of another solution. The Detroit City Railway Company have been for some months experimenting with storage batteries, and while very satisfactory results have been attained, the company have been at the same time conducting other experiments, the result of which is the proposed new system, of which Mr. R. Van Renssellaer Sill is the inventor. Trolley wires, whether overhead or in conduits, and storage batteries, have no place in the new system, the current being carried from the dynamo through an insulated wire placed underground between the rails of the track. The track is divided electrically into sections and the current passes from the main line by means of conductors through a converter and switch on the surface and to one rail, thence through the wheels on that side to the motor on the car, and returns by means of the wheels and rail on the other side. Mr. Sill has been experimenting with the system for a year, and it is said to work to the entire satisfaction of the company, experimentally. An 80 ampère current with an E. M. F. of from 0 to 150 volts, according to the speed at which the car is running, operates the system, and the current will pass through only that section of the track over which the car is passing. It is estimated that $5,000 per mile will equip a road exclusive of car equipments. A trial will be made on the company's road within a month or two.

Mr. J. H. Reid is out of the city on a trip to California. He will spend about six weeks in the west looking after business interests.

Mr. Charles P. Williams, the Pennsylvania representative of the North American Construction Company, was in Chicago on business last week.

The National Electric Construction Co. have recently placed a 20-light 2000 candle power dynamo of the Schuyler system in their station at 14 and 16 Calhoun Place, Chicago.

The Kickapoo Transit Company has been formed at Springfield, Mo.; capital stock, $20,000; incorporators, W. H. Park, C. A. Walterhouse, William Reinhoff, J. D. Williams and others.

The North American Constructon Company are erecting an electric plant in Youngstown, Ohio, which will consist of five alternating incandescent dynamos of the Westinghouse system.

The Merrill (Wis.) Railway & Lighting Co. will install an electric street railway system in that city, the Westinghouse apparatus being used. Work has been begun on the road and the line is to be in operation within seventy days.

The Sperry Electric Company shipped a 50-light arc dynamo to the Paterson Illuminating Company, Paterson, N. J., this week They are well pleased with the results obtained from their new large size dynamos, several of which have recently been installed.

The Knapp Electrical Works, of this city, were visited with a fire on the 13th, the damage done by fire and water probably amounting to $3,000. The loss is fully covered by insurance. Mr. M. A. Knapp was at the time in New York, but upon receipt of the news was quickly at home The company is at business as usual, and has experienced but slight inconvenience in the matter.

New Companies.—Cairo Electric Street Car Line, Cairo, Ill.; capital stock, $100,000. West Duluth Electric Company, West Duluth, Minn.; capital stock $50,000. Calumet Electric Street Railroad Company, Chicago, Ill.; capital stock, $50,000.; to construct a street railway line from some point in Chicago to the boundary line between Illinois and Indiana. Incorporators, N. K. Fairbank, Joel D. Harvey, William V. Jacobs, Otho S. Gaither, and S. E. Gross. This company is considering both the overhead electric and the storage battery systems and expect to have the first four miles of their line under way in a short time. The capital will be increased as rapidly as needed.

The Pennock Electric Railway System is to be installed on Capt. John Hall's road in Peoria, Ill., Mr. George B. Pennock, manager of the Pennock Company, having secured a contract for eight motor cars equipped with their system. The motive power for this system is furnished by a primary battery, for which the inventor makes strong claims. A single cell, it is said, will supply a current of 50 ampères at an E. M. F. of 2 volts for about five minutes when a short rest will restore it to its normal condition. The motor cars will be 15 feet in length, and weigh not to exceed 6,000 pounds, and each will carry 180 cells of battery. The cells will be arranged in sections, and by means of an automatic switch the sections will be called into use, one after another, for a period of five minutes each, thus permitting each set to be restored to its full working condition before being called to again perform work. The complete system will cost about $24,000, or $3,000 per car, and the cost of maintenance is estimated by the inventor to be not to exceed four cents per car per mile. The motors used will be specially wound for 40 volts and 150 ampères. The Pennock cell consists of a carbon box 17x5x5 inches, closely fitting within which is a porous cup containing solution and the zinc element.

The Westinghouse Electric Company began work on the 12th inst., on an electric street railway in Pittsburg, Kansas. The line is to be about 2½ miles in length, double track being laid part of the distance. This will be the first plant erected by the Westinghouse Company, and they are sparing no pains to make it a model installation.

W. P. Adams & Company, western representative of the McIntosh-Seymour engine, are to be congratulated upon the sale of two 200-horse power engines, made this week, to the Chicago Edison Company for their Adams street station. The Chicago Edison Company have been for some time looking into the various engines, and their having finally selected this make, together with the recent sale of 600-horse power by the same firm for the new Wisconsin Central Depot, speaks well for the McIntosh-Seymour engine and their western agents. This firm has something new in the shape of a 500-horse power tandem double compound engine, designs of which are in their western office. Two of these engines have been sold in Salem, Mass., and are giving splendid results.

The Wisconsin Electric Club took formal possession of its rooms in the Plankinton Block, Milwaukee, and held its opening banquet Thursday evening, May 15th. At the close of the elaborate banquet an original poem was read by Mr. Bradshaw, electrician of the New Insurance Building, which was followed by a talk from the president. Toasts were responded to as follows: "The Advancement and Application of Electricity in Our City," John B. May. "Electric Cranks," E. H. Bottum. "Electric Cranes," A. J. Shaw. "What I don't Know about Electricity," D. J. Whitmore. "The Electric Telegraph," Peter McGill. "The Telephone," John D. McLeod. "Automatic Fire Alarm," William C. Schaefer. "Electrocution," Harry Sawyer. "Electric Cars," John A. Hinsey. "Storage Batteries," Alex. Bevan. "The Electric Press," J. B. O'Hara. "The People and Electricity," R. C. Spencer. "The Phonograph," H. D. Goodwin. F. M. I.

ELECTRICAL TEST INSTRUMENTS.

Philadelphia has the reputation with some of being rather slow and conservative but it is interesting to notice that Queen & Co. the well known makers of electrical test instruments, have apparently outgrown their surroundings and are building up a wonderful business in their line. Until within the last two or three years practically all the measuring apparatus used in this country was imported from abroad, a popular feeling existing that the value of an instrument was enhanced if a foreign name appeared on it. We are glad to say, however, that such is not the case now. Queen & Co. have demonstrated that they can make electrical test instruments at least equal in quality to the best of foreign makes, and as reasonable in price. They are finding customers for their standard resistance boxes, portable testing sets, ammeters, voltmeters and their specialties, in all parts of the United States and have even had inquiries from abroad. They report a recent large sale to the Northwest, comprising Ayrton & Perry instruments, portable testing sets, Cardew voltmeters, tachometers, etc., to the amount of about $1,500. This is a sample of the demand for their apparatus. We are informed that a new and enlarged edition of their catalogue I-66 is in the printer's hands now. It will pay all who desire a copy to correspond with them.

Recreation.—The employés of two English Electrical concerns recently played a matched game of cricket. It would be helpful to American Electrical industries if their employés would indulge in a friendiy contest now and then on the base ball field.

Personal.—Mr. W. H. McKinlock, of the Central Electric Co., Chicago, is in town.

STORAGE BATTERY PLANT.

There is now established a storage battery plant composed of sixty 300 ampère cells made by the Pumpelly Storage Battery Company, at the Erie Flat, cor. of 37th street and Lake ave., Chicago, which furnishes the flat with one hundred lights from 10 p. m. to early morning continuously. This plant is charged from 7 o'clock p. m., when the dynamo starts up, until 10.30 p. m., and while the dynamo is furnishing 200 lights during that time it is also charging the battery of 60 cells. This is done in the following way: The dynamo is a Thomson-Houston compound wound incandescent machine of 300 light capacity, furnishing a current of 170 ampères, and 110 volts. This necessitates the charging of the batteries in parallels of two, that is thirty cells in each series. The dynamo at present has to furnish to the lights in the building a current 100 ampères, and has about 70 ampères to spare. These 70 ampères are divided by a simple method of switches between the two series of batteries, 35 ampères going to each, from 7 o'clock until 10.30, thus putting into the battery what may be called in general par'ance 122 ampères. After 10.30 p. m. one hundred lights are needed in the halls and other places until early morning, say five hours, which would be 150 ampères. Hence the battery, when installed, is charged with 300 ampères; as it loses each night about 50 ampères more than is put into it. The first charge is called upon to furnish the extra current for, say three nights, and on the third day the dynamo is started up early in the afternoon and charges the cells with a current of 100 ampères, 50 to each series. The charging current in this case is taken from the dynamo by cutting out the series coil, and making a shunt wound dynamo of it as far as the battery current is concerned. Two Rheostats, lately invented by Foree Bain, are placed one in each series of cells, with an Edison Ampèremeter connected, so that the current going to each series of batteries can be evenly controlled, a very important point, since one cell in the series of less internal resistance than the others might be the means of carrying all the current, leaving one of higher resistance without a charge. The plant gives great satisfaction and comfort to the occupants of the beautiful building. Although the house is piped for gas, none seems now to be needed, and the entire plant is run with nearly the same amount of coal that would be burned did the dynamo shut down at 10:30 and the occupants of the flat use gas for the rest of the time. The light from the battery is for at least two hours much better and clearer than from the dynamo, and after that quite as good. The manner of connecting with this style of dynamo was planned by Mr. Harry Osborn who has charge of all the lighting plants for the Pumpelly Company, and it works admirably.

New Signal Systen for Railway Traffic.—Captain A. Frassinari, First Lieutenant Del Buono, and Commander J. Nigra, manager and proprietor of the electrotechnical establishment in Alessandria, have invented an electric signal system, the object of which is to ensure safety in railway traffic and to advoid collisions. The Italian Minister of War has invited the inventors to Rome in order to test the system, and the Minister of Public Works is expected to help in the trials. Details of the system are not given.

Lights Going Out.—For a year or more the buoys marking the channels in New York harbor have been lighted by electricity to enable the mariners to reach the city by night as well as by day, but their lights are now likely to go out through the exhaustion of the appropriation for their maintenance. These lights are connected with shore through sub-marine cables, and have given good satisfaction to navigators. The latter will have to feel their way in the dark when the lights are out.

Erg-ten.—This term is disposed to designate ten million ergs, or $1 \times 10^{10} = 10{,}000{,}000$.

THE ALTERNATING TRANSFORMER SYSTEM IN SOUTH AMERICA.

A correspondent of the London *Electrical Review*, writing on the above-named subject, says :

The alternating transformer system which has only of late been introduced into South America finds there continued and very satisfactory extension. This fact is the more significant as the industrial development of the South American States is still in a very primitive stage ; and, indeed, South America derives its supplies of industrial articles almost exclusively from Europe. The rapid extension of the transformer system is due in part to the demand for light in civilized tropical regions (which is much more intense than in northern countries), and, in part, to the very high prices of gas in the South American towns. Hence the competition of the electric light is easy and tempting, which induces the erection of extensive electric works. For such installations, at least in large towns, the use of the transformer system is the cheapest and the most convenient, especially as in South America there is no objection to the application of aerial leads on a large scale.

The first application of the transformer system was at Montevideo with two machines, each of 80,000 watts, erected in 1887 by MM. Luis Podesta and Luis Topolansky. After this installation had been set in successful action, its owners succeeded in floating a large electric company, which was constituted under the title "La Uruguya," and after obtaining a concession for the electric lighting of the city, it erected large works with six machines of the Zipernowsky type, W_6, collectively of the capacity of 480,000 watts, which have been already in successful operation for nearly a year. Certainly the working conditions are still rather South American, as is shown very drastically in the following interesting extract from a letter of the managing engineer. He writes :

"Spring is now beginning, and the street boys have begun their usual games, slinging, aiming stones at the porcelain insulators on the supports of the leads, kite flying, etc. It is needful to keep a sharp eye on the primary leads. Three men go about all day armed with long poles in order to knock down kite-tails from the leads."

Of still greater interest is the subjoined extract from another report :

"We must watch lest the lamp-lighters of the gas company, who, from intelligible reasons are the sworn foes of the electric light, do some mischief. There are, even in our own staff, some men who, from ill-will, seek to play tricks on their fellows. For half the town I have thirty men in this service, as well as some secret inspectors, armed with knives, who look out for the mischief makers. I myself often enough range the streets by night, accompanied by my first official, with loaded revolvers in our pockets. The chiefs of the wire and lamp inspectors are on horseback, as also myself and my chief official, and as soon as any mischief begins we gallop up from all sides."

As an interesting detail in the execution of the electric works at Montevideo, I may mention that the condensing water for this installation is drawn from the sea at a distance of 250 metres. The condensation arrangements have been supplied by Tangye Bros., Limited, of Birmingham.

At Buenos Ayres an installation is in course of erection with two alternating current machines of the type A_8, each for 320,000 watts (consequently a joint capacity of 640,000 watts). The electric machines and transformers, as well as the steam engines, have been already supplied, the former by Ganz & Co., of Buda-Pest, the latter by the Machine Company of Brünn. Both the steam engines (of 600 H. P. each) and the alternating current machines make 125 revolutions per minute, and are in direct connection, so that the magnet wheel of the alternating current machine forms the fly-wheel of the steam engine.

At Mercedes a transformer installation for lighting the town has been erected. An alternating current machine of the type A_7, for 160,000 watts is here in use. It is driven by means of a band by an engine of 300 H.P., supplied by Ruston, Proctor & Co., of Lincoln. A second engine is to be procured by way of reserve.

In Brazil the transformer system is being worked by an electric company at San Paulo. It was founded in 1887 under the style "Marques Monthe y Ca.," and wished to begin with erecting a large transformer installation at San Paulo. But the slender means of the company did not permit the completion of the works which they had commenced. They had to confine themselves to the erection of a small continuous current installation, driven by a locomotive for lighting up a limited district of the town. Last year the company was reorganized with an accession of fresh capital, and the undertaking, thus strengthened, adopted the name Companhia Luz Electrica de San Paulo, and is occupied with the erection of two electric works at San Paulo and Casa Branca.

The installation at San Paulo is for the present equipped with an alternating current machine of the type A_5, of 50,000 watts, and a corresponding number of transformers, the latter enclosed in iron cases and fixed on wooden supports. The motive power is furnished by a Westinghouse engine of 80 H. P.

At Casa Branca there is used an alternating current machine of the type, A_3, (30,000 watts), driven by a "Colonial" steam engine by the firm, Tangye, Limited, of Birmingham. Here, also, the transformers are placed in iron cases on wooden supports.

Both at San Paulo and Casa Branca wood is used as heating material in the installations. In Brazil the competition of the electric light with gas is much facilitated by the high price of gas-coal, whilst wood for fuel can be very cheaply procured from the primitive forests. Insulated aerial leads are used in both cases.

Shaver Telephones.—The Shaver Corporation report a very brisk demand for their acoustic telephones. They are now four months behind in their orders, so great has been the call for these instruments, and the Corporation asks the indulgence of their patrons. The Corporation's capacity for putting out their telephones will, in thirty days, be doubled and with these increased facilities delays in filling orders will be avoided in the future. In this connection some figures will be of interest : Two hundred girls have been engaged for nearly four months in mailing advertising circulars of the Shaver Corporation. They mailed 100,000 circulars per day for over three months. Altogether 10,000,000 circulars were sent out. It cost thousands of dol'ars to do this but it pays to advertise liberally. The increased business of the concern is abundant evidence of the truth of the business maxim that advertising pays.

Personal Notice.—National Electric Manufacturing Company, of Eau Claire, Wis., have established an eastern agency in this city, at 50 Broadway, with Mr. Z. Latshaw as manager. A construction company has also been formed in connection with the office. Mr. Latshaw is well-known in the electrical field, having been the New York agent of the United Gas Improvement Company, of Philadelphia, and operating the Heisler System. The National Company are to be congratulated on securing one of the brightest and most competent men in their line.

The International Telegraph Congress.—Out of the 150 invitations to take part in the Congress at Paris, 90 have been accepted ; 37 government administrations and 53 telegraph companies are included in the latter number. The festivities in honor of the congress will be a banquet, an evening at the opera, and two official receptions and entertainments at Compiègne and Versailles.

LARGE ELECTRIC RAILWAY CONTRACT.

Nothing is more indicative of the rapid growth and development of the South than the manner in which the towns and cities in that part of the Union are adopting electricity for illuminating purposes as well as for operating all kinds of machinery. The street car service is also undergoing a revolution or transformation in that section at a rapid rate, and the time is not far distant when the southern mules, with all their mulish tricks and vices, will be relegated to other service than that of hauling street cars through the handsome cities and prosperous towns now springing up in every southern state.

Among the most prominent cities, which nature appears to have specially designed, by reason of its fine geographical position and almost illimitable mineral resources, to speedily become the metropolis of the Sunny South, is Birmingham, Ala., the citizens of which are as full of sand as the citizens of the great English town of Birmingham, the metropolis of the Midlands, after which it is named. The rate at which this southern city is growing is simply phenomenal ; and within the last few days there has been commenced there an undertaking surpassing anything of the kind ever before attempted, and placing Birmingham in the front rank of American cities. This is the consolidation of the Birmingham and Bessemer Railway Company, and the Union Railway Company, under the title of the Birmingham Railway and Electric Company, which company will now operate from sixty to one hundred miles of road, the entire length of which will be equipped with electricity.

This equipment will necessitate an outlay of well nigh $2,000,000, and the contract for the entire undertaking has been placed with the Thomson-Houston Electric Company. The consummation of this colossal undertaking is due to the enterprise and fine business capacity of Mr. T. T. Hillman, one of the most brainy, popular and successful men in the South, who, in this great undertaking has associated with him some of the strongest men of Birmingham. This gentleman owns rich coal and iron interests and may be considered one of the commercial leaders. He is also a self-made man and stands deservedly high in business circles.

Mr. Hillman has been elected President of the newly consolidated company and Mr. Robert Jennison, Manager. The company will at once place contracts for rails, car bodies, engines and boilers for the central power station which is to be equipped with a steam plant of 2,500 horse power capacity. The overhead construction will be adopted, the centre iron pole being used for supporting the conductors.

This consolidation and the placing of the contract with the Thomson-Houston Electric Company has created quite a breeze in many parts of the South, and it is a positive fact that already its effect is being felt among speculators and prospective settlers and the markets are strengthening in every direction. The undertaking is considered by representative men to be fraught with good for the entire South.

The Ferranti System in France.—The Ferranti system appears to be meeting with considerable success in France. The Compagnie Nationale d'Électricité has at the present moment Ferranti machines in operation at the Paris Municipal station, at Nancy, Rethel, Vierzon, Sens, Melun, and Hâvre, and concessions have just been obtained at Nimes, a town of 70,000 inhabitants, and at Troyes (Aube), a town of 65,000 inhabitants. Some successful public tests were also made a few days ago at Paris with an arc lamp designed by M. O. Pattin, which it is intended to run in connection with the Ferranti system.

Eddy Currents.—Armature cores are laminated for the purpose of avoiding the formation of eddy, or Foucault currents.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED MAY 13TH.

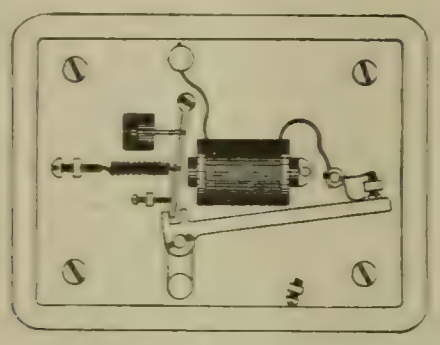
427,513. Electro-plating Bath for Copper. Wm. B. Hollingshead, Bronxville, N. Y., assignor to James G. Batterson, Hartford, Conn. Filed Sept. 23, 1889.

427,515. Electrical Transmission of Power. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Original application filed Nov. 18, 1889. Divided and this application filed Feb. 17, 1890.

427,522. Electric Switch. Ocron S. Platt, Bridgeport, Conn. Filed Oct. 31, 1889.

427,523. Electric Switch. Ocron S. Platt, Bridgeport, Conn. Filed Oct. 31, 1889.

427,530. Electric Current Regulator. Ernest P. Warner, Chicago, Ill. Filed Feb. 3, 1890.



NO. 427,724.—AUTOMATIC ELECTRIC CUT-OUT.

427,534. Stopping Mechanism for Knitting-Machines. James T. Ashworth, Bristol, Conn. Filed May 25, 1889.

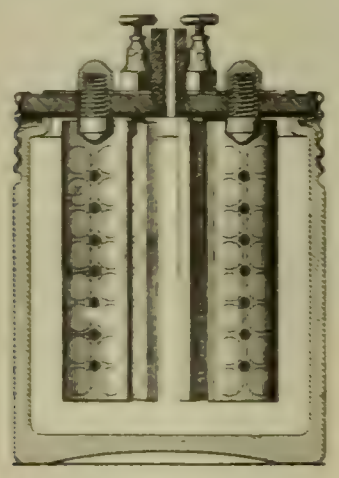
427,540. Lightning Arrester. Louis Bell, Lafayette, Ind. Filed Nov. 7, 1889.

427,541. System of Electrical Distribution. Louis Bell, Lafayette, Ind. Filed Nov. 7, 1889.

427,548. Fuse Block. Charles F. Brush, Cleveland, Ohio. Filed Nov. 21, 1889.

427,549. Electric Pole. John M. Burton, Wichita, Kans. Filed Mar. 18, 1890.

427,569. Trolley Arm for Electric Cars. William F. Harriman, Des Moines, Iowa. Filed Feb. 24, 1890.



NO. 427,789.—SECONDARY BATTERY.

427,571. Alternating Current Apparatus. Edward Heyman and Frank W. Heyman, Boston, assignors to James E. Maynadier, trustee, Taunton, Mass. Filed June 10, 1889.

427,574. Electric Heater. Benjamin C. Howard, Baltimore, Md. Filed Dec. 28, 1889.

427,589. Guide for Trolley Wheels. Henry A. Marks, Lynn, Mass. Filed Feb. 24, 1890.

427,620. Electro Magnet. Francis J. Patten, New York, N. Y. Filed Dec. 28, 1889.

427,621. Multiple Switch Board Test System. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 6, 1888.

427,622. Switch Board. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 16, 1886. Renewed Feb. 24, 1890.

427,623. Test Circuit for Multiple Switch Boards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1888. Renewed Feb. 24, 1890.

427,624. Multiple Switch Board Test Circuit. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1888. Renewed Feb. 24, 1890.

427,628. Trolley or Collector Wheel for Electric Railways. Sidney H. Short, Cleveland, Ohio. Filed Mar. 18, 1890.

427,674. Carbon Brush for Motors. Leo Daft, Plainfield, N. J., assignor to the Daft Electric Light Company, New York, N. Y. Filed May 23, 1889.

427,681. Electro Matrix Machine. George A. Goodson, Minneapolis, Minn., assignor to the Minneapolis Electro Matrix Company, same place. Filed Mar. 23, 1889.

427,710. Composition for Supports for Secondary Battery Electrodes. Walter F. Smith, Philadelphia, Pa., assignor to the United Electric Improvement Company, Gloucestor City, N. J. Filed Sept. 10, 1889.

427,711. Fire Alarm Regulator. Clarence J. Spike and Hedley V. McLeod, Halifax, Nova Scotia, Canada, assignor of one-half to Arthur C. Hawkins, same place. Filed Nov. 19, 1889.

427,724. Automatic Electric Cut Out. Edward M. Bentley, New York, N. Y. Filed Mar. 16, 1888.

427,725. Electric Railway. Edward M. Bentley, New York, N. Y. Filed Aug. 9, 1888.

427,726. Contact Device for Electric Railways. Edward M. Bentley, New York, N. Y. Filed June 5, 1889.

427,742. Telephone Exchange Apparatus. John J. Carty, New York, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed Mar. 23, 1889.

427,746. Electrical Conductor for the Transmission of Power. William J. Cordley, Richmond, Va., assignor of one-half to Walter D. Moses, same place. Filed Aug. 6, 1889.

427,748. Electric Meter. Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Electric Improvement Company, Gloucester City, N. J. Filed Nov. 25, 1889.

427,749. Method of Measuring and Registering Electric Energy. Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Electric Improvement Company, Gloucester City, N. J. Filed Nov. 30, 1889.

427,751. Electrical Converter. Sebastian Z. de Ferranti, Hampstead, County of Middlesex, England. Filed Oct. 10, 1888. Patented in England, France, Belgium and in Italy.

427,762. Electric Signal. Josef Haas, Jr., Vienna, Austria-Hungary. Filed July 10, 1889.

427,781. Electro Pneumatic Clock System. Carl A. Mayrhofer, Berlin, Germany, assignor, by mesne assignments, to the Electro Pneumatic Time Company, New York, N. Y. Filed Dec. 5, 1889.

427,783. Electric Circuit Closer for Railway Signals. Frank E. Morgan and Frederic A. Lane, New Haven, Conn. Filed June 17, 1889.

427,785. Secondary Battery Electrode. James F. McLaughlin, Philadelphia, Pa. Filed Mar. 17, 1890.

427,789. Secondary Battery. Thomas F. Nevins Brooklyn, N. Y., assignor of one-half to John W. Carter and Harry Carey, both of same place. Filed Dec. 8, 1888. Renewed Apr. 9, 1890.

427,823. Fuse Plug. William A. Anthony, Hartford, assignor to the Mather Electric Company, Manchester, Conn. Filed Feb. 23, 1889.

427,876. Telegraph Key. John S. Kaylor, Bismarck, Ill. Filed Aug. 26, 1889.

427,878. Guard and Stay for Electric Railway wires. Conrad J. Kilian, Milwaukee, Wis., assignor of one-half to Dustin Atwood, same place. Filed Dec. 30, 1889.

427,879. Electric Indicator. Frederic A. Lane, New Haven, Conn., assignor to the New Haven Clock Company, same place. Filed Apr. 5, 1889.

427,917. Multiple Switch Board. Charles E. Scribner. Chicago, Ill., assignor to the Western Electric Company, same place. Original application filed Mar. 20, 1882. Divided and this application filed July 28, 1884.

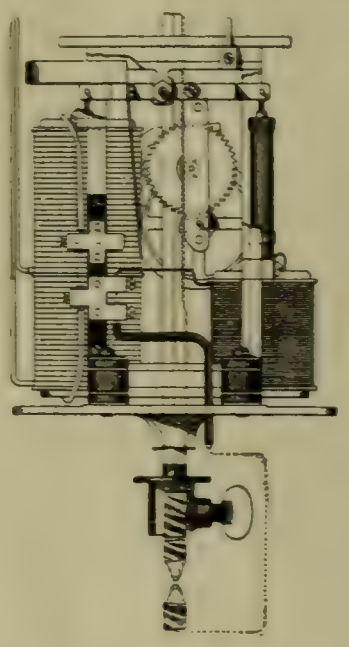
427,928. Non-Conducting Covering. Joseph L. Stillman, Fresno, Cal. Filed Nov. 13, 1889.

427,951. Incandescent Electric Light Bulb. Thomas B. Atterbury, Pittsburg, Pa. Filed Oct. 23, 1889.

427,953. Electric Train Signaling Apparatus for Railways. Eugene J. J. de Baillehache, Paris, France. Filed Feb. 21, 1889.

427,966. Motor Car. George M. Brill and John A. Brill, Philadelphia, Pa. Filed Oct. 12, 1887.

427,971. Method of Electric Welding. Chas. L. Coffin, Detroit, Mich. Filed Apr. 24, 1889.



NO. 428,008.—ARC LAMP.

427,974. Means for Effecting Communication in Telephone Systems. Louis J. Crossley and Walter Emmott, Halifax, and John F. Harrison. Bradford, County of York, England. Filed July 14, 1886. Patented in England.

427,978. Alternating Current Motor. Michael von Dolivo-Dobrowolsky, Berlin, Germany, assignor to the Company Allgemeine Elektricitats-Gesellschaft, same place. Filed Nov. 13, 1889. Patented in Germany, France, Belgium, Luxenburg, Italy and in Switzerland.

427,984. Automatic Lightning Arrester. Claude M. Griffin, Kansas City, Kans. Filed Jan. 18, 1890.

427,986. Lantern for Electric Arc Lights. John W. Gwynn, Bucyrus, Ohio, assignor of four fifths to J. B. Gormley. Robert Maudsley, Mary Blanch Lement and Kate E. Lement, all of same place. Filed Sep. 24, 1889.

428,008. Arc Lamp. Philip Lange, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed Jan. 11, 1890.

428,026. Process of Shrinking and Fulling Felt by Electricity. Francis C. Taylor, Danbury, Conn., and John R. Hard, New York, N. Y., assignors of one-half to Peter V. Husted, New York, N. Y. Filed Feb. 21, 1889.

428,030. Electrical Target Trap. James Wolstencroft and William H. Soley, Philadelphia, Pa. Filed Aug. 14, 1889.

MAGNETIC QUALITIES OF STEEL.—The name "steel" covers as large a variety of magnetic qualities as it does of mechanical. Beyond the differences which result from difference in chemical composition, the range is extended by the effects of mechanical treatment, and above all by the effects of annealing, hardening by quenching, and tempering. As a rule, steel which is mechanically soft or "mild" is magnetically soft, its permeability is comparatively high, and its coercive force is low; and steel which is mechanically hard is magnetically hard. Thus, if we compare samples differing in their percentage of carbon, we find, as a rule, corresponding differences of magnetic hardness; the harder samples—that is to say, those with more carbon—are less susceptible and have more coercive force. Again, as regards the effects of temper, specimens which have been hardened by quenching from a red heat are magnetically much harder than specimens of the same composition which have been annealed.

Other constituents than carbon affect the magnetic quality, often very greatly. Chromium and tungsten increase the coercive force immensely; and tungsten, in particular, is a usual constituent in magnet steel.

BLEACHING BY ELECTRICITY.—Russians now do bleaching by electricity. The method is stated to be much cheaper than that hitherto used, where chloride of magnesium was employed. The operation also does not require so much attention; the emptying and refilling the tank with the solution in which the electrolytic apparatus is placed being about all that is necessary.

CONVERTERS.—In order to reduce the magnetic resistance converters are iron-clad.

INSURING ITS EMPLOYEES LIVES.—The Detroit Electric Light and Power Company, it is said has a plan of insuring the lives of its employees for $5000.

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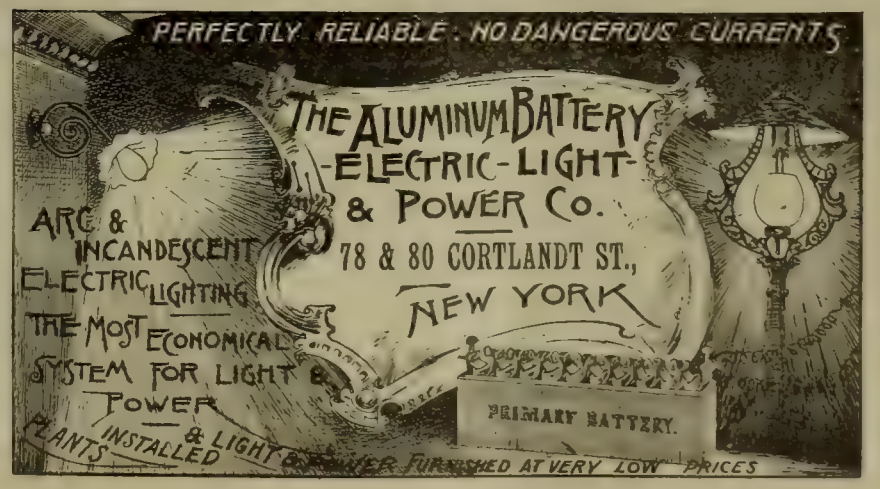

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NEW YORK, MAY 31, 1890.

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SLOW SUBWAY CONSTRUCTION.

The Subway Construction Company and Commissioner of Public Works Gilroy, do not get along together very well. At every meeting of the Board of Electrical Control, the Commissioner has some complaint to make about the lack of enterprise on the part of the Subway Construction Company. He claims that their dilatoriness interferes with the paving of streets. At the last meeting of the Board, on the 19th inst., he had a similar tale of woe, and Mayor Grant directed him to proceed with the work of paving in all the streets involved, and that if the Subway Company is not ready in each of them the resolution directing subways to be laid in those streets will be rescinded and no other electric lights can be used in those streets than the Edison system.

One of the noticeable features of the subway muddle has been the entire freedom of the Edison Company from all connection with the fight. That company wisely kept out of the trouble, and while the different factions were at war with each other, trying to annihilate or swallow each other, the Edison Company has been like the busy bee, improving each shining hour. They had not time to fight, and by standing aloof they gained the confidence of the city officials as well as that of the general public. All through this fight the Edison Company have been putting down their wires in a quiet way, and they have discreetly kept in harmony with the authorities, as Mayor Grant's order to Commissioner Gilroy indicates. The Edison Company have given the Commissioner no trouble whatever. They have always planned their work so as to precede the pavers, and just as soon as their pipes are properly laid underground the pavers follow right after. If there was as much industry and sincerity shown by the Subway Company as by the Edison there would be no reason for the constant friction between it and the authorities. The result of it all is that the Subway Company will likely be shut out of many streets altogether, while the Edison Company are enjoying the reward of their wise forethought.

THE KEMMLER CASE.

The Supreme Court of the United States on May 23d, denied the application for a writ of error in the celebrated Kemmler case. The application to this Court was for a writ of error to bring up for review the judgment of the Supreme Court of the State of New York, affirming an order of the county judge of Cayuga County, remanding the relator to the custody of the warden of the State prison at Auburn, upon a hearing upon *habeas corpus*. The Court holds that cruel and unusual punishment means barbarous methods of punishment, such as burning at the stake, crucifixion, etc., and that the prisoner is not deprived of rights under the fourteenth amendment of the Constitution.

The next step in the case will be the argument of the appeal from the decision of County Judge Corbett, of Cayuga County, denying a writ of *habeas corpus*, asked for on the ground of the unconstitutionality of the power conferred on Warden Durston, in the execution of criminals, which power it is claimed to be vested in the sheriff of the county wherein the conviction is had. The appeal will come up before the General Term at Buffalo, on June 3d. This appeal does not effect the death penalty itself, or the crime, or manner of the execution, and it is expected that the General Term will dispose of it in time to allow it to be carried to the court of appeals at its Saratoga June session.

It is thought Kemmler will be executed some time in August.

DETERMINED PROPERTY OWNERS.—The property owners of Newport, R. I., do not propose to allow their property to be encumbered by telegraph poles if they can prevent it. In our Boston letter this week an account of a small war between the property holders and the Providence Telephone Company is given. There must have been some lively times during the efforts on the part of the company to plant their poles, and under no other circumstances probably would the worthy citizens handle hoes and spades than to protect their property from the defiling influences of telegraph poles. It must have been an inspiring sight to look upon the citizens standing in the holes dug for the poles defying the workmen to proceed. They seem to have finally got the better of the invading company, and the remains of the telegraph poles are, at last accounts, being used as supports for lanterns at night.

THE BAIN MOTOR-DYNAMO.—On another page we describe and illustrate a Motor-Dynamo designed by Mr. Foree Bain, of Chicago. While motors and dynamos are in general reversible, they do not, as is well known, give good practical results when reversed. A motor-dynamo, that is, a machine that may be used either as a dynamo or a motor, is therefore a desideratum. The test of the machine in question, shows a high efficiency, 95¼ per cent., and some novel features in the construction of the field magnets will be observed. One of these is the shortness of the magnetic circuits. The voltage per foot of active wire in the armature at the velocity given is remarkably high, and the data given indicate a very efficient machine. Mr. Bain has in this new machine overcome all the difficulties due to bad contacts in field magnet joints, and in this new form of magnet there is absolutely no loss of enegy due to false poles. Mr. Bain is one of that class Prof. Perry spoke about as being the ones we look to for the best designs for motors and dynamos. He certainly is exploring a field that is full of possibilities, and the details of his method of compounding, which he has lately invented, will be looked forward to with a great deal of interest.

THE INCANDESCENT LAMP.—Trial was begun in the Supreme Court, this city, on May 22d, of a suit brought by Walter K. Freeman, against the United States Electric Lighting Company. Freeman claims that he is the inventor of the incandescent lamp and not Edison. He brings his suit against the United States Electric Lighting Company, alleging that a written contract was made with that company in June, 1881, which provided that if a patent were obtained on Freeman's alleged inventions which should be superior to the patent which Edison had at that time obtained, the company should have the option of taking it or paying him $100,000. No patent was granted, and he claims that the company was derelict in pushing the claim. He lays his damages at $150,000, part of which is for salary due for failure of the company to continue him in its employment. It is contended by the defence that the contract was not made for the benefit of the company, that the defendant made the application to the Patent Office in his own behalf, and that his application was rejected as invalid. It is further claimed that Freeman secured the contract by false representations and pursuant to a scheme of fraud to get money and employment without giving anything of value in return.

MUNICIPAL LIGHTING UNCONSTITUTIONAL.—In answer to a request by the Massachusetts Senate on the Attorney General of that State for an opinion as to whether "under the provisions of the constitution, cities and towns have authority to construct and maintain within their own limits and for their own use systems of lighting by gas or electricity, and whether in connection with such systems they will sell gas or electricity for private use in such cities or towns," that officer gives it as his opinion that cities and towns under the provisions of the constitution of the commonwealth have no authority in connection with such system of lighting to sell gas or electricity for private use in such cities or towns, and that any act of the legislature conferring such authority would be void.

Considerable discussion has taken place in that commonwealth of late on this subject, and the matter has attracted a good deal of attention. Within the State a peculiar condition of affairs exists. The town of Danvers has been operating its own electric light system for some time with success and advantage, it is said. Since the Attorney-General has declared such operations by municipalities unconstitutional, considerable interest centers on the Danvers situation. A prominent business man of the place declares that the town will continue to supply its own lights until it is stopped, and that their position will be defended as long as it is tenable.

AN IMPORTANT APPOINTMENT.—It is reported that Mr. Samuel Insull has been appointed Gentral Manager of the Edison General Electric Company. This company embraces all the Edison interests, and in the course of a few months, the offices of the various concerns will be centered in the Edison building, which is now in course of erection on Broad street near the Stock Exchange. An official verification of the report of Mr. Insull's appointment could not be obtained, but there is no doubt that there is good ground for it, and it is more in the nature of a fact than a probability.

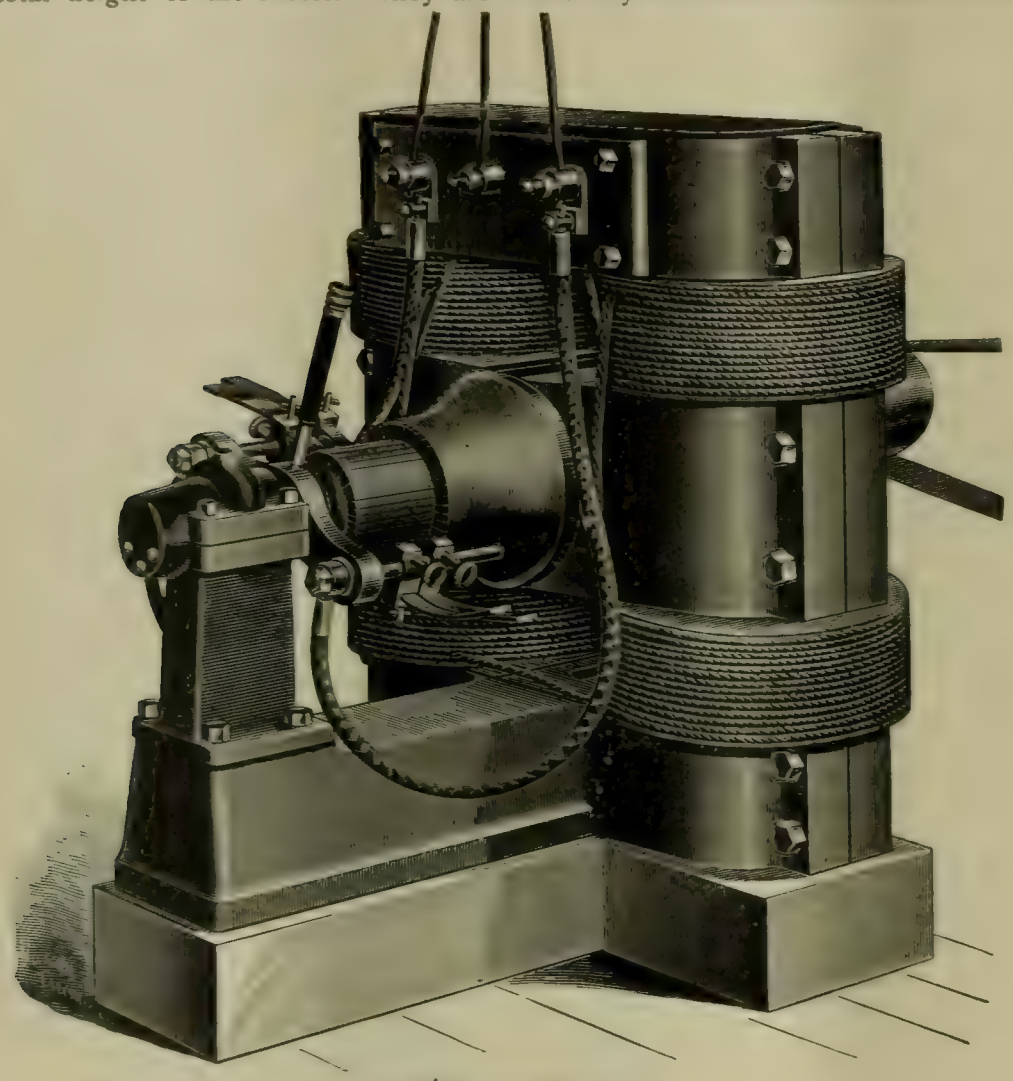
RETROGRESSION.—The Gas Commission of this city gave a contract, on May 22d, for lighting 2,500 street lamps to the Standard Gas Light Company at $13.04⅓ a year, each.

"FACTS WORTH KNOWING."—The Commercial Efficiency of the Leading Systems of Electric Lighting, is the title of a brochure just issued from the pen of Mr. Harold P. Brown.

A MOTOR DYNAMO.

Prof. Perry remarked in a recent lecture that we must look to our electrical engineers who are also mechanics, or to our mechanical engineers, who are also electricians for the best designs for motors and dynamos.

Mr. Forbe Bain, of Chicago, has recently designed and put on the market the motor-dynamo which we illustrate herewith. The cut is made from a seven horse-power Motor recently installed in the warehouse of the Chicago Paper Co. The Motor is used to operate a large freight elevator and paper cutting machine, and it is entirely satisfactory to the purchasers; a recent test shows an efficiency of 95¼%. The field magnets consist of two shafts of Norway annealed iron, one on either side of the armature, equal in length to the total height of the Motor. They are



BAIN'S MOTOR DYNAMO.

clamped at either end by the double yoke pieces and midway between by very heavy pole pieces, this secures a maximum contact between the pieces, the field is the "consequent poles" type, with two paths for the flux of magnetism.

The pole pieces are of equal size and weight and consequently of equal magnetic density, therefore the armature is not pulled harder against one side of the bearing than another, but it floats in a field, in which the magnetic lines are equal and properly distributed. The double magnetic circuits are extremely short. The coils are wound on spools and slipped over the cores, the spools are only three inches long on this size Motor. There is absolutely no loss of magnetism due to false poles, usually produced by bad contacts in field magnet joints. The bearings are self oiling.

The armature produces 1.4 volt per foot active wire, with inductive velocity of 48 feet per second. The field is maintained with less than one half an ampère, or 1¾ per cent. of the total current, and a density of about 600 ampères per square inch. The conductors on the armature are figured at a density of 2,700 ampères per square inch. The field resistance is nearly 1,300 times higher than that of the armature. The Motor runs quietly and very near constant speed with variable load.

Mr. Bain calls this type of machine his Motor-Dynamo, not that it is a separate motor and dynamo combined in one machine, but that it may be used as either a motor or dynamo. His machines show equal efficiency when they are used as dynamos. He builds this type of machine in sizes from 5 to 100 horse power, the larger sizes have a peculiar compounding, one of his late inventions, which will be illustrated at another time.

CHEMICAL REACTION IN THE PLANTÉ SECONDARY CELL.

During the period of charging a storage battery peroxide of lead collects on the plate connected with the positive pole, and hydrogen on the one connected with the negative pole. At first only a thin film of the oxide is formed, and a small amount of hydrogen collected, and the absorption of the gases soon ceases. The plates are then discharged. During the discharge the peroxide, which is insoluble in sulphuric acid, is reduced to monoxide. Pb O, which is immediately reduced to sulphate of lead, Pb S O 4, by the acid present in the solution; while the oxygen atom, taken from the peroxide, unites with the lead on the opposite plate, forming monoxide, which in turn is reduced to sulphate. The plates are then charged in the reverse order, and the sulphate on the plate now connected with the positive pole is reduced by the oxygen to peroxide, while that on the opposite plate is reduced by the hydrogen to spongy lead which adheres to the plate in a finely divided condition. As each subsequent charge, after discharge and reversal, produces the same result, each coating continues to increase in thickness; and the spongy lead affording increased facility for the formation of the peroxide, the chemical action proceeds more rapidly. But the increased thickness of the peroxide soon interposes a strong resistance to this action, hence a period of repose previous to the discharge becomes necessary, and during this period local action takes place. This consists in the reduction of the peroxide to sulphate from the reaction of the supporting lead plate; the metallic lead having a strong affinity for oxygen, the peroxide parts with one atom of its oxygen, which unites with the lead, and the resulting monoxide is immediately reduced to sulphate by the acid.

HORN'S ELECTRIC TACHOMETER.

Nearly two years ago, says the London *Electrical Review*, we illustrated and described the action of the Horn Electric Tachometer, which struck out a perfectly new line, and undoubtedly possessed merits sufficient to give it a position quite apart from the usual forms of these instruments. Founded upon Arago's discovery of the formation of currents in a copper disc rotating in a magnetic field, its construction is so disposed that while employing permanent magnets the calibration of the instrument remains the same, although the strength of the magnet may alter. This most important point has been very fully proved by going so far as to reverse the polarity of the magnet and again restoring it, after which, in every experiment, the calibration of the instrument has shown itself to be unaltered. As it is extremely improbable that the degree of magnetism after each experiment was the same, it is clear that the indications of the instrument are not affected by any such changes of magnetism as would result from time only.

Inasmuch, again, as the instrument is entirely independent of the action of gravity, it is especially adapted for use at sea, when the ordinary tachometer working by centrifugal action is liable to serious errors due to the motion of the ship. Further, the absence of delicate fitting, which is so necessary in the old type of instrument in order to minimize friction, enables the electrical instrument to be produced at a price below any other form, and it may be treated with much greater freedom without fear of upsetting the correctness of its readings.

The necessity for tachometers in all moving machinery is being thoroughly recognized and inasmuch as the new instrument can be made equally well either for permanent use or in a portable form, both for laboratory and every day work, and giving direct readings without any necessity for time measurements, its application will, without doubt, enormously extend.

The instruments have been employed in Government departments and leading engineering shops and have given most satisfactory results.

CLUB ROOMS OPENED.—The new rooms of the New York Telegraph Club, at 32 Cortlandt St., were formally opened on Monday evening, May 19th. There was present a large audience composed mainly of telegraphers, including many lady operators. The exercises consisted of speaking, recitations and music, and the whole affair was informal and interesting. The rooms are very tastefully fitted up. Billiards and other light games are features of the club. There is also a gymnasium, and the reception room, which is elegantly papered and furnished is an attractive one. Pictures of prominent people in the electrical world adorn the walls. To meet the expense of fitting up the rooms bonds were issued. These were very liberally subscribed for by the telegraph companies and individuals. The club has strong hopes of owning its own home in the near future.

THE WOMAN'S FAIR.—The proceeds of the Woman's Exchange Fair, at the Lenox Lyceum, this city, which closed on the 15th inst., will be about $30,000. It is stated that the cost of lighting the central tower, otherwise the May-pole, and streamers was about $1 per minute. There were between 4,000 to 5,000 people present at the close of this exhibition which was a very unique and attractive one. It will be long remembered by those who were fortunate enough to visit it, and it is safe to say that there will never be such another.

PERSONAL.—Mr. H. D. Stanley of the Bridgeport Brass Company was in this city last week.

THE WALLER-MANVILLE SYSTEM OF ELECTRIC TRACTION.

The essential feature of this system is the employment of a flexible conductor sufficiently small to permit of its being placed in, or withdrawn from a conduit through a slot.

The conductor being flexible, the supports can be at long intervals; and can therefore be placed in side openings to the conduit itself. By this means space is provided for large and efficient oil insulators.

Removable covers are provided to these side openings or hatchways, giving ready access to the insulators. The insulators are mounted in such a manner that on removing the cover they can at once be lifted out.

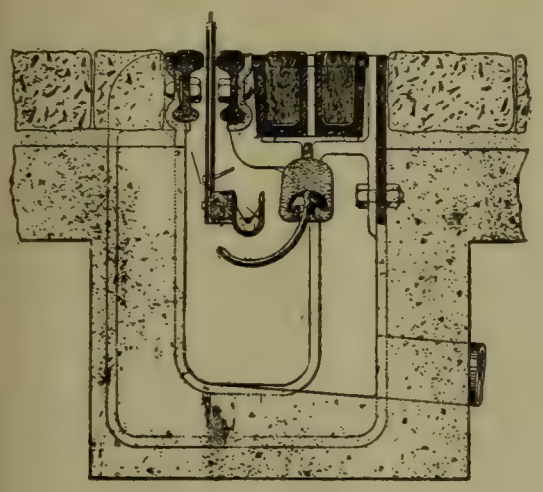


FIG. 1.

The collecting arm is designed so that the shank can be withdrawn through the slot, and the collector proper (or brush) through any hatchway.

Under ordinary conditions the conductor simply rests on supporting arms without being attached thereto. When it is necessary to firmly attach the conductor to its support, as for instance on sharp curves, absolute flexibility is still maintained, as the supports are so designed that whilst rigidly resisting either a longitudinal or a lateral strain, the same freedom of upward movement is allowed as in the case of the conductor itself when unattached.

Simple automatic apparatus is provided at intervals to maintain a constant strain upon the conductor. The current is collected by means of a

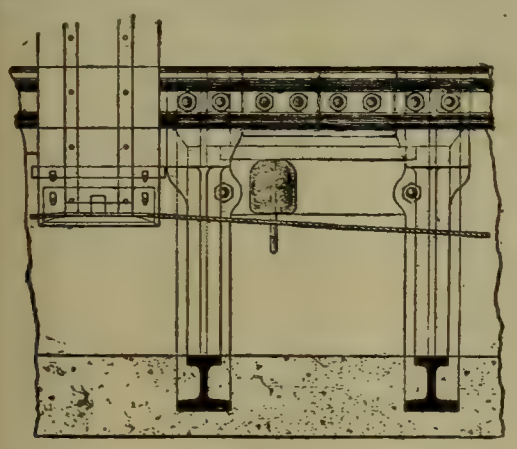


FIG. 2.

U-shaped collector in which the conductor runs; the collector lifting the conductor off the ordinary supports during its travel, and, in the case of those supports to which the conductor is attached, lifting the support itself.

Fig. 1 is a cross section through a hatchway and shows the ordinary form of curved support on which the conductor rests, and the oil insulator to which this support is attached. The conductor is shown lifted off the support by the collector. Details of the collecting shoe, showing the arrangement for detaching it from the shank, are given in figs. 1, 2 and 3.

In cases where a double conductor is used, the arrangement is duplicated, the insulators and cables being arranged one on each side of the collector arm.

Fig. 2 is a longitudinal section through the tube, giving a front view of the curved arm and a back view of the collector.

For turning round curves a swivelling arm is mounted on oil insulators. The conductor is held by this swivelling arm, both being lifted by the collector, thus maintaining the flexibility of the conductor as regards upward movement, while rigidly resisting either a longitudinal or a lateral strain.

Fig. 3 is a sectional plan showing a hatchway. These hatchways would be placed about 30 feet apart.

Figs. 4 and 5 show respectively a side and front elevation of the tension or straining gear. This consists of a gun metal plate or yoke mounted on two swivelling arms and supported by oil insulators, and provided with small pulleys so arranged that the conductor, or cat-gut cord in continuation of the conductor, is led to one side, so that a balance weight can be attached thereto. This weight serves to keep the sag of the conductor between its supports constant in all changes of temperature.

As the pulleys are arranged on the swivelling arm, the whole apparatus is free to lift in a similar manner to the single swivelling arm, the conductor being led through an eye in the shaft on which the apparatus revolves, the upward or downward movement of the tension frame in no way affects the length of the conductor, and consequently no resistance to this movement is caused by the weight of the counter-balance. This tension gear would only be required at long intervals, occurring, say, every quarter of a mile.

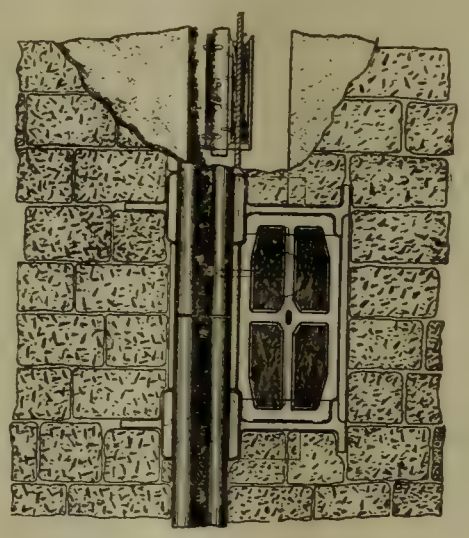


FIG. 3.

It will be observed that this invention relates entirely to mechanical details, and that no new electrical conditions are introduced, which might involve an element of uncertainty. The system is applicable to the distribution of electricity from a central station by any known method, whether in parallel or in series, or employing one or two conductors. It can be laid in a conduit situated either beneath one of the ordinary track rails, or between the rails, or outside the track.

The first method is generally preferable for new lines, as being less costly and exposing less metal on the road surface.

The second method might be desirable in some cases, for instance, in the conversion of a cable tramway into an electrical line. The fact that in this system none of the electrical parts are built in would enable this conversion to be made without practically interfering with the traffic on the line.

The last method is suitable in applying the system to ordinary existing tramways, as in constructing a conduit outside the track but little interference with the traffic would be necessary. The facility with which the collecting arm can be removed renders it easy to use this system in continuation of an overhead line.

The following special advantages are claimed for this system as compared with any other conduit system:—

(1) Immunity from danger; all the electrical apparatus being so situated as to render it impossible for contact to be made therewith except by the collector.

(2) Cheapness in construction, and simplicity in working and renewal.

(3) The most perfect form of insulation, as with a flexible conductor the supports can be at long intervals, and need therefore only be provided at hatchways, permitting of the use of oil insulators.

(4) The employment of a rigid arm, without springs or other devices, to carry the collector: thus completely obviating any risk of the collector

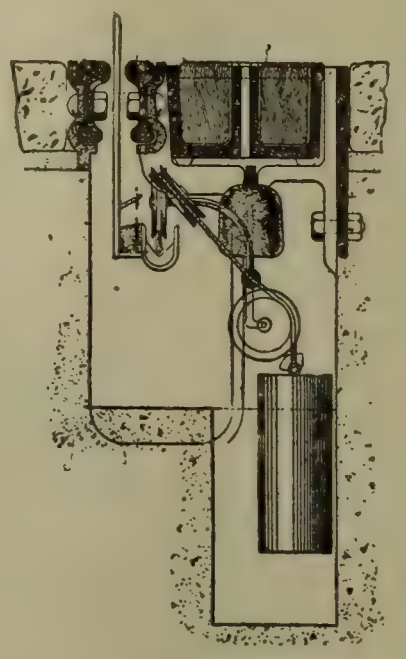


FIG. 4.

coming into contact with the roof or walls of the conduit.

(5) The facility with which any portion of the electric fittings can be laid, removed or renewed, the conductor being dropped into position or removed through the slot, and the insulators and their attachments through the hatchways. The collector shank can also be withdrawn through the slot, and the collector proper through any hatchway.

(6) The absence of any obstruction whatever in the tube underneath the slot, thus permitting a sweeper being attached to a car for the purpose of cleaning out the conduit when required.

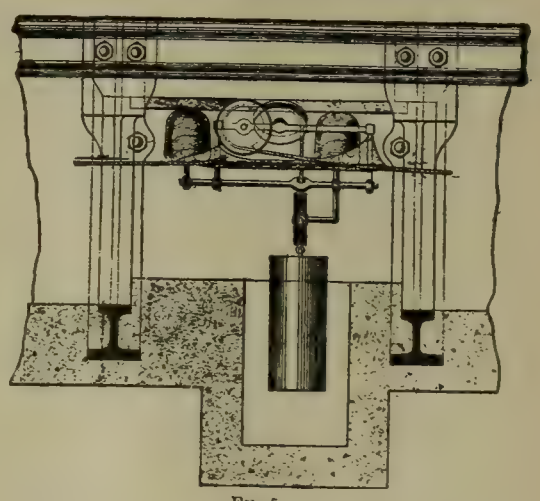


FIG. 5

(7) The absence of all points or crossings on the conductor.

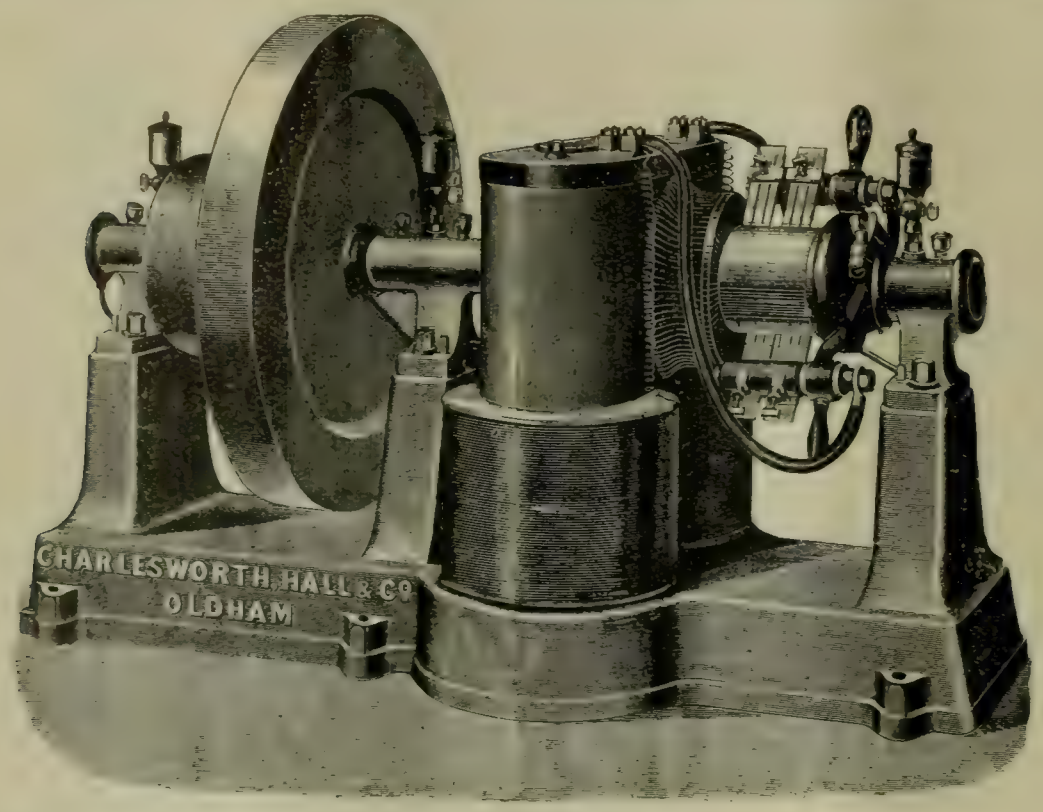
(8) The applicability of the system to any known means of distributing electricity from a central station, whether in parallel or in series or employing one or two conductors.

(9) The facilities given for using this system in conjunction with a system where overhead conductors are used.

ELECTRIC RAILWAYS.—The Sprague Electric Railway and Motor Company, have just closed a contract with the Newark Rapid Transit Company, Newark, N. J., for 16 motor cars. The Company has also received an order from the Piqua, Ohio, Electric Railway Company for two more motor cars.

DYNAMOS DRIVEN BY GAS ENGINES.

The accompanying illustration represents a dynamo manufactured by Messrs. Charlesworth, Hall & Co., London, and is designed to be driven by a gas engine. The illustration and the particulars of the dynamo are taken from the London *Electrical Review*. These machines are carefully worked out mechanically as well as electrically, and the lubricating arrangements are convenient and perfect. Each bearing is fitted with a special sight-feed lubricator, which, when once adjusted, can be turned on or off, and increased or decreased at any time when found necessary. They are also fitted with two simple siphon lubricators, which are intended to be used if any of the bearings should become heated. The waste oil is caught in the enlarged ends of the pedestals, and runs from these into the insides of the pedestals and down into the standards carrying them, and can be drawn out as required. These arrangements keep the machine entirely free from oil except where wanted. The bed-plate has been extended to support the extra weight of the fly-



GAS ENGINE DRIVEN DYNAMO.

wheel, which is 30-inch diameter, and weighs about 6 cwt. After being turned all over, this has a wrought hoop, previously bored, shrunk on, and then turned up. The shaft is of hard steel, and is 2-inch diameter in the bearings at the pulley end, and 1⅞-inch at the other end. The bearings are of aluminium bronze, each 8 inches long. The pulley is 13-inch diameter, and carries an 8-inch belt. The bed-plate is of massive construction, and well ribbed to withstand rough usage in transit and fixing.

The magnet cores are of soft charcoal iron, fitted into holes bored through the bed-plate, and secured in their places by screws. The pole-pieces are in one forging with the magnet cores, and are bored from the pedestals to receive the armature, which is placed exactly in the centre. The armature frame is of strong aluminium brass, and the core, which is 12-inch diameter, is built up of soft charcoal iron discs insulated from each other, and has an area of 40.5 square inches. The commutator bush is a steel casting, with wrought iron nut and washer, and is 6½-inch diameter; it has 80 hard drawn copper bars, 1 inch deep, and is insulated entirely with mica. The armature is wound with 200 convolutions of one No. 8 B.W.G., and has a resistance of .045 ohm. The magnet is shunt wound only (for charging accumulators), and each leg is wound with ten layers of No. 14's and sixteen layers of No. 15's, and has a total resistance of 31.6 ohms. There are two brushes on each side of the commutator, each of which

LINEFF'S SYSTEM OF ELECTRIC TRACTION.

The opposition to the slot in underground systems of electric railway has led to the invention of various methods of picking up the current from an underground conductor placed in a conduit without a slot. The London *Electrical Review* gives a preliminary description of a system which is now in its stages of development, and which, according to that paper, is an exceedingly simple solution of the problem. Mr. Lineff is the inventor, and by his system continuous currents may be tramsmitted from the generating station to the motors on the cars without the use of an open conduit. The system is now undergoing a series of tests by experts, and a public trial of the first car will shortly take place. The following particulars represent the main features of the new method, but the information given must only be regarded as a preliminary notice, as some of the details of the system may yet be modified.

The system is of the closed conduit type with sectional conducting rails. The current will be taken from an electric rail laid in sections, either at the inner side of one of the two rails or in the middle of the track. At the bottom of the conduit, below the sectional rails, is a bed of concrete, and upon this, and almost completely insulated by asphalt, is placed the copper conductor. The top of the conductor is surmounted by a piece of hoop iron which forms the connection between the electrical rail and the conductor. Underneath the car is placed one or more electro-magnets. It will be evident that on the car passing on to the track the electro-magnets induce magnetism in those sectional rails upon which the car for the time being happens to be placed. The induced magnetism then attracts or raises the hoop iron, thus forming the connection between the conductor and the car magnets. The current then passes through the latter to the motor and thence by the car wheels to the track rails.

ELECTRIC LIGHT IN MISTY WEATHER.—Absorption of light by water vapor reduces the lighting power of electric arc proportionately more than the incandescent lamps in misty weather.

THE TEMPERATURE COEFFICIENT OF INCANDESCENT LAMPS.

As very few observations have been made as yet upon the temperature coefficients of the resistance of incandescent lamps, the following results will, writes Herr F. Uppenborn in *La Lumière Electrique*, doubtless be of interest.

In measuring the resistance of lamps whose temperature varied considerably, a bath of linseed oil was made use of. The lamp experimented upon was attached to an agitator capable of being seesawed up and down and down and up inside a Bohemian glass full of oil suspended within an enamelled pot, which was likewise furnished with an agitator. The oil being at boiling point the pot was placed inside a box containing sawdust, and the resistance measured at intervals whilst it cooled. By immersing a nitrogen thermometer in the glass jar the temperature of the incandescent lamp was ascertained. Some difficulty was met with in establishing contact between the lamp and the wire used for taking the measurements, and it was only possible to make use of lamps with platinum hooks; and the contact of the latter with the copper wires was obtained by means of a galvano-plastic deposit.

The measurements still presented some difficulty owing to the lamp's resistance not being constant. This was owing to the heating of the wires by the current which served as the measure, notwithstanding that the latter was furnished merely by a Leclanché element, and was assuredly very slight. The difficulty, however, was avoided by inserting a great resistance in the battery circuit, and the results so obtained are given below :—

I.

Lamp's Temperature. Degrees.	Resistance ohms.
300.0	51.003
273.0	51.826
245.0	52.688
209.0	53.834
175.0	54.982
137.5	56.174
22.5	59.492
20.0	59.560

II.

286.2	100.10
284.5	100.19
282.0	100.60
254.0	104.70
251.5	105.05
250.5	105.15
210.0	111.15
209.0	111.35
208.5	111.40
165.0	117.80
164.0	117.94
163.0	114.40
114.5	125.34
113.0	125.54
112.0	125.75
70.2	131.85
68.6	132.05
68.0	135.25
47.5	135.25
46.0	139.14
26.6	139.24
20.1	139.34
19.6	—

By turning these observations into a system of co ordinates, it was found that they could be exactly combined by means of the formulæ—

$$y = a + b\,x.$$

The temperature coefficient, referred to the resistance at 20°, is

0.000513

as regards Table I., and

0.001056

in the case of Table II.

The two lamps were apparently of English manufacture.

ELECTRICITY SUPPLANTS STEAM.

The subject of electric railroading has received a great deal of attention in the Southwest, and this part of the country is fully awake to the advantages of electric power for car propulsion. The State of Texas has now two electric railways in operation on the Sprague Electric System, and others are in course of construction. One of the roads in operation is the Dallas Rapid Transit Railway, a view of which is shown herewith. The motive power for operating the cars on this railway was formerly furnished by a steam dummy which has now been abandoned for the more modern power.

Our view shows one of the electric cars drawing the old steam dummy. The engraving was made from an instantaneous photograph, and shows the ex-engineer of the steam engine trying in vain to catch the train which is going so rapidly that he is left behind. An interesting circumstance in connection with this view, which shows very clearly the easy manipulation of the electric car, is the fact that the motor car is being operated by a young lady who is in charge of the controling switch, while another young lady is acting as conductor. By way of comparison it might be mentioned that the steam dummy required an engineer and fireman to run it besides a train conductor on the train.



SCENE ON THE DALLAS, TEX., RAPID TRANSIT RAILWAY.

The electric road has proven very popular in Dallas and has carried a large number of passengers since its installation. The method of overhead construction used is the single bracket as shown in the illustration.

TELEPHONE LINE ALONG THE AQUEDUCT.—The Aqueduct Commissioners decided on May 21st to contract with the Metropolitan Telephone Co. for the construction of a private line of telephones from the gate house at 135th street, to the Croton dam, connecting the various stations on the line of the new aqueduct The rental is $5,500 a year, and the cost of construction $5,000, will be borne by the Commissioners. The work of erecting poles and wires will be conducted under the supervision of Commissioner of Public Works Gilroy.

LOSS OF LIGHT.—The light cut off by ordinary glass globes of arc lamps is 10 per cent. Light ground glass cuts off 30 per cent., and heavy ground glass 45 to 50 per cent.

EASTERN NOTES

BRANCH OFFICE OF THE ELECTRIC AGE, ROOM 10, COOK BUILDING.

BOSTON, May 23, 1890.

There is talk of the Robinson Radial Car Company locating in Newburyport.

The Boston Electric Light Company, are building a new station at Jamaica Plains.

The poles for the electric road from Newton to Waltham are being erected and the road is expected to be in working order June 1.

The Connecticut Motor Co., through their New England agent, have sold a 7½ H. P. and a 10 H. P. motor to Boston parties.

The Suburban Electric Light and Power Co. have filed another petition to the Supreme Court for a writ of mandamus to compel the Board of Aldermen to allow them to erect poles for the support of their wires in the city of Boston.

John T. Cox, a well-known citizen of Attleboro, Mass., was killed while trying to board a moving electric car in that place last Friday.

An exhibition of the phonograph was given by Col. Sampson, last Tuesday, at the rooms of the Women's Educational Industrial Union.

Col. C. M. Ransom, of *Modern Light and Heat*, lies dangerously ill at his home. At one time last week it was thought he would not live an hour.

The ten new boxes of the Gamewell Police signal System for Waltham have been placed in position and will be in working order in a few days.

Prof. Thomson of the Thomson-Houston Electric Works, has lately patented an invention which applies the principles of electric welding to soldering and cementing.

The contracts between the towns of Oldtown and Milford, Me., and the Oldtown Electric Company for lighting the streets of the two villages with arc lights have been signed.

Mr. Frank Baldwin who, for some time past has had charge of the private line department for the N. E. T. & T. Co., has been transferred to Cambridge as manager of the office of that company.

The new condensing engine is now set up and in running order at the plant of the Citizens' Light and Power Co., in Burlington, Vt. It is of sufficient size to carry all the lights in use as well as those in the woolen and merino mills.

Mrs. Susan Fanchette, of Gloucester, administratrix of the estate of the late Fred. S. Fanchette, has filed a notice for suit for damages for $5.000, against the Gloucester Electric Company. Fanchette was killed at Gloucester by an electric shock.

Harry Bottomly, of the Thomson-Houston Electric Company's factory in Lynn, has gone to Kansas City to take charge of a large power plant there. F. C. Bates, a former expert, will take charge of the wiring and shop plant, the position vacated by Mr. Bottomly.

Messrs. S. L. Holt & Bart, of Boston, have been awarded the contract for furnishing the steam-power plant for the electric railway between Augusta and Gardiner, Maine, consisting of two 100 H. P. Porter automatic engines, two 100 H. P. boilers, steam pumps, clutch pulleys, belting, etc.

The residence of the Hon. F. L. Ames, in North Easton, is to be lighted by electricity. A dyamo is to be placed in one of the factories which will be run during the day by water-power for the purpose of charging storage batteries. The house of ex-Gov. Ames will be lighted in the same manner.

The Union Street Railway Company, of New Bedford, petitioned the Board of Alderman for the right to erect poles and run wires on certain streets for the purpose of operating part of its road by electricity. The petition was granted on condition that iron poles, such as are used in Boston for the trolley system shall be erected.

At a meeting of the East Boston Citizen's Trade Association, held last Monday evening, a committee of twenty was appointed to make arrangements for a mass meeting to see if something cannot be done to induce the West End Railway Company, to furnish better service in that district, and to ask for the immediate construction of the electric system.

Lieut. Cahoun, superintendent of the expert department at Thomson-Houston Works, in Lynn, has designed a detached trolley, which, when it strikes a frog, will drop off. It is attached to a chain and can be immediately replaced. It has been successfully tried on the West End Road and twelve more will be immediately put on.

The Essex Electric R. R. Co. have decided to give the contract for furnishing the electrical power for car equipments and station to the Bay State Co. at Peabody, the successor to the Robinson-Foster. The double Trolley system is to be used. The work is being pushed along very vigorously on the road, and as the line is not long it will probably be in running order before the summer is ended.

Articles of association for the Garden City Electric Street Railway Company, of Newton, have been prepared and a large number of subscriptions received. The capital stock of the company is $40,000. Among the prominent subscribers are Messrs. Alley, of Lynn; Col. Hewins, of Lynn; A. R. Nutchell, of Newtonville; Jas. H. Nickerson, of West Newton; W. H. Mandell, William O. Hunt and Albert Plummer. The storage battery system will be used.

The gas commissioners have rendered their decision in regard to the electric light question at Abington, which they have had under consideration for some time, and the Westinghouse Company has had leave to withdraw. This leaves the franchise in the hands of the Electric Light and Power Company of Abington and Rockland. The selectmen first granted the franchise to the Westinghouse Electric Light Company, but before they recorded their vote, or

before the papers were passed they rescinded their decision and granted a franchise to the Abington and Rockland Electric Light Company, which is composed chiefly of citizens in the two towns named.

For the past week there has been considerable opposition to the Providence Telephone Company setting its poles in the streets of Newport, R. I. The abutters stood in front of their respective estates, and with hoes and shovels filled up the holes as fast as the company's men dug them, or jumped into the holes as soon as they were dug to prevent the placing of the poles. Mrs. Henrietta Lieber, who owns two estates, called upon the chief of the Fire Department who also has charge of all poles and wires, and upon being told that nothing could be done, notified the chief that she would have the poles cut down that night. The chief, knowing the restraining influence of fire alarm wires, and wishing to prevent possible damage, summoned his men and had the fire alarm wire stretched on the poles threatened, which had the desired effect. When the telephone men came and strung 24 wires this so incensed the abutters that last Saturday a gang of twenty or thirty men appeared in front of Mrs. Lieber's and commenced cutting. The chief protested, but each abutter said he would be responsible. The poles and wire were carted to a vacant lot, the streets carefully swept and lighted lanterns placed on the stumps of the poles.

W. J. P.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS' ANNUAL MEETING.

At the annual meeting of the American Institute of Electrical Engineers held in their rooms on 23rd street, May 20th, the following officers were elected for the ensuing year: President, Prof. Anthony; Vice-Presidents, Prof. Francis B. Crocker, J. Wetzler and Frank J. Sprague; Managers, H. W. Bennett, P. B. Delany, H. A. Foster and J. C. Chamberlain; Secrertary, R. W. Pope; Treasurer, George M. Phelps. After the election of officers a paper was read "On Electricity in the Navy," by Gilbert Wilkes, U. S. N. At the conclusion of the reading of the paper, a short discussion ensued, after which the meeting adjourned to reassemble next day in Boston, according to the programme announced in our last issue.

The general meeting of the American Institute of Electrical Engineers was called to order May 21st, at the Institute of Technology, Boston, by Prof. Elihu Thomson.

Prof. W. A. Anthony, of Manchester, Conn., was, on the 20th, elected president in New York, but, owing to a slight illness, did not feel able to preside.

The proceedings were opened with addresses of welcome by Gen. Francis A. Walker, Ph. D., LL. D., President of the Institute of Technology.

He said he thought it especially appropriate that the members should meet in the Institute of Technology, where some of them gained their electrical training.

The first paper of the morning was on "Electric Lighting in the Tropics," by Wilfrid A. Fleming of New York. As he was absent, his paper was read by Joseph Wetzler. He said:

"One of the chief difficulties that an engineer experiences who is called upon to install a plant of any considerable size in tropical countries is the trouble of procuring any kind of skilled labor for this class of work. Another difficulty is that he is so far from his base of operations, the factory.

"Electric lighting has already gained many warm adherents both in the East and West Indies, more especially in the former, where plants of considerable capacity have been in active operation for the past eight years.

"A central station plant that the writer was engaged upon lately in one of the chief cities of the West Indies, would compare favorably in size and equipment with one situated in the United States.

"The people took to it from the start, paying cheerfully the prices that were demanded. To an indolent race it was a great boon.

"In the tropics, as is well known, there is no twilight. Darkness comes on within ten minutes of sundown and the whole plant practically goes into operation at once.

"In the year 1877, the first commercial arc lamp was in use at the office of the Bombay *Times*, and if I remember correctly it was the first light shown in the Indian empire. From that date on the demand for lighting has been on the increase.

"Owing to the high price of coal, which is a costly article in the tropics, ranging from $8 to $50 a ton, delivered, it is well to employ the most efficient and economical engine for motive power, more especially for central station work.

"In the station previously referred to we were running with high speed compound condensing engines with satisfactory results.

"Apart from the vicissitudes incidental to life in the tropics, there is, I think, always a satisfaction and pleasure in the successful completion of an installation, knowing as one does that it is a potent factor in the greater civilization of those countries, demonstrating to the inhabitants, who have heretofore depended on artificial illumination of the same primitive character and manner as their forefathers used through ages past, what science, aided by her lieutenants, pluck and energy, can accomplish."

The next paper was announced to be "A Study of Arc Light Carbons," by Louis B. Marks of Cornell University.

His paper was an exhaustive and technical discussion of the subject, taking into consideration the structure of the carbons, tests of their life, their efficiencies and candle power measurements, and observations of the arc and carbon points. He says in his introduction:

"Now that our dynamos and lamps have reached such a state of perfection, the subject presents itself as pre-eminently important. The arc light pencil, considered as an individual part of the plant, is indeed a small thing, but in it undoubtedly lies the weak spot of the system."

Many tables of statistics, and a series of photographs and diagrams of the carbons aided the speaker.

Discussion was participated in by George W. Blodgett, of Boston, Prof. Elihu Thomson and others.

Dr. Edward L Nichols of Cornell, spoke on a new photometer, which he said was much more reliable and simple than the old Bunsen instrument. A brief discussion followed.

A paper on "Magnetic Data of the Sprague Street Car Motor," by H. F. Parshall of New York, was read by O. T. Crosby, of New York. It was illustrated with blue print plans and diagrams.

A communication was received from the Boston Society of Civil Engineers, extending courtesies.

The session adjourned at 1 o'clock, and the members assembled on the steps of the institute, where a group photograph was taken.

The afternoon session opened at 2.30, the attendance being about the same. Papers were read as follows: "Industrial Utilization of the Counter Electromotive Force of Self Induction," by T. B. Lockwood, of Boston; "Practical Aspect of Alternating Current Theory," by Dr. M. I. Pupin of New York; "Automatic Electric Welding Machines," by Hermann Lemp, Jr., of Lynn. This paper was especially interesting, being accompanied by experimental demonstrations. "The Limitations of Steam and Electric Transportations," by O. T. Crosby, of New York, was the last paper of the afternoon session. The Boston Electric Club entertained the members at a dinner at the Parker House.

After doing justice to the elaborate menu, the members were entertained with an interesting and instructive paper by Prof. S. E. Barton, president of the Mutual Electric Insurance Company, on the relations of fire insurance to electrical insurance, as viewed from a fire insurance standpoint. Prof. Barton's paper in full will be found on page 7.

The next speaker was Prof. Thomson.

Prof. Anthony, president of the American Institute of Electrical Engineers, said that electrical appliances have come to stay.

"There is no experiment about it," said he, "and I see in the application of electricity great prosperity; Fifty years from now we shall find the electrical problem so far advanced as to challenge our sincere admiration."

Secretary Ralph W. Pope, of the American Institute of Electrical Engineers, followed.

Assistant Superintendent Dumoulin, of the power station of the West End Street Railway Company, then told of the West End's great electric system, and termed Boston the great electrical metropolis of the world.

Capt. Eugene Griffin, general manager of the road department of the Thomson-Houston Company, spoke in a very humorous vein, and told several funny stories. He was followed by C. F. Pritchard, president of the New England Association of Gas Engineers, who explained all the tricks of the trade.

Prof. E. L. Nichols, of Cornell University, spoke of the good accomplished by electrical courses in the college.

James E. North, of the New England Insurance Exchange, followed with interesting remarks.

Senator Metcalf came next, and F. L. Bell closed the speechmaking.

The banquet ended with three cheers for the Boston Electric Club.

Thursday the institute, by invitation, visited and inspected the Institute of Technology, after which they were taken in hand by the officials of the West End Railway Company and shown over the central power station. They were then taken to Chestnut Hill and returned in special electric cars, after which they lunched at the Parker House. In the afternoon thay visited the factories of the Thomson-Houston Electric Company and the Thomson Electric Welding Company in Lynn, going over the Revere Beach Road in a special car.

EDISON-LALANDE BATTERY.

Enthusiastic reports concerning the performance of the Edison-Lalande Battery continue to be received. Among the latest are two from Philadelphia. Five months ago the Pennsylvania Railroad Company placed 60 cells of this battery in the Jersey City office, and have been working a Philadelphia wire ever since. The report says the E. M. F. is steadily maintained, and the battery is still at work. The same company is working 18 wires out of a battery of 80 cells, and two wires out of another battery of 20 cells, making 20 wires out of 100 cells. These 100 cells displaced 368 cells of Callaud battery which were formerly required to do the same amount of work. The report says Edison-Lalande battery gives better service, particulary noticeable in wet weather.

ALTERNATING CURRENTS.—It has recently been shown by a series of experiments on dogs that while the alternating electric current is distinctly more deadly than the continuous, its fatal superiority is far less than some former experiments would lead one to think.

JUST THINK OF IT.—During the last three years the ancient and reliable rush light and candle caused 391 fires in London, gas was responsible for 594 more, the kerosene lamp started 707 conflagrations, and the dangerous, devastating electric wire caused just three.

LARGE ORDER.—The Central Electric Company of Chicago, Ill., received an order this week for one million feet of Okonite wire.

This we understand is the second large order received within the past two months. The goods continue to grow in favor.

RELATIONS OF FIRE INSURANCE TO ELECTRICAL INSURANCE.

PAPER READ BY PROF. S. E. BARTON AT THE MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, HELD IN BOSTON, MAY 21ST.

At the annual meeting of the National Board of Fire Underwriters in New York on the 8th of this month, several very interesting papers upon important topics affecting the welfare or illfare of the business, were presented.

An extract from the newspaper reports of that meeting reads as follows: "The most interesting report came from the committee on lighting and heating, read by Chairman John H. Washburn. 'The great problem before us to-day,' he said, 'is the management of the various systems of electric lighting, which is not the harmless thing we had imagined, but a most prolific source of danger. It has come to stay, however, and in time it will probably be as safe as any light in use.'" With the report a graphic diagram was handed in, which showed that while electric wires and lights were responsible for losses of only $460,000 in 1886, the value of property injured by fire which could be traced to the same source in 1889, was $5,533,000.

Such a report coming from a body, representing, as its name implies, the Fire Underwriters of the Nation, conveys to the public the idea that "the relation between fire insurance and electric interests from the Underwriters' standpoint" is a very gloomy one for the former.

I was sorry to see such a bald statement go forth without any explanation as to how it was arrived at, or what it indicated. If it was intended to indicate, as it certainly does to every person not acquainted with the facts, that the danger of fire from electrical causes had grown to be twelve times greater in 1889 than it was in 1886, it is shamefully unfair, because it is untrue.

As the figures given are indentical with those contained in the "Chroncle Fire Table" published by the Chronicle Company of New York, I presume they came from that publication, and therefore it is fair for me to draw from the same source to show how unfair the report really is.

Those tables show that in 1886 there were 29 fires from "electric wires and lights," causing loss of $460,000; in 1887, 66 fires and $681,000 loss; in 1888, 91 fires with $1,587,000 loss; and in 1889, 74 fires with $5,533,000 loss. The yearly increase in the *number* of fires reported is nowhere near the percentage of increase in the use of electric lights and wires, and therefore the number of fires was not used to show the comparative hazard by years. It looked much more startling to use the amount of loss, and for that reason I presume it was used; I can see no other reason for using it. But where did the great increase in amount of loss come from? Why! from the Boston fire of last Thanksgiving day which "everybody says was caused by the electric wires," but which *nobody* has proved.

The Fire Marshal, in his investigation, exhausted his energies and all means at his disposal, and certainly the bulk of the testimony taken would naturally lean towards fixing it upon the electric wires. The Massachusetts Insurance Commissioner, in his 1889 report just issued, says "the preponderance of the testimony seems in favor of the theory that it was caused by the electric wires;" therefore, in his opinion (which is good enough for me), it is a "theory" that confronts us and not a condition nor a fact. That loss amounted to about three millions and a half. It was injected into the destruction account of "electric wires and lights," making the account four times as large as in 1888, and yet, admitting the right to charge one fire to that account at all, it only increased this number of accidents by one. Supposing the fire had got still further beyond the control of the firemen and had destroyed one hundred millions instead of three and a half millions? Of course it would have proved (according to the logic of the National Board) that electricity is twenty-two times as hazardous as the report makes it out to be.

The official return of the big fire at Lynn says it was caused "by a draft from an open door blowing the blaze from an oil stove down around the burner, causing the stove to explode." The loss at that fire was about four and one-half millions, and I presume it should be charged in equal proportion to open doors, drafts and oil stoves.

Two fires were reported in Massachusetts last year as caused by reflected rays of the sun. If they had destroyed five and a half millions of property the combination of the sun and a reflecting surface might fairly be regarded as "a most prolific source of danger."

In the language of the report which I have referred to I am compelled to say that the committee that made it "is not the harmless thing we had imagined, but a most prolific source of misrepresentation." Let me bore you with a few figures from the Massachusetts Insurance Report referred to, as to causes of fires. They are the official returns from all the towns in the State, and cover the period from 1844 to 1889, inclusive.

Broken and exploded kerosene oil lamps and lanterns:		
Number of fires in	1884, -	138
in	1889, -	217
Increase of 1889 over 1884, 39½ per cent.		
Explosions of gas: number of fires in	1884, -	4
in	1889, -	8
Increase of 1889 over 1884, 100 per cent.		
Careless use of matches: number of fires in	1884, -	45
in	1889, -	90
Increase of 1889 over 1884, 100 per cent.		
Children playing with matches:		
Number of fires in	1884, -	78
in	1889, -	118
Increase of 1889 over 1884, 49 per cent.		
Ignition of curtains and goods by gas and candles:		
Number of fires in	1884, -	42
in	1889, -	38

Decrease in 1889 from 1884, 10 per cent. and this decrease is doubtless due to the fact that the incandescent lamp is rapidly replacing the gas jet and candle in windows and stores.

In 1884 "electric wires" caused six fires, and in 1889, seven; increase in 1889 over 1884, 16 per cent.

Total number of fires for the whole six years, from each cause, is as follows:

Broken and exploded lamps and lanterns,	947
Explosions of gas, - - - - - -	28
Ignition of curtains and goods by gas and candles, - - - - - -	253
Careless use of matches, - - - -	447
Children playing with matches, - -	473
Electric wires, - - - - -	42

Besides these, during the same period, 25 fires came from gas and candles near woodwork, and 1884, 1885 and 1887 are not included as they were not reported.

Lightning caused 208 fires; plumbers' pots, 27; thawing water pipes, 89; tramps, 54. There appear to be none charged to the much despised "tramp wire," unless he was the means of conducting the subtle fluid in some of the 42 cases against electric wires.

Cigar stubs in wooden spittoons caused 41 (1884–5 not reported).

Smoking caused 233 fires to say nothing of the 3,024 marked as "unknown," many of which were doubtless due to this "most prolific cause," and yet "the management of the various systems" of smoking is not regarded as the "great problem" before the Fire Underwriter of to-day. He smokes day in and day out, perhaps causing his own share of fires, and yet he looks with increasing alarm upon a system of distributing light and power for the benefit of mankind, that has only been charged with causing 42 fires in Massachusetts in five years, as against 233 from smoking.

Let me step outside the confines of my little native state and give you a few comparative figures for the whole country, taken from the Chronicle Fire Tables for the year 1888. (I have used 1888 instead of 1889 because I happened to have them more handy). I have selected a few classes of risks in which electric lights and wires are probably more generally used than in others.

In clothing stores the whole number of fires reported for this year is 1,072, 28 of which came from gas jets, 21 from lamps exploding, 5 from lamp accidents, 3 from gas explosions, 13 from matches—in all 74, as against 6 from electric lights and 9 from electric wires.

In country and general merchandise stores 4,847 fires are reported, of which 39 came from lamp explosions, 8 from lamp accidents, 3 from gas jets, 20 from matches—in all 70, as against 1 from electric wires.

In crockery and glassware stores 179 fires are reported, of which 8 came from lamp explosions, 7 from lamp accidents, 3 from gas jets, 4 from matches—in all 22, as against 1 from electric wires.

In dry goods stores 1858 fires are reported, 123 of which came from gas jets, 34 from lamp explosions, 6 from lamp accidents, 7 from gas explosions, 19 from matches—in all 197, as against 10 from electric wires and 3 from electric lights.

In fancy goods stores 519 fires are reported, 28 of which came from lamp explosions, 7 from lamp accidents, 27 from gas jets, 9 from matches, 2 from candles—in all 73, as against 4 from electric wires.

In the United States in 1888 the whole number of fires from the above named causes is reported as follows: Lamps and lantern explosions, 528; lamp and lantern accidents, 190; gas jets, 179; gas explosions, 63; matches, 592—in all 1552, as against 49 from electric lights and wires.

There were 53 from stationary engines and boilers, and that number, though small, can be reduced just as fast as the electric motor takes the place of the boiler and stationary engine.

In the matter of insurance upon electric generating stations, the "great problem" is practically settled; and it has been settled by the establishment of an Electric Mutual Insurance Company, organized for the prime purpose of improving and insuring such risks. There is no trouble whatever to-day in procuring ample insurance in the strongest of stock or mutual companies, provided the Electric Mutual carries a part of the risk; and I predict that within one year companies that have heretofore frowned upon an offer of insurance upon the best of such risks, or have charged excessive rates, will be competing for the business. The one truth contained in the extract of the National Board report, namely, that the "business has come to stay," together with the fact that the owners of stations are willing to take their own risks by insuring in a company of their own, has inspired many of the underwriters with courage who were previously possessed of fear and doubts.

Of the 31 fires that were reported in electric light stations in 1888, 11 were from exposure to other risks, 4 were from unknown causes, 5 were from causes not reported, 1 each from engine, furnace, spontaneous combustion, lightning and explosion, while 6 came from "electric wires;" showing that after all it is not the mysterious electric current, nor the pranky wire that are responsible for the havoc, but that the ordinary causes that pertain to other risks, such as improper location contiguous to bad neighbors, and carelessness of various kinds, are the chief sources of danger.

In seven years previous to and including 1888, eighty fires are reported in electric light stations—about eleven per year on the average.

On the whole I don't know what the relation between the interests is, from the Underwriters' standpoint. What are his views to-day may not be to-morrow. There is no hazard that Underwriters, as a rule, have made so little effort to understand, and consequently they are too largely guided by the caprice of popular prejudices and beliefs, neglecting to carefully study tables of experience and be guided by the logic of events. There is also *no* hazard around which they have ever thrown so many restrictions. Those of us who know what peculiar and improbable conditions must exist in order for the

"electric wires" to cause fire, can only look on and hope. Enlightenment comes slowly but surely, and the day is not far distant when the large majority of Fire Underwriters, forgetting their present ideas, will say, "I always maintained it was the safest kind of light power." In the meantime the present rapid development will go on regardless of the Underwriters' standpoint. A few years ago his favor or opposition meant easy or slow progress for the electrical pioneer, because the first question asked was, "how will your wires and lights affect my insurance?" But the business has "come to stay" and that question is less frequently asked.

The same difference however, exists to-day that always did exist between good and poor installation, and therefore it should be the aim of the electrical men to seek the co-operation of the Underwriters in securing the observance of safe fundamental rules.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE
35 COMMERCIAL BANK BUILDING.
CHICAGO, May 24, 1890.

THE WESTINGHOUSE ELECTRIC COMPANY, sold two 1,500 light alternating incandescent dynamos this week to parties in Minneapolis.

THE NORTH AMERICAN CONSTRUCTION COMPANY, are installing an incandescent electric light plant of the Westinghouse system at Rochester, Pa.

THE STREET RAILWAY CO., at Duluth, Minn., has let the contract for its electrical equipment to the Thomson-Houston Company. The entire plant will cost about $150,000.

MR. J. H. MUNSON, an expert from the Northwestern University, is now in the engineering force of the National Engineering Bureau of this city, having been appointed to that position this week.

WORRELL ELECTRIC CONSTRUCTION COMPANY, has been formed at Chicago, to construct and maintain electric plants; capital stock $500,000; incorporators, C. E. Gaylord, M. J. Frost, C. Y. White.

METROPOLITAN ELECTRIC RAILWAY COMPANY, has been formed at Springfield, Mo., with capital stock of $500,000; incorporators, L. M. Rumsey, George W. Parker, B. F. Hobert, R. C. Kernes, and others.

THE FORT DEARBORN LIGHT & POWER CO., has been formed at Chicago, to buy and operate electrical machinery, etc.; capital stock $25,000; incorporators, A. L. Baker, E. F. Runyon and S. T. Parks.

It is reported that Henry Villard has purchased a two-third interest in the Seattle, Wash, Electric Light Company, for which negotations have been pending for some time. The present plant is valued at $150,000, and $250,000 will be spent in erecting a new plant and increasing facilities.

LEBANON, Mo.—The Electric Light franchise which was adopted by the council and submitted to the people for ratification, was adopted with only four dissenting votes out of 322 cast. The city will have 23 lights and all business houses will be lighted by electricity.

The great feature of the Minneapolis, Minn. Exposition next fall will be the Edison Electrical Exhibit, comprising almost the entire display which was at the Paris Exposition, and with some additions of later inventions. The management of the Exposition are in high spirits over securing this exhibit, which will be under the care of experts from Mr. Edison's laboratory.

W. P. ADAMS & Co., Chicago, closed contracts this week with J. E. Cornell, for a 100 H. P. engine, and with W. E. Githens for a 90 H. P., both of the McIntosh-Seymour make. These engines will be installed in the Hyde Park Hotel and will drive dynamos for lighting the hotel and furnishing light for commercial purposes.

MORE RAPID TRANSIT FOR CHICAGO.—Articles of incorporation have been filed for the Chicago Arcade Rapid Transit Railway Company, with a capital stock of $8,000,000; to construct a line from a point on Fifth avenue between Madison and Harrison streets, with branches on Milwaukee and North avenues, to the present or future limits of the city; incorporators and first board of directors, E. Louis Kuhns, H. A. Ritter, A. F. Shuman, Percy L. Shuman, Joseph H. Defrees, all of Chicago.

The Electric Plant in the Chamber of Commerce Building is nearing completion. This plant consists of 3,700 Mather incandescent lamps and is being installed by the Chicago office of that company. It is expected that the plant will be in operation in a week or ten days. This installation has been put in with great care and it will be one of the finest incandescent plants in the country. The Mather company have lately placed 830 lights in the Volblatz Brewery at Milwaukee, and have just completed the installation of a plant of 1,300 lights in the Endicott Arcade building in St. Paul, one of the finest office buildings in the West.

THE ILLINOIS ELECTRIC MATERIAL COMPANY, has been organized with headquarters in this city, and will occupy the offices at 341 Rookery Building. The names appearing at the head of this company are well known in the electrical fraternity, and the company will start with plenty of Chicago push, and a firm financial backing, the $25,000 of capital stock having all been taken up. The officers of the company are H. S. Winston, President and Treasurer; E. L. Clark, Secretary; and Ernest Hoefer, Manager. Mr. Hoefer is known as the Western representative of the Bishop White Core and the Trinidad moisture proof wires, and Mr. Clark has been representative of the Walworth steel and iron poles and brackets. The new company will have the agency of the goods named and will handle a general line of electrical supplies. They will carry a complete line of goods in stock and have already two car loads of wire in their warerooms. They also expect soon to carry a stock of poles in the city, to aid in promptly filling all demands.

F. M. I.

INCORPORATED.—The McCreary Electrical Specialty Company has been incorporated and will succeed and carry on the business established by Mr. Alfred A. McCreary, at 18 and 20 Cortlandt street, this city. The company will manufacture and place upon the market, patented electrical specialties. Mr. A. A. McCreary is vice president and general manager of the new company, and C. C. Foster is secretary and treasurer.

TEMPERATURE OF THE ARC.—The temperature of the electric arc varies with the strength of current and size of the carbons, being higher with thinner carbons and stronger currents.

APPOINTMENT.—Mr. E. J. Deming has been appointed city wire inspector in Minneapolis, Minn. Mr. Deming is an experienced Electrician, and has contributed articles on electrical subjects to the local press.

DIED.—John Weatherspoon, one of the oldest and best known electricians and gas men in the country, died in this city on May 22d. It is said he was the first to introduce the use of electricity into the London theatres. He was a member of several theatrical unions.

BUSINESS MENTION.—The National Electric Manufacturing Company, successors to the electrical department of the New Haven Clock Co., will move its entire electrical plant from New Haven to its new factory, situated at Milford, Conn., about June 1st The new factory is said to be one of the finest ever erected for the purpose of manufacturing electrical goods. The goods of this Company are well-known throughout the world.

WHAT A WHITEWASH BRUSH CAN DO.—A curious accident occured at Macy's store, corner 6th avenue and 14th street, Thursday night of last week. A kalsominer left his brush leaning against an insulated electric wire. The lime in the brush destroyed the insulation which caused the automatic fire alarm signal to act. This called out the fire department, but when they got to the store they found that there was no fire. The damp brush had caused all the mischief.

LIGHTNING'S FATAL WORK.—The village of St. Mahlen, near Hildesheim, Germany, has been visited recently by severe hail storms, which have done a great deal of damage. On May 22d people gathered in a church to pray for a cessation of the storms. While the services were in progress a thunder storm came up and the church was struck by lightning. Four persons were instantly killed and twenty were injured, four being rendered completely blind. The people were panic stricken, and in the mad rush for the doors two children were crushed to death.

CONSOLIDATION OF GAS AND ELECTRIC LIGHT INTERESTS.—In the Massachusetts House of Representatives, on May 21st, the Senate bill to authorize the consolidation of gas and electric light companies was passed. The bill is the same one reported back by the committee with an amendment recommended, to require the agreement for consolidation to be approved by a vote of two thirds in number and interest of the stockholders of each company at meetings duly held for that purpose; and another making it necessary for the board of appraisers to be unanimous.



A DETERMINATION OF "*v*," THE RATIO OF THE ELECTRO-MAGNETIC UNIT OF ELECTRICITY, TO THE ELECTRO-STATIC UNIT.*

BY PROF. J. J. THOMSON, M. A., F. R. S., AND G. F. SEARLE, B. A.

The experiments made by Prof. Thomson in 1883 having given a value for "*v*" considerably smaller than the one found in several recent researches, it was thought desirable to repeat the experiments. The method then used was to find both the electro-static and the electro-magnetic measures of the capacity of a condenser, the electro-static measure being calculated from the dimensions of the condenser, and the electro-magnetic measure by determining a resistance which would produce the same effect as that produced by repeated charging of the condenser when placed in one arm of a Wheatstone's bridge. In the experiments in 1883, the condenser used in determining the electro-magnetic measure was not the same as that for which the electro-static capacity had been calculated, but one without a guard ring, the equality of the capacity of this condenser and the guard ring condenser being tested by the method given in Maxwell's "Electricity and Magnetism," Vol. I., p. 324.

In repeating the experiments the authors adopted the same method as before, using, however, a key of different design for testing the equality of the condensers by Maxwell's method. The results were very consistent, and practically identical with those obtained in 1883. In reply to the objection which has been made that the capacity of the leads might explain the low value of "*v*" obtained previously, the authors state that these are allowed for by the way the comparison between the two condensers is made, for the same leads are used in the determination of the electromagnetic measure of the capacity of the auxiliary condenser and in the comparison of the capacity of this condenser with the one with the guard ring; and the capacity, of the auxiliary condenser is adjusted until its capacity, plus that of the leads, equals the capacity of the guard ring condenser; and in the electro-magnetic measurements it is the capacity of the auxiliary condenser, plus that of its leads, which is found.

As the use of the auxiliary condenser introduces additional sources of error, they endeavored to determine the electro-magnetic measure of the guard ring directly, using a complicated commutator, which worked both the guard ring and condenser. The first commutator used was one where the contracts were made by platinum styles attached to a tuning-fork; the results obtained with this were not so regular as could be desired, so the tuning-fork commutator was replaced by a rotating one driven by a water motor. A stroboscopic arrangement was attached to the commutator, which enabled its speed to be measured and kept constant. With this arrangement, which worked perfectly, they got values for the electro-magnetic measure of the capacity of the condenser distinctly less than those obtained by the old method. After a good deal of trouble it was discovered that in the experiments by which the equality of the capacities of the guard ring and auxiliary condensers were tested the guard ring did not produce its full effect. When the guard ring of the standard condenser was removed, and the capacity of the auxiliary made the same, the two methods gave identical results; but the effect produced by adding the guard ring was less in the old method than in the new. It was found by calculation that the effect produced by the addition of the guard ring in the old method was distinctly too small, while in the new the observed and calculated effects agreed well together. The new method possesses great advantages over the old one, inasmuch as the auxiliary condenser is entirely got rid of; and since the commutator is a rotating one, its speed can be altered with much greater ease and accuracy than can be done with a tuning-fork. The old method was therefore discarded in favor of the new one.

The following are the results obtained by this method:—

ELECTRO-STATIC MEASURE OF THE CAPACITY, 397.991.
ELECTRO-MAGNETIC MEASURE.

First Set of Experiments.

No. of times the condenser is charged per sec.	Capacity X 10^{21}.	No. of times the condenser is charged per sec.	Capacity X 10^{21}.
64	443.427	64	443.298
32	443 571	55	443.478
48	443.52	42	443.443
80	443.45		

Mean, 443.457.

Second Set.

64	443.043	55	443.766
48	443.097	48	443.378
32	443.378	32	443.646
80	442.950	16	443.672
64	443.686	80	443.163

Mean, 443.377.

Third Set.

64	443.369	80	443.530
32	443.257	55	443.835
48	433.770	64	443.401

Mean, 443.527.

The mean of all the observations = 443.454 × 10^{-21}.

The means of the observations for different speeds are given in the following table:

No. of times the condenser is charged per sec.	Capacity X 10^{-21}	No. of times the condenser is charged per sec.	Capacity X 10^{-21}
80	443.275	42	443.443
64	443.370	32	443.463
55	443.693	15	443.672
48	443.442		

These agree very well together, the greatest difference being about one part in 1,000.

Taking 443,454 × 10^{-21} as the electro-magnetic measure of the capacity, the value of "*v*" is 299.58.

* Abstract of a Paper read before the Royal Society.

TELEPHONIC EXTENSION IN SCOTLAND.—The National Telephone Company, has just completed the erection of new wires between Glasgow and Edinburgh. Previous to the latter being brought into daily use, an opportunity to speak over them was afforded last Friday to the representatives of the press in Dundee and the local representatives of the press in Glasgow, Edinburgh and Aberdeen. Through connection with the Glasgow Telephonic Exchange having been secured, conservation was carried on with various gentlemen there; and next, the necessary connections having been made, conversation was carried on with Sir W. Thomson at the Glasgow University. The speakers at both ends of the wire were quite distinctly heard, all speaking in the ordinary conversational tone of voice. Communication was afterwards carried on with gentlemen in the Edinburgh exchange, and the results were equally satisfactory.

TANNING BY ELECTRICITY.—*Engineering*, of London, reports an interesting trial of electricity for the conversion of hides into leather, which took place in Bermondsey on May 14th. The tanning was accomplished in a revolving drum twelve feet in diameter and eight feet long, rotating at eight revolutions a minute. Turpentine and tannic acid were used to saturate the hides, and a strong current of electricity was caused to flow from a metal band which runs around the interior of one end of the drum to a corresponding band on the other end. The drum, after revolving five days, was opened, and the leather appeared to be of excellent quality. This system shortens the process of tanning from months to days, and seems to be a successful revival of an experiment made at Buda-Pesth ten years ago.

BOOKS ON ELECTRICAL SUBJECTS.

The A, B, C, of Electricity.—An explanation of the various ways electricity may be generated and usefully applied. By Wm. H. Meadowcraft. Cloth, 108 pages, 35 illustrations. 50 cents.

Bell-Hanger's Hand-Book. By F. B. Badt. Flexible cloth binding. 106 pages, 97 illustrations. $1.00.

The name of this book is unfortunately too narrow in application. The book gives complete information on batteries, of the different kinds, uses and method of application to different classes of work; Bell work, including fire alarms, annunciators, etc., and a good deal of instruction about electrical things in general.

Induction Coils, How Made and Used. By Dyer. Boards. 50 cents.

The Electric Motor and its Applications. By Martin and Wetzler. Second edition; 292 large quarto pages, 316 illustrations. $3.00.

This is the only complete and reliable work on this important and interesting subject, and is brought up to date. The second edition has four newly added chapters covering American and European motors, alternating current motors, and the pyro magnetic motor. Anyone interested in electric railway progress will find this work very valuable.

Dictionary of Electrical Words, Terms and Phrases. By Edwin J. Houstin. 656 pages, 397 illustrations. $2.50.

This book is virtually an electrical cyclopedia, and was compiled after great search and labor. It includes nearly 2,500 distinct words, terms or phrases. It is the most complete work of the kind in existence and has filled a long felt want. One possessing a copy of this book need not remain in ignorance concerning anything pertaining to electricity.

Principles of Dynamo Electric Machines. By Carl Hering. 279 pages, 59 illustrations. $2.50.

This book gives practical directions for designing and constructing dynamos. An appendix contains several articles on allied subjects, and a Table of Equivalents of Units of Measurements.

Practical Information for Telephonists. By T. D. Lockwood. New edition, revised, 192 pages. $1.00.

Mr. Lockwood is eminently qualified to give the information contained in this book, and he does it in a manner that is as interesting as it is valuable. Everyone interested in the telephone service should study this book, as it is full of matter, some of which at least will be new to everyone, however familiar he may be with the telephone.

Elementary Treatise on Electric Batteries. By Alfred Niaudet. Translated from the French by L. M. Fishback. 266 pages, 55 illustrations. $2.50.

The Galvanometer and its Uses. By C. H. Haskins. Third edition; 74 pages, illustrated. $1.50. A manual for Electricians and Students.

This is an invaluable work for any one whose duties require the use of this very important instrument.

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C. & C. MOTOR FAN OUTFITS.—The C. & C. Motor Company of this city are anticipating hot weather, but provide means by which it is possible to keep cool. They have just issued a neat little pamphlet illustrating and describing their portable fan outfits, which are a boon to suffering humanity in hot weather. By the use of these outfits great comfort can be enjoyed during the heated term, when indoors, the fans keeping the air in constant motion, and at the same time keeping it pure.

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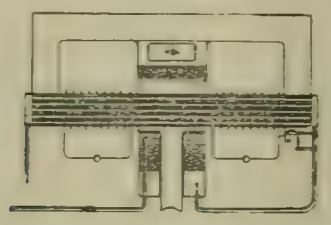
ELECTRICAL PATENTS ISSUED MAY 20TH.

428,042. Method of Producing Alternating Electric Currents. Mahlon S. Conly, Hyde Park, assignor of two-thirds to William B. Sterret, Chicago, and John F. Weare, Hyde Park, Ill. Filed July 9, 1889.

428,046. Terminal for Electric Cables. Joseph A. Hanagin, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Mar. 25, 1889.

428,050. Ground Detector. Charles H. Macloskie, Allgheny, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Aug. 31, 1889.

428,055. Manufacture of Telegraph Cables. William R. Patterson, Chicago, Ill. Filed May 14, 1889.



NO. 428,057.—PYROMAGNETIC ELECTRIC GENERATOR.

428,057. Pyromagneto Electric Generator. Nikola Tesla, New York, N. Y., assignor of one-half to Charles F. Peck, Englewood, N. J. Original application filed May 26, 1887. Divided and this application filed May 25, 1889.

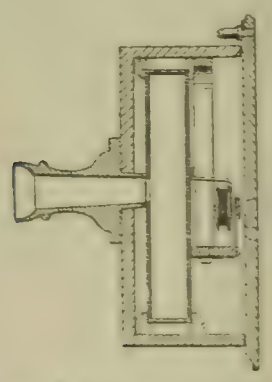
428,066. Arc Lamp. Charles P. Breese, New York, N. Y. Filed Feb. 11, 1890.

428,071. Insulator for Electric-Railway wires. Harold P. Brown, New York, N. Y. Filed Mar. 10, 1890.

428,072. Trolley System for Electric Railways. Harold P. Brown, New York, N. Y. Filed Mar. 10, 1890.

428,073. Commutator-Brush for Dynamos. Lewis Van Brown, Asheville, N. C., assignor of one-half to William H. Inloes, same place. Filed Aug. 15, 1889.

428,084. Electric Meter. Alphonse Frager, Paris, France. Filed Jan. 29, 1890.



NO. 428,174.—TELEPHONE.

428,087. Process of Electro-Deposition. Davis Garrett, Kansas City, Kans., assignor of one-half to James Clark, same place. Filed Dec. 4, 1888.

428,095. Electric Signal-Circuit. Orlando W. Hart, Fall River, Mass. Filed Aug. 23, 1889.

428,098. Electric Railway. Rudolph M. Hunter. Philadelphia, Pa., assignor, by mesne assignments, to the Thomson-Houston Electric Company, Boston, Mass. Original application filed May 22, 1886. Divided and this application filed Jan. 14, 1888.

428,116. Galvanic Battery. Archibald J. MacDonald, North Tiverton, R. I., assignor to Henry E. Townsend, trustee, Boston, Mass. Filed Aug. 24, 1889.

428,136. Trolley-Arm Support for Electric Railways. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed Mar. 13, 1890.

428,169. Electric Motor Regulator. Walter H. Knight, New York, N. Y. Original application filed March 13, 1886. Divided and this application filed June 5, 1889.

428,174. Telephone. John C. Ludwig, San Francisco, Cal., assignor of one-half to A. C. Paulsell and Martin Corcoran, same place, and T. C. Coogan and H. T. Compton, Oakland, Cal. Filed July 6, 1889.

428,175. Electric Locomotive. James F. McLaughlin, Philadelphia, Pa. Filed March 17, 1890.

428,189. Three Wire Multiple Switch-Board System. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 10, 1888.

428,210. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed March 18, 1886. Serial No. 195,742. Divided and this application filed Feb. 8, 1889.

428,211. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor, by mesne assignments, to the Thomson-Houston Electric Company, Boston, Mass. Original application filed Dec. 15, 1888. Divided and this application filed May 21, 1889.

428,221. Synchronous Multiplex Telegraphy. Francis J. Patten, New York, N. Y., assignor to J. M. Seymour, Brick Chuch, N. J. Filed Jan. 10, 1890.

428,222. Multiplex Telegraph. Francis J. Patten, New York, N. Y., assignor to J. M. Seymour, Brick Church, N. J. Filed Jan. 10, 1890.

428,223. Multiplex Telegraphy. Francis J. Patten, New York, N. Y., assignor to J. M. Seymour, Brick Church, N. J. Filed Jan. 10, 1890.

428,224. Synchronous Multiplex Telegraphy. Francis J. Patten, New York, N. Y., assignor to J. M. Seymour, Brick Chuch, N. J. Filed Jan. 10, 1890.

428,225. Synchronous Multiplex Telegraphy. Fancis J. Patten, New York, N. Y., assignor to J. M. Seymour, Brick Chuch, N. J. Filed Jan. 10, 1890.

428,226. Synchronous Multiplex Telegraphy. Francis J. Patten, New York, N. Y., assignor to J. M. Seymour, Brick Church, N. J. Filed Jan. 10, 1890.

428,247. Magnetic Lock. William W. Fenner, Kansas City, Mo., assignor of one-third to Emma Rhodes, same place. Filed Jan. 31, 1890.

428,256. Magnetic Lock. John Schneider, New York, N. Y. Filed March 5, 1890.

428,273. Graphophone. Mark L. Deering, Cleveland, Ohio. Filed Dec. 20, 1888.

428,280. Electric Meter. Jacob E. Mehren, Chicago, Ill., assignor to the American Electric Meter Company, same place. Filed Oct. 7, 1889.

428,289. Armature for Dynamos, &c. Albert Schmid, Allegheny, assignor to the Westinghouse Electric Company, Pittburg, Pa. Filed June 6, 1889,

428,290. Electric Meter. Ernst W. Von Siemens, Berlin, Germany. Filed Dec. 9, 1889. Patented in Germany, England, Switzerland, Belgium, France and in Italy.

428,317. Regulator for Electric-Current Generators. Gustav Pfannkuche, Cleveland, Ohio. Filed June 8, 1888.

428,358. Cut-Out. Nathan P. Stevens, Concord, N. H. Filed Nov. 15, 1889.

428,378. Electric Furnace for Melting Metals. Edward A. Colby, New Haven, Conn. Filed April 14, 1887.

428,379. Electric Induction Device. Edward A. Colby, New Haven, Conn. Filed Sept. 19, 1887. Renewed Oct. 21, 1889.

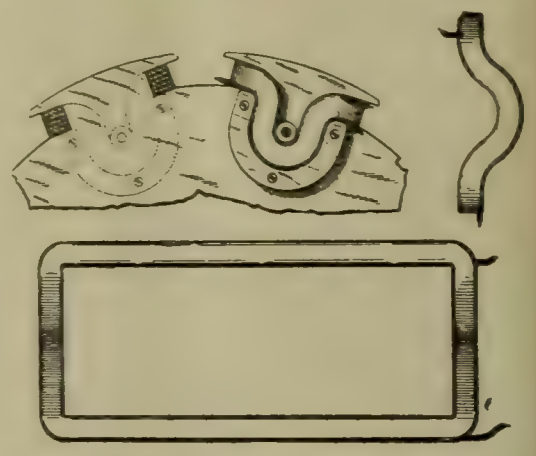
428,380. Dynamo-Electric Machine or Electric Motor. Edgar Croasdale, Philadelphia. Pa. Filed Jan. 26, 1886.

428,420. Voltaic Armor. Albert I. Scott, Allegheny, Pa. Filed Feb. 20, 1890.

428,433. Electric Gas-Lighter. Robert T. Walton, Philadelphia, Pa. Filed July 18, 1889.

428,435. Alternating Current Arc Lamp. George Westinghouse, jr., Pittsburgh, Pa. Filed Mar. 19, 1890.

428,454. Electric Motor. William H. Chapman, Portland, Me , assignor to the Giant Electric Motor Company, Boston, Mass. Filed Dec. 30, 1889.



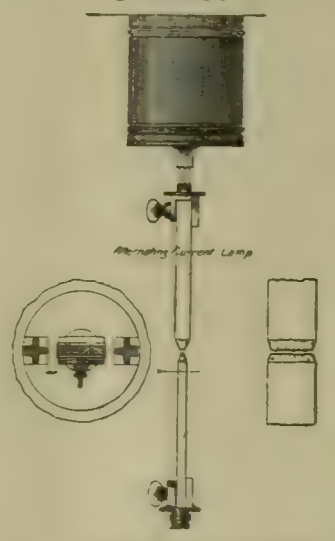
NO. 428,289.—ARMATURE FOR DYNAMOS.

428,499. Electric Railway. Jerome B. Legg and John Nile, St. Louis, Mo. Filed Oct. 10, 1888.

428,545. Electric Insulator. Emery Andrews, Kennebunk, Me., assignor to the Leatheroid Manufacturing Company, same place. Original application filed Nov. 4, 1889. Divided and this application filed Jan. 24, 1890.

428,564. Electric Cut Out. William J. Jenks, New York, N. Y. Filed Dec. 10, 1888.

428,575. Method of Building Electrical Converters. William Stanley, Jr., Great Barrington, Mass., assignor to George Westinghouse, Jr., Pittsburg, Pa. Original application filed Nov. 23, 1886. Divided and this application filed Mar. 6, 1889. Patented in England, France, Belgium, Germany, Italy and in Canada.



NO. 428,435.—ALTERNATING CURRENT ARC LAMP.

428,576. Electric Semaphore Apparatus. Frederick Stitzel and Charles Weinedel, Louisville, Ky. Filed Mar. 21, 1889.

FRENCH TELEPHONE STATISTICS.—The French Minister of Commerce has published statistics showing that on April 1st, 1890, there were 12,800 subscribers to the various telephone systems, distributed as follows :—Paris system, 7,445 subscribers; departmental systems taken over by the State, 2,630; old State systems, 2,725. On September 1st, 1889, the date at which the State took possession of the lines, there were only 11,442 subscribers. This gives an increase of 1,538 subscribers in seven months.

ANSWERS TO INQUIRIES.

R. H. J.—The iron cores of the field magnet and armature of a dynamo, together with the air spaces between them, constitute a magnetic circuit along which the magnetic lines pass. The whole number of magnetic lines flowing along this circuit can be calculated if the exciting force and the sum of the magnetic resistances are known. These calculations are by a process resembling calculations by Ohm's law for electric circuits.—Ed. ELECTRIC AGE.

Editor of THE ELECTRIC AGE: Can you recommend a book which describes briefly the different systems of electric lighting? There are so many publications that one is apt to become confused in his effort to choose.

Wilmington, Del. "ANODE."

Answer.—There are a good many books on the subject, all of which we can recommend. You cannot read too much in this line. You might try "The Elements of Electric Lighting," by Atkinson. This is a very good book, and it is judiciously brief. We can send it to you by mail. Price $1.50.—Ed. ELECTRIC AGE.

R. S. asks for a description of the distinguishing features of the Mather dynamo. This dynamo is designed for incandescent lighting only, and its chief peculiarity is the form of the field magnet, which is circular. The armature is of the drum type and is without interior ventilation. These are the only features peculiar to this dynamo. Essentially, it is about the same as machines of other makes. For full description of the machine we refer you to works on electric lighting.—Ed. ELECTRIC AGE.

Editor ELECTRIC AGE.—In the construction of field magnets for dynamos what quality of iron is used—cast or wrought?

Kansas City. "MECHANIC."

Answer—Cast iron is generally used, although it is sometimes preferable to use wrought iron. Lamination of the core is recommended to give the lines of force their proper direction.—Ed. ELECTRIC AGE.

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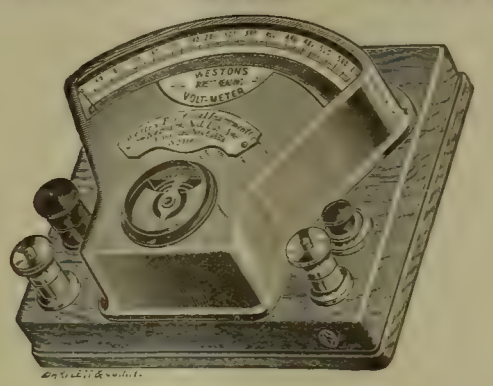
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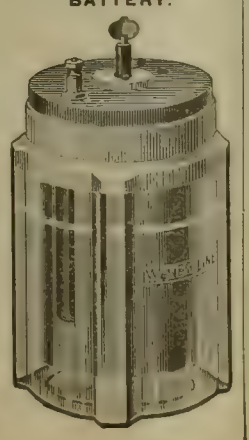
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NEW YORK, JUNE 7, 1890.

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ELECTRIC WIRES.

During the last session of the State Legislature e Senate Committee on General Laws, which ndertook an investigation into electrical matters, quested its electrical expert, Mr. F. W. Jones, make a report on the present situation regardg the use of electric wires in the State of New rk, and the legislation needed for the better otection of life and property by such use. r. Jones has submitted his views to the comittee, but the Legislature having adjourned, e report has not yet been made public. We ve, however, secured an advance copy of the me, the first part of which will be found on other page of this issue. The balance of the port will appear in the succeeding issue.

Mr. Jones handles his subject in a masterly anner. Indeed, there is no one more qualified pass upon this important question than he. he first part of his report relates to wires used telegraph and telephone purposes, and he otes the laws, National and State, passed at ious periods up to the present time, regulating e building and use of the same. "Up to 78," says Mr. Jones, "no special laws were cessary for controlling the use and distribution electric currents, so far as danger to life and perty was concerned, inasmuch as the teleph, telephone and domestic companies used mparatively feeble currents. Since 1878, however, electric light and power companies have rung into existence using dynamo machines d storage batteries yielding electric currents enormous quantity and high pressure which, not rigidly guarded and properly applied der most exacting conditions, will prove very ble to main or kill, and consume property by e."

Mr. Jones refers incidentally to the immense vantages enjoyed by the Western Union Teleph Company in the matter of right of way over railroad lines. To understand what these advantages mean in practice, take that company's lines between New York and Philadelphia. These lines are 92 miles long, while those of other companies between the two named cities, vary between 112 and 167 miles in length. These competing companies are debarred from the right of way on railroads, and are compelled to string their wires on circuitous turnpikes, hence the much longer length of lines between given points.

The report entire makes very interesting reading, and Mr. Jones makes some very sensible and practical suggestions on the subject under consideration.

IMPROVED UNDERGROUND CABLES.—Of inventors there may be said to be two classes—one looking for new things and the other improving existing methods of accomplishing results. In these days the latter class accomplish more good for mankind than do the former. It is well-known that in electric operations there are a great many weak points, that need to be strengthened in order to obtain the best results. One of these weak points has been overcome by Capt. Willard L. Candee, in an improved method of prolonging the life-time of an underground electric cable, on which invention he has just received letters-patent. Much trouble has been caused by moisture gaining access to the interior of the cables through capillary action in the fibre of the wire covering. The exposed ends become damp by exposure to the atmosphere, and long before the cable has served its time it becomes defective as to insulation. Capt. Candee overcomes these difficulties by so insulating the exposed ends of cable conductors, with okonite or like material, that it is an impossibility for moisture to penetrate into the interior and cause any of the serious annoyances referred to. On another page will be found a full description of the invention.

THE INSURANCE QUESTION.—In referring to the report of the recent meeting of the National Board of Fire Underwriters on the subject of electric risks, in our issue of May 24th, we questioned the accuracy of the figures in that report representing the number of fires caused by electric currents. The paper read by S. E. Barton before the recent Boston meeting of the American Institute of Electrical Engineers, throws the light of day on the falsity of those figures. He charges the committee who made the report with misrepresentation, and shows by the committee's own figures how the real facts have been distorted and misrepresented. Electricity seems to be a bugaboo among some of the underwriters, but their alarming reports have no real effect among the larger portion of the parties interested, for they know better than to allow themselves to be needlessly frightened, and when such an authority as Mr. Barton scrutinizes such statements the truth is bound to prevail.

ELECTRIC POWER ON THE BRIDGE.—In reply to a question regarding the advisability of substituting electric power for cable power for the propulsion of the cars on the Brooklyn Bridge, Prof. Elihu Thomson says: Of course there would be no particular difficulty in superposing on it [the bridge] an electric system if desired, or replacing the cable system with an electric system. I cannot say that I have studied the problem so thoroughly as to pronounce off-hand on the desirability of these latter changes. I am far from being a believer in supplanting all other systems in such special cases of fitness by electric systems. "Candles are still used," he continues, "and so is gas and kerosene, though we have electric lights. Fitness must govern." Prof. Thomson states that he has always been of the opinion that the Brooklyn Bridge is a case to which the cable system is particularly adapted.

FIRE ALARM SERVICE.—Boston is gaining a great reputation for the enterprise shown in electrical matters. The fire commissioners of that city have adopted a plan which is a wise one, and which will greatly add to the efficiency of the fire department. They have employed a telegraph operator for each district chief, whose duty it will be to keep up telegraphic communication between the fire alarm boxes and the fire department. An operator will be stationed at a general fire alarm telegraph office at the City Hall, from which point every engine house can be communicated with. The value of this innovation will be great, as it will enable every fire chief to keep in constant communication with all of the fire department stations during the progress of a fire. It would be wise for other cities to follow Boston's example in this respect; much property might be saved thereby.

PORTABLE TESTING INSTRUMENTS.—The demand for portable electrical testing instruments has increased to such an extent in late years that manufacturers are constantly improving them with a view to making them more convenient to carry and perform their functions with greater accuracy. Messrs. Jas. W. Queen & Co., of Philadelphia, have just brought out a new series of portable testing and resistance instruments, which we describe and illustrate on another page. These instruments have a great range of application and no doubt will be found very valuable to those who have use for this class of electrical instruments.

A NEW APPLICATION OF ELECTRIC HEATING.—According to certain Italian journals the dome of St. Peter's is cracking in a somewhat serious manner. *La Lumière Electrique* states that a similar state of things was discovered about 100 years ago, and was remedied by encircling the dome with a strong band of metal. This band was heated, and its contraction on cooling was found to be sufficient to close up the fissures. The same journal suggests the use of electricity if a similar method should be tried in the present case.

ELECTRICAL CHIMES.—An employe in the office of the architect of the Capitol, Washington, has invented an electrical musical machine. The keyboard is similar to that of an ordinary typewriter, and its keys are connected electrically with a number of electric bells arranged beneath the table. Pressure on each key closes the circuit of an electric bell, and when the keys are operated by an expert any tune may be played on the machine.

THE JOULE MEMORIAL.—A meeting of the Joule Memorial Committee was held at the Manchester, (England) Town Hall, May 12th, to meet Mr. Alfred Gilbert, A. R. A. At the close of a conversation on the subject of the proposed statue, a resolution was unanimously passed adopting the resolution of the Art Sub-Committee in favor of the bestowal of the commission on Mr. Gilbert, who undertook to execute the work.

OBITUARY.

KARL FRISCHEN.

On the 8th of May, Karl Frischen died at Berlin. In his death electrical science has lost one of her most distinguished promoters. His numerous services in the interests of telegraphy and electric signaling for railways, assure him and honorable fame.

Karl Frischen was best known to telegraph electricians in this country through his connection with the development of multiplex telegraphy. In 1854 he made an important improvement upon Gintl's method of simultaneous transmission in opposite directions over one wire. This invention is the basis of some of the most successful methods of duplex telegraphy now in use. In 1863 Frischen published a description of a modification of his invention of 1854, which is essentially the polar duplex of to-day. The Stearn's Duplex does not differ materially from that of Frischen.

THE CARTWRIGHT PROTECTOR.

The increasing number of wires carrying electric currents of large volume has made it necessary to devise means to protect telephones and other apparatus depending on small electric currents for their operation from injury in case the two classes of wires become crossed. It is well known that large currents, such as those used for lighting, or street railway purposes, will destroy the delicate apparatus used on telephone, telegraph and fire alarm circuits, and may even fire the buildings into which these wires enter. It is not practicable in cities to so string the two classes of wires that all danger of their becoming crossed will be removed absolutely. The various wires in cities must, of necessity, cross and recross at different elevations. In case of breakage of any of these there is liabilty to actual contact between them. It is here where the danger lies. Inasmuch, therefore, as this element of danger cannot be entirely removed, it becomes necessary to devise automatic means of protecting our property against the intrusion of stray currents of great volume. Many devices of this sort have been brought out and put upon the market. A very efficient instrument of this class is the Cartwright Protector.

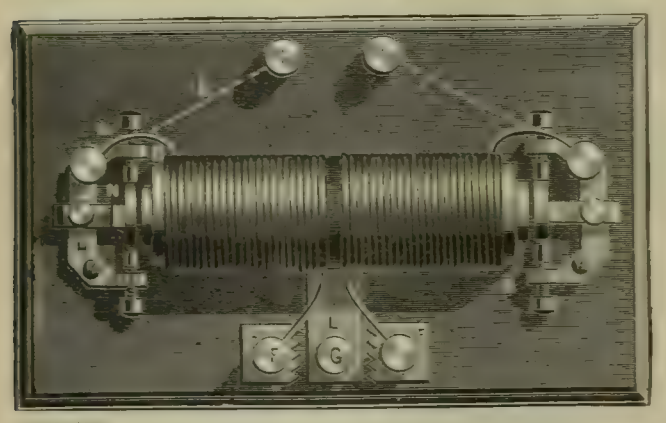


FIG. 1. PLAN OF CARTWRIGHT PROTECTOR.

At the recent test made by the Boston Fire Underwriter's Union, the Cartwright Protector fulfilled perfectly all the requirements, and was the only instrument which did, no other being considered so well adapted for use on fire alarms and metallic circuits. As a result of the test, the Cartwright Protector was approved of and accepted by the Board.

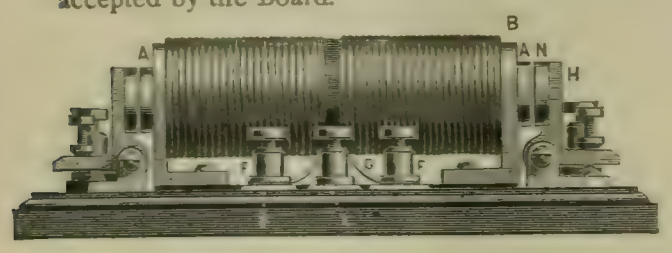


FIG. 2.

The Cartwright Protector is simple in construction and unfailing in action, and gives perfect protection to all electrical instruments against any fire which can be caused by the crossing of wires carrying a weak current by those carrying a more powerful one. So long as the current passing through the instrument protected is normal, the armatures of the protector remain quiescent, but upon the passage of an abnormal current the armatures are attracted by the core of the magnet and the current is carried to ground, thus cutting out the telephone or other instrument which would have been destroyed, and probably the building set on fire, had not the abnormal current been so diverted. So soon as the abnormal current has been carried off, the armatures are released from the core automatically, and the protector is ready for another abnormal current.

Reference to the accompanying illustrations will aid in a better understanding of the instrument and its operation. Figs. 1 and 2 show respectively the plan and elevation of the instrument, and figs. 3 and 4 show, diagramatically, the circuits and connections. In Figs. 1 and 2 two helices are seen, end to end, but magnetically separated from each other at the centre. At the outside ends the helices are supported by angle irons B, both of which are screwed to a brass bed plate.

The wire on the helices is wound in the same direction. The armature levers, H, are made of metal in bell crank form and pivoted to the bed plate as seen in the figure.

The horizontal arm of the lever is of sufficient weight to overcome the attraction caused by the normal current passing through the helices. N is the armature and A is the core of the helices. These letters also apply to the corresponding

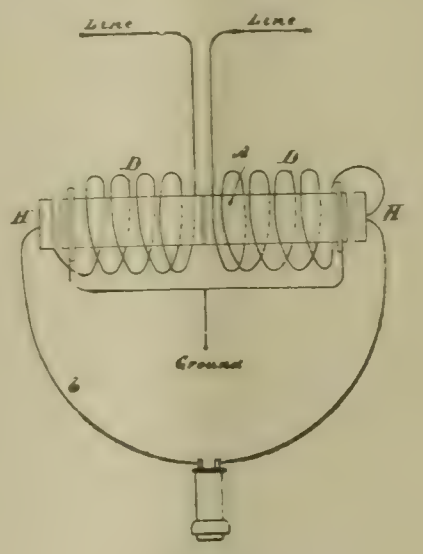


FIG. 3.

parts of the opposite helix. The outside, or line wires, are attached to binding posts F, to which are connected the inside ends of the helix wires. The outside ends of the latter are connected through the armature levers with the terminals of the instrument to be protected. Binding post G, represents the ground connection. Now referring to figure 3 it will be readily understood that so long as the current circulating in the helices remains at its normal strength the armature remains passive, but the moment the current is abnormally increased the magnetism

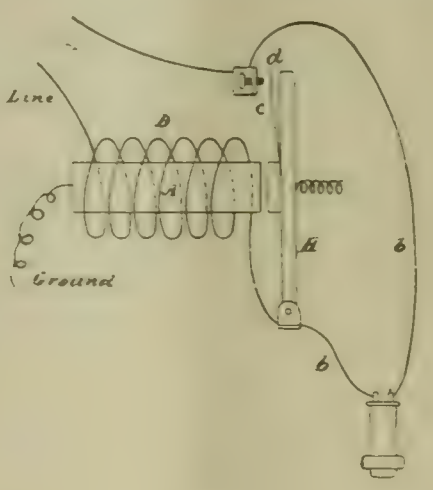


FIG. 4.

in the helix on the side through which the abnormal current enters will be so increased as to attract its armature towards the core. This action brings the armature into actual contact with the helix core, and the line wire will be put into direct contact with the ground through the core, thus shunting the current to the ground before it can reach the instrument protected. The ground connection will be maintained so long as the current remains excessive. But the moment the excess of current is removed the protector will return to its normal condition and the telephone and other instruments will be again placed into the circuit. Precisely the same action takes place if the abnormal current happens to be on the other line wire, and if both wires are similary affected at the same momen the results are just the same. Figure 4 show the circuit in another form of the protector, hav ing a single helix. Its action is similar to tha of the instrument just described, and will b readily understood by tracing the path of th currents, and connections made under differer conditions. By certain combinations of fuse and connections, alarms may be sounded whe the protection is made to operate by abnorma currents.

The simplicity and efficiency of this protectiv device are features that cannot fail to attract th admiration of all interested, and it is evident tha property protected by these instruments is absc lutely safe from the dangers incident to the d version of heavy currents from their proper paths

There is a great demand for a reliable devic of this character, and the Cartwright Protecto fulfilling every essential requirement as it doe deserves a large and extensive sale.

RANGE FINDING AT SEA BY ELECTRI ITY.

Park Benjamin, Ph. D., in an article in *Ha per's Monthly*, for June, entitled "The Enemy Distance. Range Finding at Sea by Electricity describes, in an interesting manner, Lieu Fiske's range finder, and discusses its practic application.

The employment of distance-finding appar tus, says Dr. Benjamin, is by no means limite to cruisers at sea and to forts. The Fiske ran finder, about to be installed on board of the d namite cruiser Vesuvius, will prove a m valuable ally to the dynamite gun. The pr jectile, charged with 600 pounds of nitro-gelati propelled as it is by compressed air at mu lower speed than the rifle shot, works destru tion not merely at its point of impact, but ar where within a radius of fifty feet around. B here the range is dependent upon the air pr sure, which can be regulated with wonder nicety. With the distance which the shell is go known, the accuracy of fire of the dynam gun, despite the high trajectory of its projecti may equal that of the rifle. The range finc has also been adapted to the use of troops in t field. Observers on the skirmish line, provid with the necessary apparatus and located at t extremities of a quickly measured base line, c determine easily the distance of the enemy, a not only telephone or signal back the range guide in the establishment of artillery positio and the laying of the guns, but can keep t commanding officer constantly advised changes of distance of the hostile force.

While Lieutenant Fiske's invention finds most immediate use for military purposes, it not without peaceful adaptations. Many a sl has gone ashore, even in sight of land, throu an error of judgment on the part of her navi tor as to her distance from the coast. T range finder will not only prevent such misju ment, but even at night, when the frien beacon seems to stand out like an isolated in the midst of the black chaos of sky and wa the mariner may learn with certainty his tance from the perilous shoal or reef.

That navy which possesses the most accu system of range finding, other things being eq stands the best chance of prevailing in fut wars; for the ship that can plant two shots wh before only one could be placed has a doul efficiency as a war engine. Whether afloat ashore, victory, under modern conditions, well leave her traditional dwelling-place a the heaviest battalions, and perch on the ba of him who knows best how far off the hea battalions are.

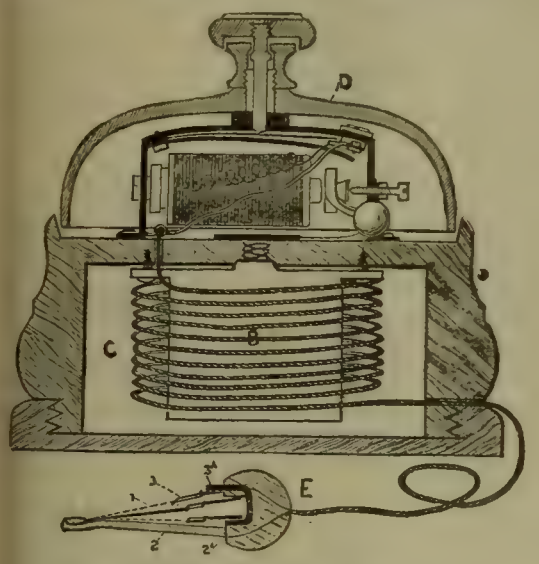
REMOVAL.—Mr. Thos. F. Clohesey, Electr Engineer, of Kansas City, Mo., has moved f the Board of Trade to 805 New York Life Bu ing in that city.

A USEFUL ELECTRIC BELL.

The following description and illustration of a eful and compact electric portable bell are taken m a London contemporary. The article has en brought out by Messrs. E. J. Tumber & Co., d combines a table call bell, invalid's bell set, rglar alarm and fire alarm. The whole apparatus, mplete with battery, cord, &c., as shown in our ustration, only occupies a space of 4½ inches.

When used as a table bell it is only necessary to ess the ivory tablet to call attention.

On unscrewing the bottom of the case the silk re conductor and contact press will be seen. The ter enables the apparatus to be used either as an dinary invalid's bell set, or by drawing back a ding tongue on the spring arm it is converted to a burglar and thief alarm, and if placed between ndow sashes, in the crevice of doors, box lids, binets, &c., falls out on these being opened, and



PORTABLE ELECTRIC BELL.

e spring being released continues to ring the bell til reset.

The fire alarm which is placed under the dome ay be set to start the bell at any required degree temperature; it is ordinarily set at 200° F.

A, Press for use as table bell; B, Battery; C, Space r flexible cord and contact press; D, Thermostat fire alarm; 1, Position when not in use; 2, aking contact by pressure at 2A for use as an or- nary press; 3, Sliding tongue pushed back, owing spring arm to fly up and make contact at , for use as thief detector.

One of the pole pieces of the electro-magnet in e bell is slotted to receive a projection on the mature, thus enabling the bell to ring with small ttery power. The battery contains no fluid and n be easily removed for recharging or renewing.

PRACTICAL APPLICATION OF STORAGE BATTERIES TO CAR TRACTION WORK.

BY MR. J. K. PUMPELLY.

Perhaps one of the most desirable uses to which rage batteries can be placed on account of the nvenience of carrying motive power from point point, confined ready for use in a comparatively all space, is that of traction on street cars, and hough money and time have been expended in periments and many failures made, there have en successes enough, notwithstanding, to con- nce practical men that the principle is good and t the faults developed can be overcome.

We may well begin here by going into the subject faults and then consider how they may be rem- ied. On a street car where storage batteries e used the absolute necessity of estimating the wer necessary to move the weight of batteries emselves and then the horse power needed to run e car loaded, is so difficult that actual experiments th such a car is about the only way in which we n satisfy ourselves as to what a battery of a certain ight will do under all circumstances, that is with ight or heavy load, on a level or a grade, straight ck or curves.

Thus far a fair estimate has been arrived at by extensive and frequent trials. Allowing that these points are comparatively settled, then we are free to turn our attention to the make up of the batteries themselves.

It is necessary to mention here how often we learn that the lack of durability and continued efficiency of the batteries themselves have been the main cause of failure. Now allowing for the moment that we have a battery that shows good efficiency and durability under any severe work which it has been called upon to perform, under any necessary knocking about and handling. Then we must judge by the character of the road itself, its curves, the frequency of stops and starts, its percentage of grades, and the most convenient length of trips, what weight of battery to use. To do this let us use some estimates in figures already fairly establsh- ed by careful trials, by which to judge.

The French engineers in their tramway electro- motive experiments seem to be careful and accurate in their figures, and although I think we have the advantage of them in our storage batteries we may take, for instance, the experiments lately made on the Levalois-Madeleine line at Paris as a fair es- timate.

I quote as follows: "The following particulars are given of the new electric cars on the Levalois–Madelaine line at Paris. Four cars at present are running. They are fitted with Fuare-Sellon-Volck- mar accumulators with twin plates 108 cells in 12 boxes, containing 9 each in series, each cell weigh- ing 33 pounds. The 12 boxes are placed in cup- boards at the angles of the cars, four in front and twelve behind. They are grouped in four groups of 27 and can be connected in four manners, one, two, three or four in series. The motor placed under the car is of the Siemens type. Its speed can be 1,600 revolutions, but is usually 1,000, reduced by endless cord gearing of 27 to 1. The reversal of the motor is accomplished by the movement of a handle fitted to the brushes; these are double and in the form of a V, one branch of the V correspond- ing to the forward and the other to the backward motion. The car weighs 7,700 pounds, it carries 3,500 pounds of accumulators, and can carry 50 passengers. At the normal speed of eight miles an hour, the electric energy necessary is as follows: on the level 4.5 h. p. (16 amp. x 200 v.); on a rise of one per cent. 8 h. p. (29 amp. x 200 v.), and two per cent. 11 h. p. (42 amp. x 200 v.). At the speed of 4½ miles an hour: on the rise of three per cent. 12.5 h. p. (46 amp. x 200 v.), and four per cent. 15.5 h. p. (57 amp. x 200 v.). At the speed of 3½ miles an hour: with a rise of five per cent. 10.5 h. p. (38 amp. x 200 v.) and 5.5 per cent. 11 h. p. (40 amp. x 200 v.).

We here learn the additional horse power needed for several different grades and the increased flow of ampère current necessary to produce this power, and the lessening of this current when the grades are surmounted at a slower rate of locomotion."

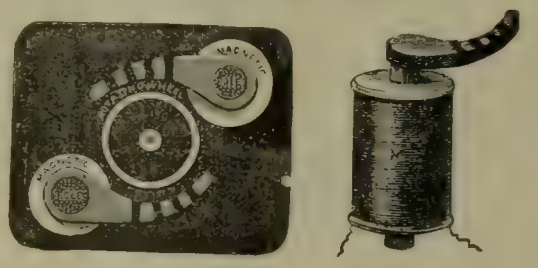
Again: we have the experiments of the Immisch motors, which seems to do good work and with very economical use of current. Motors have much to do with the use of current from a battery where the E. M. F. is for much of the time a comparatively fixed quantity, and horse power in watts is increas- ed by a greater draw of ampères from the battery. The less this current the longer will the stored power hold out and the longer the trip from one charge. This motor is series wound for 1,000 re- volutions, 160 volts and 40 ampères; hence 80 cells were used, weight 550 lbs., geared 10 to 1, effi- ciency 85 per cent. average working efficiency 75 to 80 per cent.; no trouble to start or stop on incline one foot in 20. Under E. M. F. of 80 volts the current averaged 35 ampères on a level at a speed of eight to ten miles an hour, rising to 45 ampères on incline of 1 to 20. Eighty-four cells in series, terminal 170 volts, speed increased to 12 and 14 miles on the level, with a current of 45 ampères, on grades 1 to 20, also around sharp curves the current increased to 80 ampères.

Many other experiments and estimates are before us, published in the many electrical papers, but this is sufficient to show what the demand may be on the general roads that we have. Of one thing we may be assured, this is the fact that these esti- mates are made upon the efficiency and durability of batteries so much alike in their mechanical con- struction and chemical action that the question of durability, must be first considered as a necessary improvement. Allowing that this point has been reached to-day, through the mechanical methods introduced into the battery by the writer himself, the tests for which improvements, and their results will soon be announced in the electrical journals of the day, will go on to state our opinion of what tramway traction companies could do to aid in making locomotion on street railways by the aid of storage batteries more successful and economi- cal.

(To be continued.)

THE WRIGHT–FERRANTI ALTERNATING–CURRENT METER.

The following description and illustration of the Wright-Ferranti Alternate-Current Meter are taken from the London *Electrician*. This instrument was recently devised by Messrs. Arthur Wright and S. Z. de Ferranti, of London. In the accompany- ing figures we have a rough diagrammatic repre- sentation of this meter. It consists in its latest form of a pair of vertical electro-magnets, the magnets having divided iron cores. To the poles of these magnets are attached curved horns of divided iron which lie in horizontal plane. These curved horns are magnetically throttled at intervals along their length with copper bands. The curved horns em- brace a circular space in which can revolve a light copper or iron shallow cylinder of thin metal. This cylindrical band forms the periphery of a light wheel capable of rotation on a vertical axis. Geared to this axis is a counting mechanism. The axis also carries a vane having mica blades.



WRIGHT–FERRANTI ALTERNATING CURRENT METER.

The electro-magnetic principle may be briefly described thus: The throttling of the curved iron horns causes the rapidly reversed magnetism to take the form of a lateral diffusion of lines of force from the sides of the horns. In effect a series of oppositely-named magnetic poles travels along the horn from the base, where it is in contact with the top of the electro-magnet, to the tip. These poles are represented by a series of bunches of lines of force, setting out laterally from the sides of the horn, and travelling up it. The lateral passage of these lines of force through the metal band which forms the rim of the movable wheel, generates in it eddy currents. These are continually repelled by the moving field producing them, and hence a motion of rotation is given to the wheel by the al- ternating magnetism of the magnetic poles.

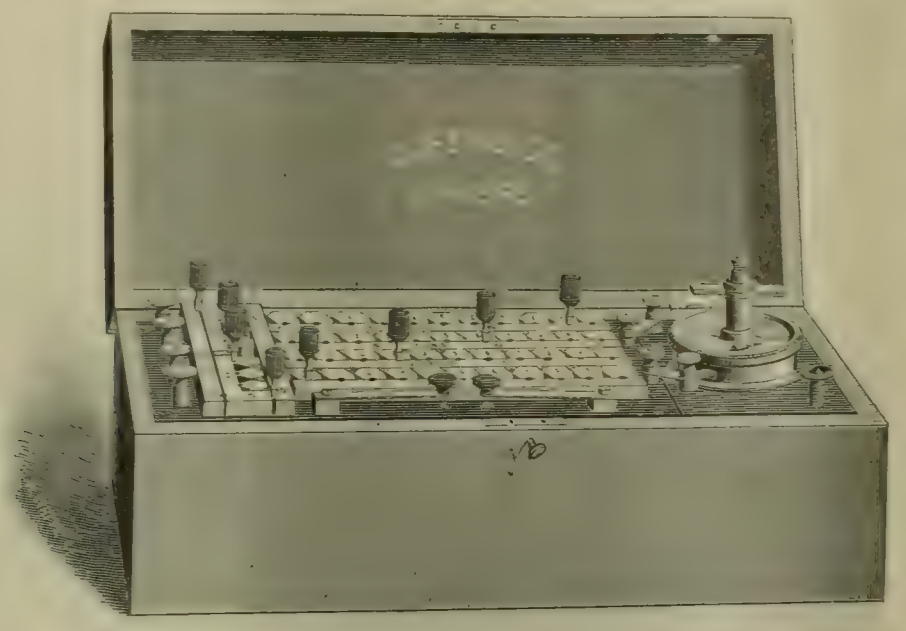
The speed of rotation, being retarded suitably by the vanes, can be made to be proportional to the current strength of the current exciting the magnets, and hence the total turns of the wheel in a given time to the total electric quantity flowing through the meter.

ELECTRIC LIGHT AT NIAGARA FALLS.—During the season of 1890, the Rapids of the American Falls, the edge of the American Falls themselves and Prospect Point in the State Reservation, will be illuminated each evening by electric light. This attraction was discontinued when the State Reservation was established in 1885, and its re- establishment will, no doubt, draw many people to the Falls.

ELECTRIC LIGHTS IN CHURCHES.—Holy Trinity Church, Chelsea, England, is now lighted by electricity. The work was done by the Brush Electrical Engineering Company.

NEW SERIES OF PORTABLE TESTING AND RESISTANCE SETS.

The following is a complete description, with cuts, of the new series of Portable Testing and Resistance Sets which are just being put upon the market by Messrs. Queen & Co., Philadelphia, the well known electrical instrument manufacturers. These sets were all designed in the laboratory of Queen & Co. and are intended to meet the requirements of electric light men, telephone line construction, dynamo and motor manufacture and general testing. They will be found splendidly adapted to the location of faults in telegraph and electric light lines, determination of armature and field resistance of dynamos and motors and the needs of government and other inspectors as well as to general expert work.



QUEEN'S TESTING SETS.—FIG. 1.



FIG. 2.

The set shown in Fig. 1 is the best and most complete of the series and is recommended for all kinds of work where considerable accuracy is required. The coils in this set are, as is seen from the figure, arranged in four rows, each row being made up of ten coils of the same denomination; the blocks in each row are numbered from left to right and from zero to ten while the longitudinal bars underneath have engraved upon them the denomination of the coils of that row. The connections of the coils are such that but one plug is required for each denomination; by inserting it in any block as many coils of that denomination are thrown in as may be indicated by the particular number engraved upon the block; thus, as the cut represents it, there are in circuit 369 ohms, *i. e.*, no thousands, three hundreds, six tens and nine units. Another special feature of this set is the arrangement of the bridge arms which are seen at the left; these are combined with reversing bars so that the proportional arms may be instantly interchanged, an operation which is absolutely necessary in many special methods. An additional advantage is that but six coils are necessary in the bridge instead of eight, as usual, to get the proportion of 1 to 1000 or 2000 to 1 thus making the set smaller and more portable. The bridge coils are 1, 10, and 100 on one side and 10, 100, and 1000 on the other. To effect this reversal two plugs only have to be changed. This use of this reversing arrangement in testing sets is original with Messrs. Queen & Co., it having never before been employed except in the most expensive and elaborate laboratory instruments.

The coils are wound of the now famous platinoid wire which has a very high specific resistance, changing by but .0023 for each degree Centigrade of temperature variation. They are adjusted by Prof. Wm. A. Anthony to an accuracy of from 1/5 to 1/10 of one per cent. while the bridge arms themselves are adjusted to a still higher degree of accuracy. The Galvanometer is a successful adaptation of a laboratory instrument to the needs of portable work and is by far the most sensitive, complete and portable instrument ever combined in a set of this character. The wire is of several hundred ohms resistance and is wound so as to have a maximum effect upon the needle; the needle itself is an astatic one and delicately suspended by a very fine cocoon fibre so that there is practically no resistance to any deflecting force. By means of a very weak controlling magnet sliding upon the suspension tube the needle can be made almost perfectly astatic, and will show an appreciable deflection for currents as small as from .003 to .005 of an ampere; the brass box containing needle and coil is movable about a vertical axis, so that the needle can always be brought to zero whatever the position of the box, as a whole. The whole galvanometer lifts out of its position in the case and can be used independently, or in connection with other apparatus if desired, there levelling screws being provided for levelling when so used. By closing the cover of the box the weight of the needle is automatically taken from the fibre and the latter protected from injury. The battery and galvanometer key are seen in the front of the box and are independent of each other. The whole is mounted up in a polished mahogany box with leather handles and lock and key and measures, when complete, but 18 inches long by 6½ inches broad. Fig. 2 is a cut of the same thing, without the galvanometer; it is of course somewhat shorter. These sets have a range of measurement from .001 ohm to 10 megohms.



FIG. 3.

Fig. 3 shows one of the other sets of the series and is of much the same general character. The coils instead of platinoid are made of German silver and are not quite so accurately adjusted, while the set is without the reversing arrangement found in the ones just described. The galvanometer is also fibre suspended, but without the automatic release; for this purpose a small set screw is used which allows the needle to be lowered when not in use. The galvanometer is permanently mounted in the case and is without the control magnet. The keys are combined into the regular double contact form. The set as represented in the cut has but three rows of resistances, viz: the units, tens, and hundreds. It is also made with an additional row of thousands. This set is also made without the galvanometer.

A great number of the preceding sets have been sold in all parts of the country and have given great satisfaction. They have been worked upon for some time and improved until they have reached their present satisfactory form. They are now being manufactured in large quantities by Messrs. Queen & Co., and introduced widely throughout the country.

ELECTRIC RAILWAYS.—Gearing for electric railways made out of raw hide is preferred to metal as it makes far less noise and wears better.

BOOKS.—All books on electrical subjects are kept by us. Send for catalogue.

STORING THE ALTERNATING CURRENT.

On April 22d, Dr. A. Foeppl, of Leipzig, delivered a paper on the subject of storing alternating currents, before the Berlin Electrotechnical Association. The paper, which we copy from the London *Electrical Review*, is as follows :

Of late it has been frequently asserted that the alternating current cannot be stored up. As far as the present technical position is concerned, this assertion cannot be objected to, but it is devoid of all foundation if it is meant to refer to a future technical development.

This appears very plainly from the fact that the energy contained in the alternating current may be converted into mechanical energy by being conducted into a motor. But mechanical work can be readily converted into any form of potential energy by known methods, and can thus be stored up. In the present technical position, however, only the storage of the energy in a secondary battery can come into question. For storing the energy of the alternating current, we should therefore have to construct an apparatus combining an alternating current motor and a continuous current generator, and which consequently should be similar to the well-known continuous current transformers.

If the alternating current armature of this apparatus is supplied with current from the exterior circuit, it runs as a motor, and the current produced in the continuous current armature is stored in a battery. But as soon as the electromotive force in the exterior circuit decreases or ceases, the battery discharges itself back into the continuous current armature, which now serves as a motor, and an alternating current is produced in the alternating current armature which flows off in the exterior circuit. The chemical energy of the storage battery, which originally arose from the energy of the alternating current, is now converted back into the alternating current energy, and the entire process (disregarding unavoidable losses) is inverted. I believe, therefore, that by this process we have the same right to speak of storing up the alternating current as the continuous current.

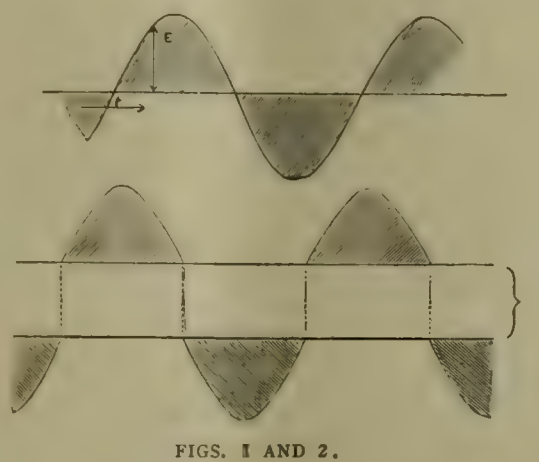
The manifold transformation, of course, involves considerable losses of energy. It may, therefore, be called an improvement, if we succeed in charging a storage battery directly by an alternating current. I have worked out a procedure which leads to this result, which I now beg to submit to you in its main features.

By way of explanation, I append the curve of tension at the clamps of the alternating current. By tension at the clamps I understand the potential difference of those parts of the alternating current circuit from which the current is to be taken to feed the battery. As a preliminary approximation, this curve (fig. 1) may be regarded as a sine line. For every branch of the exterior circuit in which no electromotive force occurs (*e.g.*, by induction), it may at the same time (if the proportions are suitably selected) be regarded as the current curve of the alternatiug current.

In order to employ the alternating current characterized by the curve, fig. 1, for charging a storage battery, there is required, in the first place, a change in its introduction after every semi-vibration of the current. An arrangement of this kind was indicated by Patten, and, as it appears from the last number of the *Lumiere Electrique*, had been previously proposed by Gaulard. Patten's arrangement has been described during the last few months in the principal technical journals. Hence it will be sufficient if I mention that the original alternating current is divided into two branches by the introduction of a commutator. One branch conveys the negative and the other the positive ways, as is shown in fig. 2. Hence a pulsating continuous current flows in each branch.

Such a current cannot, however, by any means, as Patten states, be used directly for charging a storage battery. The alteration of the insertion does, indeed, prevent the clamp-tension of the main lead from altering its sign during the connection. But it makes no difference in the periodic variation of the clamp tension. On the contrary, the counter-electromotive force of the battery retains its value unaltered. As long as the clamp-tension is greater than this counter-force, the battery may be charged. But at the beginning and towards the end of the connection a discharging takes place. Under such circumstances it does not appear how a permanent charge of the battery is to be effected.

When I first began to occupy myself with this problem I had no knowledge of Patten's researches. From the reasons laid down I rejected at once a simple alteration of insertion, and instead I sought to effect the connection of the battery



FIGS. 1 AND 2.

to the alternating current lead in such a manner that the counter-electromotive force of the battery should follow approximately the same law of variation within each current-period as the clamp-tension.

To elucidate this, I represent the length of the battery by A, B (fig. 3), *i. e.*, A, B must be proportional to the number of cells of the battery arranged in series. If we suppose that each cell is charged to the same tension, A, B may then at the same time be regarded as a graphic representation of the electromotive force of the battery. In A, B let there be taken two points, C and D, which may about correspond to two connecting clamps of the cells of the battery. If A

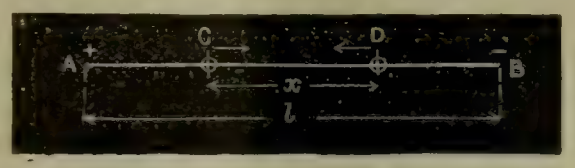


FIG. 3.

signifies the positive pole of the battery the potential difference of the points, C and D, is likewise positive; and according to what has been said above, proportional to the extent, x, between both points in fig. 3. But if we set both points in motion in the direction of the arrows in the figure the distance, x, and consequently the potential difference of the points will first become smaller, then null, and lastly, negative.

Let it now be supposed that the points, C and D, execute pendulum vibrations between the ends of the battery, A and B, with a difference of phase equal to half the time of vibration. The law of variation of the distance, x, and hence of the potential difference of both points agrees in every respect with the law of variation of the clamp-tension of an alternating current conduction, as shown in fig. 1.

The vibrating points, C and D, may therefore be used as the points of attachment for the direct connection of the alternating current lead to the battery. For this purpose the condition is essential that those vibrations must be synchronous with the period of the alternating current, or better with the period of the clamp-tension of the alternating currrent. It is seen that, according to the production of the required attachment, the alternating current will be directly converted into chemical energy in the storage battery, in the same manner as in a continuous current installation. It likewise needs no demonstration that the process is reversible exactly as in a continuous current installation.
no demonstration that the process is reversible exactly as in a continuous current installation. On the supposition that the connection of the points, C and D, is maintained unaltered, there flows an alternating current from the battery to the main lead as soon as the clamp-tension of the point of ramification falls.

In one respect only is there a noteworthy difference between this case and that of a continuous current battery; whilst the latter is always traversed in its entire length by a current of equal strength, the current here, in any moment, passes only through the portion of the battery situate between C and D, whilst the parts of the battery situate beyond this length are free from a current. The middle of the battery is, of course, almost uninterruptedly traversed, but by a current of varying intensity. We may say that the current passing through the battery, even if it is kept in the same direction, still shows the properties of an alternating current.

This fact must be kept in view in the construction of the battery. The cells lying in the middle take more ampère-hours than those towards the ends. To prevent an unequal consumption, they must have a greater capacity than the latter. This demand mav be met in every practically occurring case by the use of cells of different sizes, or by parallel arrangement.

For the better explanation of these relations, I venture to propose for any battery so constructed the name "alternating current battery."

I have endeavored in the previous exposition to state the idea which lies at the foundation of my procedure as clear and definite as possible, and detached from all details of construction. I hope thus to secure the advantage that no objections can be urged against the essence of the matter, for, so far as I can see, the process is quite free from objections.

Against the constructive execution of the idea, to which I now proceed, objections of various kinds are, of course, possible. There is, however, scarcely a new procedure which does not encounter practical differences in its execution. I believe that I can show that these difficulties, in the present case, cannot by any means be considered as exceptionally serious.

(*To be continued.*)

ATMOSPHERIC ELECTRICITY.—In the course of four years of experimenting, M. Albert Nodon has established the fact that when the sun's rays fall upon an insulated conductor, metal or carbon, they communicate thereto a positive electric charge, which increases with the intensity of radiations and decreases with the hygrometric state of the air. At Paris the electrification is greatest at about 1 p. m., when the air is clear and dry; but it disappears on the passage of clouds near the sun. The experiments indicate the source, or, at least, one source, of atmospheric electricity, as it may be assumed that the surface of the earth becomes positively electrified, while the heated air rises with a negative charge which it imparts to the clouds. This hypothesis would explain many thunder-storm phenomena, including the frequency of such storms over forests, rivers, lakes, etc., where the cooler air causes the electrified clouds to fall toward the earth until a discharge takes place.

LITERARY.—We are in receipt from Messsrs. Mourlon & Company, Brussels, of an illustrated description of the Van Rysselberghe system of simultaneous telegraphy and telephony. The work gives a brief history of long-distance telephony, which is followed by a description of the system named and its practical applications.

IMPROVED ELECTRIC CABLES.

Capt. Willard L. Candee, Treasurer of the Okonite Company, has just received a patent on an improved method of preserving the insulation of underground cables. The invention has reference more particularly to the construction of cables or multiple electrical conductors of a class in which individual conductors are insulated from one another by a braid of fibrous substance, or by a wrapping of paper, or of other like material which, so long as it is perfectly protected from moisture, constitutes an effective electrical insulation. Cables now in use are generally constructed in this manner, the group of conductors being encased in an impermeable sheath or tube of lead or similar material. In the transportation and carrying of such cables great care must be exercised to prevent exposure of ends of separate sections to moisture which by being readily taken up by the fibrous covering will follow along the conductors by capillary attraction and impair and destroy insulation for a greater or less distance according to the amount of moisture absorbed. This causes great trouble, no matter how carefully joints may have been formed, frequently nece sitating the cutting out and replacing of the defective portions whereby expense and delay are entailed. To avoid this difficulty in a measure it has been customary to cover the ends of the sections of cable with the lead or other metallic cap. This expedient, however, is serviceable only during the transportation and since the caps must be removed when the cable is laid and the ends of the several wires united. During this operation the wires are necessarily exposed, and if the ground be excessively moist, or if rain be falling, the damage may be as great as if the cable had not been protected in the manner explained.

The object of the present invention is to obviate the difficulty above pointed out by the production of a cable having paper or fibrous insulation around the several conductors, which shall be perfectly protected against access of moisture, not only during transportation but also during the operation of laying the cable in any atmospheric cond tions or when the trench contains water. This object is accomplished by surrounding the several wires of the cable for a distance of, say, six inches or more, when the ends of the sections in the waterproof substance or compound—such as okonite, rubber, gutta-percha or the like—filling with such substance the interior of the protection sheath or casing. At the ends of the conductors where the waterproof compound is applied the fibrous wrapping or envelope is removed so that the okonite or other material comes into direct concontact with the wires and envelopes them individually as well as collectively.

The presence in the cable of a plug or filling of water repellant substance, at intervals, effectively prevents access of moisture to such parts of the conductors as are inclosed in the fibrous insulating material and in conjunction with the interior case or sheath serves to protect the insulation as perfectly as if the conductors were separately encased in the waterproof compound for their entire length.

The improvement is applicable to single insulated conductors as well as multiple electric conductors. For example, an electric light wire which may be insulated by wrapping of cotton saturated with paraffine encased in a lead tube and protected at its ends by being embedded in a waterproof compound as above described.

The protection afforded by the present invention is advantageous wherever fibrous insulation is treated as commonly done, with paraffine or a like substance, to prevent deterioration and impairment of electrical insulation which would otherwise take place.

THE MINNEAPOLIS INDUSTRIAL EXPOSITION.—Major W. M. Reagan, General Manager of the Minneapolis Industrial Exposition, has returned home after a stay of several weeks in the East. He came East for the purpose of securing the Edison Exhibit, which was the greatest attraction at the recent exhibition at the Lenox Lyceum, for the Minneapolis Exposition. Reports state that he was successful, and that the Edison Exhibit at Minneapolis will be larger than that at the Lenox Lyceum. It is said that many of Mr. Edison's latest inventions will be included. Minneapolis is making grand preparations for a great show, and with the Edison attachment the show is bound to be a great success.

PHONOGRAPH CONVENTION.

Delegates representing the phonograph and graphophone interests from all over the country met in convention at the Auditorium Hotel, Chicago, May 28th and 29th. Thirty one companies were represented, being the state companies operating under the North American Phonograph Company of New York. The objects of the convention were to provide for a permanent organization, to discuss questions relating to the perfecting of details of the instruments, and for conference as to the best methods of doing business by sub-companies. It had been expected that Mr. Edison would be present, but being unable to attend he was represented by Mr. Samuel Insull, general manager of the Edison General Company, and a phonograph delivered a message sent in cylinder form from Mr. Edison.

The officers elected for the ensuing year are A. W. Clancy, of Des Moines, Iowa, president; A. B. Crumer, of Washington, D. C., secretary; H. B. Goodwin, of Milwaukee, Wis., treasurer.

The first day's session was devoted to a discussion regarding the methods of manufacturing machines, and a resolution was adopted asking the home company to call in all machines now in operation and replace them by those having all the latest improvements. At the evening session President Lippincott of the North American Company delivered an address which was received with attention.

The second day was devoted to the discussion of business methods. The convention sat on both days with closed doors, newspaper men being entirely excluded, but to make amends a special invitation was issued to them to be present on Thursday evening, May 29th.

At this session reports were received from the various companies as to their progress. The largest record of machines in use was that of the Metropolitan Company of New York, who report about 400 machines, three-fourths of which are used for business purposes, and one-fourth for amusement and entertainment. Several firms employ six and eight instruments each. A considerable use is found for the phonograph by those who attend to correspondence in the evening at their residences, letters being dictated and the rolls containing same carried to their places of business the following morning.

The Columbia Company, of Washington, D.C., have upwards of 350 instruments in use, about three-fourths of which are graphophones. They have fifty machines in the hands of members of Congress, most of whom use the graphophone.

The Chicago Central Company report 100 machines in use in Chicago, and have as many as eleven machines in a single place, the establishment of S. A. Maxwell & Co. They have about thirty machines which are used for exhibition and amusement purposes; the balance being employed for business purposes.

The Colorado and Utah Company have about one hundred machines in use, the novel feature of their report being that they have two machines using about 700 cylinders a week in the hands of a Chinaman; probably the only Chinaman in the United States using a phonograph.

The assertion sometimes made that the phonograph could not be successfully used for reporting purposes was disproved in a practical way at the convention, the entire proceedings being reported by Mr. H. D. Goodwin, of Milwaukee, and Mr. W. H. Smith, of Washington, D. C. In taking the proceedings the reporter repeated into a phonograph, run by an electric motor, the words as they dropped from the lips of the speakers. Two instruments were used alternately, an assistant removing the cylinder which had been filled and replacing it by a new one while the other instrument was used. The cylinders were immediately removed to another room and their contents type-written, thus having the complete proceedings in print as soon as the meeting adjourned.

The convention closed with an exhibition given for the benefit of the newspaper men present. A phonograph repeated, to the entire satisfaction of all, several selections recited into it and closed with the stirring strains of "Yankee Doodle" whistled into the funnel by the chairman.

In the background were several of the omnipresent "nickel in the slot" machines, from which selections by Gilmore's band, selections from various operas, from great speeches, etc., *ad infinitum*, could be had to suit the investor's taste.

An instrument arranged in compact form and operated by a crank was shown, for use by traveling men and other persons requiring a portable instrument. This was on exhibition for the first time.

The convention adjourned to meet a year hence, at the call of the executive committee, at Kansas City, Mo.

The companies represented were the Alabama Company, Kansas Company, Chicago Central Company, Michigan Company, Old Dominion Company, Tennessee Company, Georgia Company, Texas Company, Ohio Company, Wisconsin Company, Minnesota Company, Missouri Company, New England Company, New York Company, Metropolitan Company, New Jersey Company, Montana Company, South Dakota Company, Pacific Phonograph Company, West Coast Company, Florida Company, Spokane Phonograph Company, Iowa Company, Nebraska Phonograph Company, Colorado and Utah Company, Illinois State Company, Wyoming Company, Eastern Pennsylvania Company, Western Pennsylvania Company and Columbia Company.

LARGE ELECTRIC MOTOR CONTRACT.—What is said to be the largest order ever given for electric motors is that just closed by Mr. T. F. Clohesey, representing the Detroit Electric Motor Company, in Kansas City, Mo. The contract is with the Jasper County Electric Power Company, of Webb City, Mo., and calls for 140 electric motors, ranging from five to six to 20 horse power, the total horse-power being 1,000. These motors are to displace steam in use for mining purposes, such as ore crushers, jiggers, pumping, hoisting, tramming, ventilating, and a variety of other purposes. Under the terms of the contract 200 horse power must be in operation in 30 days and 500 horse power in sixty days.

NEW CATALOGUE.—Messrs. Jas. W. Queen & Co., of Philadelphia, the well-known manufacturers of and dealers in scientific apparatus, have just issued the second edition of catalogue 1-66 of electrical test instruments. This catalogue is the most complete of its kind ever published in this country. Among the articles listed, and which have never been catalogued before, are Queen & Co.'s Standard Resistance Sets, Portable Testing Sets, and Photometers. The firm's reputation for the quality and accuracy of their instruments is a well merited one. The new catalogue may be obtained on application.

CHANGED TO ELECTRIC POWER.—The Sandusky, Ohio, street railroad has passed into new hands. The new company proposes to at once equip the road with the Sprague system of electric power. The single overhead trolley will be used, and the line is to be extended to the new Soldier's Home. The new cars will be lighted by electricity.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BANK BUILDING,
CHICAGO, May 31, 1890.

THE ST. JOSEPH (Mo.) LIGHT AND FUEL COMPANY has been formed, with a capital stock of $500,000; incorporators, Charles McGuire, O. M. Spence, J. W. Heddens, Geo. E. Black and others.

MR. D. P. ALEXANDER, president of the Citizens' Horse Railway, of Belleville, Ill., has asked the City Council for an ordinance to permit the changing of the motive power of the line to electricity.

THE N. W. THOMSON-HOUSTON COMPANY have opened a branch office at 625 Nicollet avenue, Minneapolis, Minn., and have purchased the stocks of electric fixtures and appliances owned by J. B. Wheatly and Benner Bros.

MR. S. D. GREENE, Manager of the United Edison Manufacturing Co., in this city, in company with Mr. Samuel Insull, Manager of the Edison General Co., who has been in attendance at the Phongraph Convention held here, left for New York Friday evening.

THE WESTERN UNION TELEGRAPH COMPANY have secured new quarters in St. Louis, into which they will soon move, having occupied temporary quarters since being burned out some months ago. Their new home is a four story building on Pine street, between Fourth and Fifth streets.

THE CENTRAL ELECTRIC CO., report one sale of 1,000,000 feet of No. 16 Okonite wire this week, which is perhaps one of the largest sales on record of a single size. Mr. W. H. McKinlock, of that company, has just returned from New York, and ordered while there three million feet of Okonite for stock. The company look forward to a great business in wire during the next few months.

WORK on the electric street railway lines at Minneapolis, Minn., has progressed rather slowly owing to the delay experienced in getting the materials on the ground, but the work will be pushed rapidly toward completion now, most of the material having arrived. The Standard Oil Company are endeavoring to have oil adopted as the heat producing agent in the power stations of the line.

THE SPERRY ELECTRIC MINING MACHINE COMPANY, of this city, have recently made some changes in their office. Mr. W. D. Ewart, President of the Link Belt Machinery Company, succeeds Mr. A. L. Sweet as President of the company, and Mr. A. D. Dana, Treasurer of the Link Belt Company, will occupy the position of treasurer of the Mining Machine Company. Mr. H. E. Goodman will retain the position of secretary and manager, and Mr. Elmer A. Sperry that of Electrician. It is believed that this combination with the Link Belt people will greatly increase the facilities of the company, and aid materially in demonstrating the value of the Sperry Mining Machine.

STREET CAR LIGHTING.—An interesting experiment is in progress on a West Madison street car in this city. The car has been equipped with a storage battery of ten cells by the Illinois Anglo-American Storage Battery Company. These cells furnish light to three 16 c.p. incandescent lamps, and have been running three nights on a single charge. The car is very brilliantly lighted, the citizens who have used the car are enthusiastic over the contrast, and the company are reported as well pleased with the result of the experiment, after having given the battery a severe test as to its ability to withstand shocks. Next week a similar equipment will be applied to an open car on the same road, and if it is as successful, the people of the west side may hope to have good light on all cars on this line at no very distant date.

PROF. F. B. BADT, of the United Edison Manufacturing Company, returned to Chicago this week after a six weeks' trip in the West. Professor Badt personally superintended the placing of an electric refinery in the Anaconda Smelting Works, Anaconda, Mont., and from there went to the Pacific coast, on a business and pleasure trip. He mentions the Edison station, at Spokane Falls, as being finely equipped and especially as having one of the finest waterfalls on the globe.

THE CENTRAL UNION TELEPHONE COMPANY have recently purchased the telephone exchanges at Shelbyville, Ind., Vincennes, Ind , and Olney, Ill., from Mr. L. Johnson, and that at Marion, O., from Mr. H. G. Reiser. These exchanges have in operation about 60 or 70 telephones each, and the Central Union Company will reconstruct same throughout, and expect to largely increase the number of telephones in use at these places. The Central Union is just commencing work on toll lines to connect Findlay, O., with Toledo, a distance of 35 miles, Fostoria, 17 miles, and Lima, 23 miles, and expect to have the lines in operation within three months. The company is also completing a metallic circuit from Chicago to Rockford, Ill., which will include Belvidere and Meringo. They have a number of these complete metallic circuits in operation, and are deriving great satisfaction from them. Copper wire is used.

The Thomson-Houston Electric Company report the following sales: Hammond Milling Co., Hammond, Ind., 50 light, direct incandescent; Kalamazoo Electric Co., Kalamazoo, Mich., 650 light, alternating, and 50 light arc; Gratwick, Smith & Fryer Lumber Co., Oscoda, Mich., 350 light, direct incandescent; J. P. Anderson, Trenton, Mo., 30 light arc and 650 light alternating incandescent; Joliet Wheel Co., Joliet, Ill., five light arc; Moffett, Hodgkins & Clark, La Grange, Ill., 650 light, alternating incandescent; Battle Creek Electric Co., Battle Creek, Mich., 35 light arc; Salt Lake Power, Light and Heating Company, Salt Lake City, Utah, 30 light arc, and 4,650 light alternating incandescent; G. F. and E. A. Burkart, 196 W. 12th street, Chicago, 30 light, direct incandescent; C. Hebard & Son, Pequaming, Mich., 150 light, incandescent, motor type dynamo; Marysville Electric Light and Power Co., Marysville, Cal., 650 light, alternating incandescent; Swanton & Clark, Santa Cruz, Cal., 650 light, alternating incandescent; D. C. Metsker, Sedalia, Mo., 650 light, alternating incandescent.

F. M. I.

NEW YORK NOTES.

NEW ELECTRIC ROAD.—The Sprague Electric Railway and Motor Co. are equipping the Utica and Mohawk Street Railway with five cars. This road will be in operation very soon.

FIREPROOF AND WATERPROOF INSULATION.—A recent test made by the Gould Elastic Paint shows it to be one of the best insulating substances in the market. It proved to be not only fireproof but also waterproof. More details will be given regarding this valuable paint in a later issue.

REMOVAL.—The Hussey Battery Company last week removed into their new and well-appointed quarters, No. 143 Greenwich street. The establishment will be lighted by 25 incandescent lamps receiving current from accumulators charged by the well known and reliable Hussey Bluestone Battery.

LARGE ORDER FOR WIRE.—Mr. James F. Kelley, agent for the Edison machine works, at 19 Dey street, this city, reports the receipt of an order by his company for 350,000 feet of triple braided and compounded line wire. This wire is for the suburbanroute of the Lindell Street Railroad Co., of St. Louis. The Edison Machine Company's insulated wires and cables are meeting with great favor.

EXTENDING THEIR BUSINESS.—The New York Insulated Wire Company, better known as the Grimshaw Wire Co., has recently opened agencies in the central, western and southwestern states. Mr. Godfrey performed this task with satisfactory results, and each agency will carry full lines of the goods manufactured by this company. During his absence, Mr. Godfrey secured an order from the Detroit Electric Light and Power Company, for $25,000 worth of the company's competition line wire. The company's headquarters are at 649 & 651 Broadway.

BUSINESS MENTION.—The new quarters of Messrs. Zimdars & Hunt, at 127 Fifth avenue, are very attractive in appearance. The offices and salesrooms are finished tastefully in hard wood. The dimensions of the floor occupied by the firm are 20x100 ft. The factory at 52 and 54 Grove street, is double the size of the old one, occupying two floors, each 50x100 feet, and is fully supplied with the latest improved machinery for turning out their goods. The firm have recently made an addition to their specialties in the shape of a motor of new design, and make these motors from one to twenty horse power. The demand for the pneumatic and electric bells, annunciators and burglar alarms, for which goods the firm has made considerable of a reputation, continues brisk.

THE MASON BATTERY.—On May 27th there was quite a gathering at the Aberdeen Hotel, in this city, to witness the performance of a plant of 19 small cells of James H. Mason's well-known primary battery. One 25-candle power lamp and three 16 candle power lamps were lighted with results that called forth much praise and admiration for the battery. The light was turned on by Miss Foster, the daughter of the proprietor of the hotel. The exhibition was so successful that several orders were then and there given for small plants. A large number of orders were also received for fan outfits, one of which was, on this occasion, running in the hotel office. These outfits are in great demand, now warm weather is approaching. One of these fans can keep the atmosphere of a room delightfully cool in warm weather. Among those who witnessed the test were the following well-known ladies and gentlemen: Mr. and Mrs. A. W. Foster, Mr. Gus Foster, Miss Foster, Mr. and Mrs. J. S. Makensie, of Pictou, N. S.; W. A. Law and R. A. Kellond, of New York; James Keller, of the New York *Times* and wife; Mr. Frost, Manager American District Telegraph Co., New York; Thomas Watson, Springfield, Vt.; Mr. Summers, of the Standard Oil Co.; James Alden, Dr. Cheatham, Messrs. Earle and A. T. Doyle, of London, England; James Butler, Mr. and Mrs. Hornblower, C. S. Hunter, R. J. Gray, W. F. Collins and Mr. Scott of Mexico. R. J. G.

THE COMMERCIAL TELEGRAPH COMPANY.—The sentiment in favor of a commercial telegraph line between Chicago, New York and the leading commercial centres is steadily growing. One member of the Chicago Board of Trade announces that he will subscribe $50,000 towards the new project. Others stand ready to subscribe liberal amounts. It is claimed that $250,000 has been granted for the proposed Commercial Telegraph line between Chicago and New York. St. Paul and Minneapolis desire stock, and it is said that the company will be chartered at once.

PATENT FOR SALE.—Electrical Railway Cab Signal Alarm; sounds in cab of engine; covers crossings, switches, curves and tunnels; simple and reliable in all kinds of weather. Model can be seen. Good thing for promoters of companies. Address "Safety," care ELECTRIC AGE office, New York.

DESTRUCTIVE STORM.—The power house of the electric motor street car line at Laredo, Tex., a brick building, 150 by 50 feet, was blown down during a thunder storm a few nights ago, and two white men and a negro were killed.

ELECTRICAL SAFETY COMPANY,
SOLE MANUFACTURERS OF THE
Cartwright Electrical Protectors and Safety Devices.
The only Safety Device that can be used on fire alarm and other metallic circuits. Approved by the Boston Fire Underwriters' Union and the New England Insurance Exchange.
Room 21.——146 FRANKLIN STREET.——Boston, Mass.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
10 Cook Building,
Boston, May 30, 1890.

The Suburban Light and Power Company are about to use the Waterhouse dynamo for arc lighting.

Walter L. Boyden has been admitted as a member of the firm of H. E. Swift & Co., manufacturing electricians of this city.

The Boston Municipal Signal Company have been awarded the contracts for the construction of their police signal apparatus in San Francisco, Cal., and London, England.

The Vermont School Seat Co. has just closed a three years' contract with the Rutland Electric Light Company to furnish motive power to run the machinery at their new works.

The construction of the new electric railway on Grafton street, Worcester has been commenced under the management of T. W. Harris & Co. of Boston. The Johnstown rail will be used.

F. W. Braddick, electrician for the Suburban Light and Power Company, was married in Cambridge, last Wednesday, to Miss Doucette. The happy couple will take a short wedding trip, after which they will reside in Roxbury.

The city authorities of Rutland, Vt., have just signed a new contract for lighting which gives reduced rates. Arc lights of 2,000 candle power are furnished until midnight for 16½ cents and a few burn all night for 37 cents each.

The new Wightman Controller which has been tried on the Lynn and Boston Road will be given a trial on the cars of the West End Street Railway this week. It takes the place of the rheostat, using much less current on the average of a trip than the present device.

The justices of the supreme judicial court, in a decision sent to the Legislature last Wednesday, declare that the cities and towns have the right, constitutionally, to manufacture light, both for public and private use, thereby completely overruling the decision of the attorney-general.

Capt. Russell, the assistant engineer of the District of Columbia, has been in Boston under orders from the commissioners to inspect the system of electric police signals put up here by the Boston Municipal Signal Company. The District Commissioners have been much interested in this company's system, and intend to adopt it if satisfied with Capt. Russell's report.

A stock company is soon to be organized in Hartford, Conn., to be known as the Electric Power Company, for the purpose of establishing an electric plant on the Farmington River to supply the city with power for manufacturing purposes. Surveys have been made for a location and stock books have been opened. The capital will be $100,000, of which 75 per cent. will be called in up to Jan. 1st, 1891.

The Belt Line Electric Road in Lynn has commenced running its cars. The belt is not yet completed but the cars can now run from the Central Depot through East Lynn, Eastern avenue and Western avenue to the Lynn Hotel, and as soon as a curve is completed from the latter point into South street, can continue through South, Neptune, Commercial Alley, Wheeler and State streets to Market, within a quarter of a mile of the starting point.

The new electric light station of the North Adams Gas Company is completed and the machinery will be put in immediately. The dynamo and engine room is 26 x 54 feet, and the boiler house 32 x 20 feet, 30 feet high. There will be three 50-light arc machines and one 50-light incandescent machine. The buildings are so arranged as to increase and enlarge whenever necessary.

A big land purchase has just been made in Newburyport by the Newburyport and Amesbury Street Railway Co., and a power plant is to be established for running the electric lines of the company in this section. The erection of a brick building, 100 x 70 feet, is to begin at once. It will be equipped with a new engine and two large dynamos. The purchase includes twenty-five acres, and on the space not used for power house will be erected, paint, machine and repair shops. About $100,000 will be expended.

Gilbert G. McDuff, of the Fred. H. Whipple Co., of Detroit, Mich., has returned to Boston and is engaged on the commercial rating sheet which will give a rating to all engaged in the electrical field exclusively. This is a much needed thing as it will give much information to manufacturers and dealers in regard to so-called "electricians" springing up like mushrooms all over the country, and that are not reported in any other way. Firms in good standing, in and about Boston, are gladly furnishing complete reports.

At the annual meeting of the Taunton Electric Lighting Company, on May 25th, P. H. Corr was chosen president; Nomus Page, treasurer; Mortimer Westcoat, corporation clerk. Directors: A. G. Williams, P. H. Corr, N. Page, Geo, W. Colby. A dividend of seven per cent. was declared. It was voted to increase the capital stock to $50,000; to build at once a two-story brick building, 50 by 50, to put in three new engines of 200, 90 and 75 horse-power respectively; the last supplying motive power, and to change the system of incandescent light to the alternating. Other improvements are under consideration.

Prof. Elihu Thomson has patented a device to furnish power for electric railways at long distance and saving of power. This device is to run smaller wires from the power station independent of the trolley wires attached to dynamos of a much higher voltage. When the current reaches the point where it is needed it is taken by a motor generator at, say, 1,000 volts, and turns it into the current at a pressure of 500 volts. Prof. Thomson has also patented a safety conductor for induction systems of distribution. This is for the purpose of grounding the secondary circuit, and consists of a wire running from a point where an incandescent or other wire enters a building to a point near the ground where it ends in a canvas conducting surface. From the ground runs another wire to the same point and ended like it. These two conducting surfaces are separated by an insulating film—in practice a piece of oiled paper—which is impenetrable by a potential of 50 volts, that common in lighting buildings, but which, in case of lightning striking the wire, would be at once penetrated and the bolt carried to the ground.

The superintendent of the fire alarm system, Capt. Brown S. Flanders, has on exhibition in his office an invention known as the non-interference succession fire alarm box. Under the present system, if two boxes are pulled simultaneously it causes a great deal of confusion in the operating-room, and sometimes it is impossible to get a correct record of either. By means of the non-interference box this difficulty is obviated and no matter how many boxes are pulled together only one at a time will register at headquarters, and when this has finished its work the others will successively perform the same duty. The invention comes from Omaha, Nebraska, and Boston electricians claim to have a similar machine. The fire commissioners contemplate some important changes in the fire service. Each district chief will be furnished with an expert telegrapher as driver whose duty will be to cover the city at the fire boxes and do the telegraphing between the boxes and the rest of the department in their respective districts. When a general alarm is sounded it is intended to have a competent man go to the fire alarm telegraph place in the City Hall, at which place he will be in direct communication with the entire city and where he will direct the force, thus preventing any possible mistake of orders by telegraphing from the boxes.

W. J. P.

Telegraphy and Telephony in Germany.—Extensive works are being carried out on the German telegraph and telephone systems, and about £400,000 will be spent on them this year. In round figures, £150,000 will be devoted to the extension of urban and interurban telephony; £100,000 to new telegraph offices in rural districts; £40,000 to improved telegraph wires, new poles, and changing overhead lines into underground lines, and £4,500 to the extension of the pneumatic installations in Berlin and Hamburg.

Tunnel Lighting.—Repairs are being made to the arch of the Olimpino tunnel of the Gothard Railway between Chiasso and Como, and, to expedite the work, a temporary electric light installation has been put up. At the southern end of the tunnel, which is 1¼ miles long, is a compound dynamo of the latest Gramme type, and this is driven by belting from the flywheel of a portable locomotive engine and boiler. Insulated cables are run along the roof of the tunnel to 30 lamps, of which about one-third are usually employed. The lamps are movable, and are arranged in parallel.

Interesting Exhibit.—At a recent conversazione of the Royal Society, London, some very interesting apparatus was on exhibition. A set of apparatus to illustrate the use of the capillary electrometer, for investigating rapid changes of potential, was on view for the first time. A reversal of potential, occupying less than one-hundredth part of a second, can be clearly demonstrated. Phenomena connected with thunderstorms can be recorded by Mr. S. J. Symon's brontometer, which will on one slip of paper note the commencement, variation in intensity, and termination of rain and hail; the instant of each lightning flash; and the commencement and duration of a thunder clap. The instrument can be read for periods of time down to a fiftieth part of a second. Mr. C. V. Boys exhibited an arrangement to show, either by projection or by photography, the oscillatory nature of an electric spark. Some photographs represented the shadows cast by a water jet upon a rapidly moving plate by the intermittent light of an oscillatory spark. Mr. Shelford Bidwell's experiments of the electrification of a steam jet suggests an explanation of the intense darkness accompanied by a lurid glow, which is characteristic of a thundercloud.

HE ELECTRIC WIRE INVESTIGATION.

We have been enabled to secure an advance opy of the report of Mr. F. W. Jones, electri- ian and assistant general manager of the Postal elegraph Company, on the situation in New ork State with reference to the use of electric ires. Mr. Jones, as is well known, was the fficial expert for the committee appointed by ie Legislature to investigate electrical matters, ith a view to formulating a law to regulate the se of high tension and other electric currents. Ir. Jones's report in full is as follows :

POSTAL TELEGRAPH CABLE CO., ASS'T GEN'L MANAGER AND ELECTRICIAN'S OFFICE, 187 BROADWAY, NEW YORK.

HE HONORABLE GEORGE Z. ERWIN,
Chairman of Senate Com. on General Laws.

Dear Sir : In compliance with your request I ave the honor of submitting my views on the resent situation regarding the use of electric ires in the State of New York and the legisla- on needed for the better protection of life and roperty by such use as follows : For purposes f the telegraph, Congress, in 1866, passed an ct which authorized telegraph companies, duly ncorporated under the laws of the several States, o construct and operate lines in all the States nd Territories, upon any military or post roads nd to cross navigable waters. The right of elegraph companies to enjoy such privileges as conditioned upon their assenting to certain rovisions of the bill. I believe nearly all of ie principal companies gave the required as- ent.

The Legislature of New York, by an act passed pril 12th, 1848, section 5, gave to telegraph ompanies the right to construct lines along ublic roads and highways and across any of the aters within the limits of the State.

By an act of 1853, chapter 471, section 2, the oregoing privileges were made more definite nd extensive.

Chapter 512, Laws of 1879, authorized any as company in this State to manufacture and se electricity for producing light, heat or power, nd to use electricity as the means for lighting reets, avenues, public parks and places, and ublic and private dwellings of cities and vil- ges and towns within this State, and by amend- ent of chapter 73, Laws of 1882, the above owers were extended to permit such companies o make, sell or lease all machines, etc., and to y, erect and construct suitable wires or other onductors with the necessary poles, pipes or ther fixtures in, on, over and under the streets, venues, public parks and places of such cities, owns or villages for conducting and distributing lectricity, with the consent of the municipal au- horities thereof and under such reasonable regu- tions as they may prescribe.

By Act of 1879, chapter 397, every company r companies organized and incorporated under ie laws of the State for the purpose of owning, onstructing, using and maintaining a line or nes of electric telegraph within the State, or artly within and partly beyond the limits of the tate, are authorized from time to time to con- ruct and lay lines of electrical conductors un- erground in any city, village or town within ie limits of the State, provided such company hall first obtain from the common council of ties, trustees of villages and commissioners of ighways of towns, permission to use the streets ithin such cities, villages or towns for such urposes.

The Subway Acts of 1884, chapter 534,
1885, " 499,
1886, " 503,
1887, " 664,
1887, " 716,

late to the placing of all electric wires and ables underground in cities having 500,000 opulation or over. Parts of the provisions of ese laws relate exclusively to the city of New ork.

Chapter 317, Laws of 1879, authorizes any company under the Manufacturing, Mining, Mechanical or Chemical Law of 1845, or its amendments, to manufacture, furnish and sell such quantities of hot water, hot air or steam as may be required in the city, town or village where the same may be located and have power to lay pipes or conductors through the streets, avenues, lanes, alleys, squares and highways, with consent of the municipal authorities and subject to reasonable regulations and conditions.

Act of 1853, chapter 463, authorizes insurance companies to make examinations and inspections upon steam boilers and to issue certificates of inspection upon such boilers.

The Penal Code, sections 360, 361 and 362, make it a misdemeanor to carry a higher steam pressure in boilers than is authorized by law, or to wilfully or from ignorance or gross neglect create or allow to be created, such an undue quantity of steam as to burst the boilers, engines or apparatus, or to cause any accident whereby human life is endangered.

Chapter 437, Laws of 1885, and chapter 643, Laws of 1866, regulate the use of boilers in New York City, and require their test and inspection by the Sanitary Department of the Board of Police, also require persons operating steam boilers (except steam heat and railway locomotives) to have a certificate of qualification from said Sanitary Department.

The United States Treasury Department has a very extensive Corps of Engineers, for the purpose of enforcing laws, regulating the use of steam in navigation. The President of the United States, by and with the advice of the Senate, appoints a Supervising Inspector General and two Supervising Inspectors, who are directly under the direction of the Secretary of the Treasury. In addition to these there are a large number of special inspectors located on the principal seaports of the United States.

Title 52, of United States Revised Statutes, chapter 1, sections 4,399 to 4,462 inclusive, embrace very minute laws covering almost every detail of the construction of a steamboat and its steam appliances, designating specifically the materials and engineering rules to be employed in such construction.

There are, so far as I am aware, no laws of this State regulating the use of either aerial or underground wires, carrying currents dangerous to property and person, except perhaps the last part of section 4, chapter 716, Laws of 1887, relating exclusively to the City of New York, as follows : "The said Board of Electrical Control may establish and, from time to time, may alter, add to, or amend, all proper and necessary rules, regulations and provisions for the *manner of use* and *management* of the electrical conductors and of the conduits or subways therefor constructed."

The Board of Fire Underwriters, of New York, has adopted a set of rules and a system of inspection in New York City, governing the use of wires carrying currents for electric light and power, both outside and inside of buildings which are affected by insurance policies. I am unable to find the slightest legislative authority for the enforcement of such rules. This may be fortunate, however, on account of their absurd lack of fitness, and display of ignorance of the necessities of the case.

Leaving entirely to the Honorable Senators all questions of incompatibility between the United States laws and the sovereignty of this State, I will merely allude to the privileges granted telegraph companies by the general government. The telegraph has been accorded an unusual rank on account of its similarity of function to the post service, and its great importance to the public both socially, commercially and administratively. The telephone system has never been legally classed as a telegraph system, although I believe it has been tacitly ranked as such, subject to the general United States and State laws governing telegraphs.

Electric systems for domestic purposes, such as district messenger service, burglar alarms, fire alarms, and the stock quotation service in various cities, have had no special legislative regulation, beyond what may be inferred from the laws under which they were incorporated and chartered.

Up to 1878, no special laws were necessary for controlling the use and distribution of electric currents so far as danger to life and property was concerned, inasmuch as the telegraph, telephone and domestic companies used comparatively feeble currents. Since 1878, however, electric light and power companies have sprung into existence, using dynamo machines and storage batteries, yielding electric currents of enormous quantity and high pressure, which, if not rigidly guarded and properly applied, under the most exacting conditions, will prove very liable to maim or kill and consume property by fire.

Adverting (perhaps needlessly) to the present status of the various electric industries, so far as their relations to the State are concerned, it will be seen that telegraph and telephone companies are not in an enviable position for the reason that their plant is of an unprotected perishable character. Every ward, school district and village that desires to raise funds for some local purpose prefers taxing the poles and wires rather than the residents.

The freedom with which competition can be indulged in, (and properly so) has permitted many competing telegraph companies to be formed, with either grossly mistaken ideas of the cost of equipment, and the profits of the business, or what is more likely true, in most cases, a desire to divert enough of the paying business of the Western Union Telegraph Co., to force that Company to buy them out. In the latter schemes the very poorest quality of wires, poles and fixtures have been used, the poles placed zig zag along the highways with utter disregard of their appearance and lasting character, and in this way we find all our roads, highways and streets between the commercial centres of the United States, east of the Mississippi occupied by poles and wires, in some cases two distinct lines of poles on each side of the way, and mostly of the very poorest character.

The Western Union Telegraph, through contracts with railroads, enjoys the exclusive use of the right of way for its poles on nearly every railroad in the United States. This is an immense advantage because the lines are free from the foliage and limbs of forest and ornamental trees which are the great enemy of the good and continuous working of telegraph wires ; the distances are much shorter between the commercial points, than by the circuitous turnpikes. As an example the Western Union wires proper between New York and Philadelphia are 92 miles long, the American Rapid wires 167 miles, the Bankers' and Merchants' wires 112 miles and so on of others all of which, excepting the Western Union's are debarred from the railroads right of way. The break-down of poles or wires on railroads are quickly discovered and repaired by the train facilities enjoyed.

On the other hand the lines on turnpikes and wagon roads must be patrolled by men on horseback or in wagons, and spring, fall and winter such roads are frequently nearly or quite impassible from mud water or snow. In many cases of my own knowledge farmers keep shot guns with which they warn off all line men from trimming ornamental trees to place the wires in working order. The effect of this is such that on rainy days the telegrams of the public must stop on such wires on account of the leakage of current to the earth through the tree leaves or limbs in contact with the wires.

(To be continued.)

ELECTRIC ROADS IN NEWARK.—The Rapid Transit Company, of Newark, N. J., has signed a contract for the equipment of one of its lines with electricity. The Thomson-Houston system will be used.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

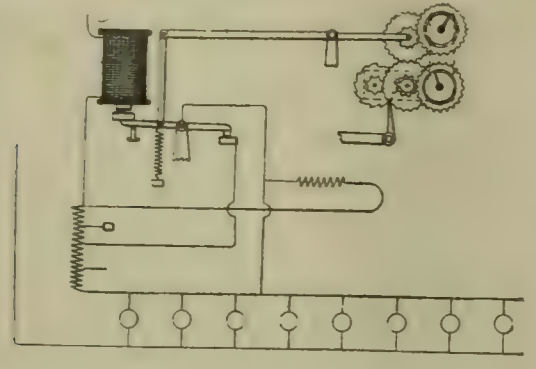
ELECTRICAL PATENTS ISSUED MAY 27TH.

428,616. Sliding Clamp for Electric Welding Apparatus. Hermann Lemp, Lynn, Mass, assignor to the Thomson Electric Welding Company, of Maine. Filed Aug. 8, 1889.

428,617. Electrical Apparatus for Welding Rings. Hermann Lemp, Lynn, Mass, assignor to the Thomson Electric Welding Company, of Maine. Filed Oct. 17, 1889.

428,618. Transformer for Heavy Currents. Hermann Lemp, Lynn, Mass, assignor to the Thomson Electric Welding Company, of Maine. Filed Dec. 26, 1889.

428,619. Method of Welding Rings by Electricity. Hermann Lemp, Lynn, Mass, assignor to the Thomson Electric Welding Company, of Maine. Filed Jan. 10, 1890.



NO. 428,649. ELECTRIC METER.

428,633. Method of Measuring Electric Currents. Edwin W. Rice, Jr., Lynn, Mass. Filed March 8, 1889.

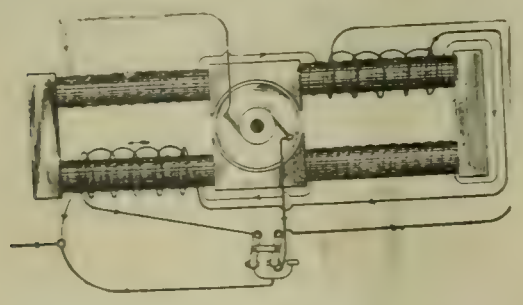
428,647. Turn-Off for Alternating-Current Circuits. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Mar. 12, 1887.

428,648. Casing for Induction-Coils. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed May 9, 1887.

428,649. Electric Meter. Elihu Thomson, Lynn, Mass. Filed Jan. 27, 1888.

428,650. Alternating-Current Magnetic Device. Elihu Thomson, Lynn, Mass. Filed Aug. 8, 1888.

428,651. System of Electrical Distribution. Elihu Thomson, Lynn, Mass. Filed Aug. 15, 1888.



NO. 428,732. ELECTRIC MOTOR AND GENERATOR.

428,652. Incandescent-Lamp Socket. Elihu Thomson and George H. Alton, Lynn, Mass., assignors to the Thomson-Houston Electric Co., of Connecticut. Filed Jan. 17, 1889.

428,653. Guard-Wire Protector and Lightning-Arrester for Electric Railways. Elihu Thomson, Lynn, Mass. Filed June 15, 1889.

428,669. Electric Locomotive. Edward Dummer, Newton, Mass Filed Feb. 17, 1887.

428,676. Electric-Circuit Closer for Clocks. Henry C. Carr, Washington, D. C. Filed Feb. 14, 1889.

428,688. Electric Low-Water Alarm. John Morehead, Detroit, Mich. Filed June 11, 1889.

428,698. Single-Cord Multiple-Switch-Board System. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1888.

428,704. Electric Switch. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed July 26, 1886.

428,705. Regulator for Dynamo-Electric Machines. Elihu Thomson, Lynn, Mass. Filed Aug. 27, 1887.

428,723. Electric-Light Hanger. Clarence L. Jeffers, Manchester, N. H. Filed June 24, 1889.

428,732. Electric Motor and Generator. Frank J. Sprague, New York, N. Y., assignor to the Sprague Electric Railway and Motor Company, of New York. Filed July 19, 1884.

428,735. Brush-Holder for Dynamo-Electric Machines. Franklin A. Weller, Lynn, Mass. Filed Aug. 29, 1889.

428,742. Commutator Collector or Block for Dynamo-Electric Machines. Charles F. Brush, Cleveland, Ohio. Filed Nov. 22, 1889.

428,743. Commutator Collector or Block for Dynamo-Electric Machines. Charles F. Brush, Cleveland, Ohio. Filed Nov. 22, 1889.

428,745. Electric Cable. Willard L. Candee, Brooklyn, assignor to the Okonite Company, New York, N, Y. Filed Mar. 19, 1890.

428,746. Galvanometer. Arthur E. Colgate, New York, N. Y., assignor to F. G. Otto & Sons, same place. Filed Mar. 5, 1890.

428,748. Device for Maintaining Electrical Connection between separate Railways Trains. Donphan M. Fike and Joseph Huffman, Des Moines, Iowa, assignors of three fifths to J. A. T. Hull, R. B. Taylor, E. J. Fairall, R. M. Dewitt, W. W. Fink, and A. J. Baker, same place. Filed Feb. 14, 1890.

428,751. Coin-Actuating Attachment for Phonographs. Louis Glass and William S. Arnold, San Francisco, Cal., assignors to R. W. Smith, same place. Filed Feb. 3, 1890.

428,774. Burglar-Alarm. Edwin Hayward, Brooklyn, and Edward S. Sims, New York, N. Y. Filed Aug. 9. 1889.

428,781. Galvanic Battery. John S. Nowotny, Cincinnati, Ohio, assignor of one-half to James J. Watrous, same place, Filed Nov. 2, 1889.

428,782. Electric Motor or Dynamo-Electric Machine. Stephen M. Potter and Harry E. Morgan. Philadelphia, Pa. Filed June 27, 1889.

428,818 Attachment for Telephone-Desks. Berthold Schram, Milwaukee, Wis. Filed Dec. 17, 1888.

428,828. Coin-Released Telephone-Lock. Harry L. Cassard, Baltimore, Md. Filed Nov. 22, 1889.

428,854. Electric Programme-Clock. John L. McCaskey, Waynesborough, Pa. Filed July 26, 1889.

428,888. Solution for Galvanic Batteries. Edward M. Burt, Paris, Ill. Filed Mar. 10, 1890.

428,917. Electrically-Propelled Vehicle. Arnold A. Ingraham, New York, N. Y. Filed Aug. 16, 1889.

428,930. Suspension for Trolley-Wires. Elmer P. Morris, Cincinnati, Ohio. Filed Jan. 6, 1890.

428,934. Electric Switch. James F. McLaughlin, Philadelphia, Pa. Filed Nov. 13, 1889.

428,935. Electric Switch. James F. McLaughlin, Philadelphia, Pa. Filed Nov. 27, 1889.

428,942. Holder for Electric Arc Lamps. Jacob Pawlowski, Cincinnati, Ohio. Filed Sept. 7, 1889.

428,970. System of Circuits for Electric Semaphores. Frederick Stitzel, Louisville, Ky., assignor to the American Semaphore Company, same place. Filed Feb. 16, 1889.

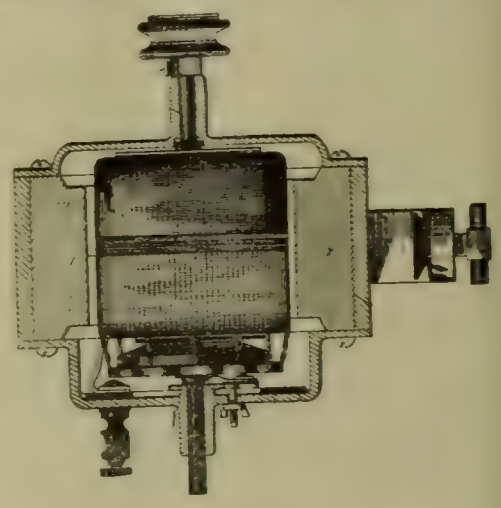
428,979. Electric Insulator. George B. Watson, Boston, Mass., assignor to the Gould & Watson Company, same place. Filed Aug. 12, 1889.

428,989. Globe for Electric Lamps. William H. Wilson, New York, N. Y. Filed Aug. 13, 1889.

429,049. Process for Assembling Secondary Battery Electrodes. James F. McLaughlin, Philadelphia, Pa. Filed Dec. 19, 1889.

429,067. Support for Electric Lights and Conductors. Charles H. Simmons, Brooklyn, N. Y. Filed Nov. 29, 1889.

429,068. Male-Genital Electrode. Agnes R. Sommerville, Chicago, Ill. Filed Dec. 19, 1889.



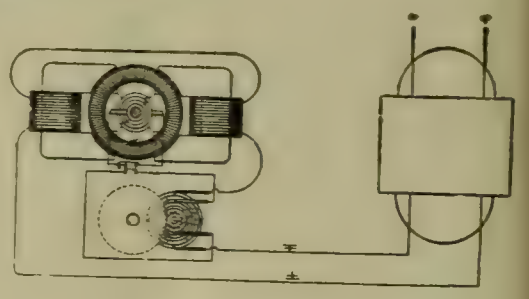
NO. 428,782. ELECTRIC MOTOR AND DYNAMO ELECTRIC MACHINE.

429,074. Staff Apparatus for Controlling Traffic on Single Line Railways. Francis W. Webb and Arthur M. Thompson, Crewe, County of Chester, England. Filed January 24, 1890. Patented in England, France and in Belgium.

429,093. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed Sept. 23, 1886. Divided and this application filed Sept. 11, 1889.

429,094. Electric Motor. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Nov. 8, 1889.

429,104. Underground Conduit for Electric Wires. Erich L. Whitthaus. Baltimore, Md. Filed Jan. 29, 1890.



NO. 429,094. ELECTRIC MOTOR.

TELEPHONE RATES IN SWITZERLAND.—Under a law recently passed by the Swiss Federal Council, an annual subscription entitles a telephone subscriber to 800 conversations, with a supplementary rate of five francs per 100 conversations. For interurban telephone systems the rates are: For a conversation of three minutes 30 centimes up to 50 kiloms., 50 centimes up to 100 kiloms. and 75 centimes for greater distances—all of which are calculated "as the crow flies." The new law appears to operate in a satisfactory manner, and the lowering of the charges has produced an appreciable increase in the receipts.

THE FRENCH TELEPHONES.—The committee nominated by the French postal telegraph department to study the question of improving the telephone service, have tested twenty different transmitters on the Paris-Brussels trunk wire (424 miles). One instrument proved itself decidedly the superior, and fifty of this type will now be used experimentally at Paris, Marseilles and Lille.

ANSWERS TO INQUIRIES.

Editor of THE ELECTRIC AGE.—The daily papers frequently refer to electricity as being "manufactured." My partner claims that it is not manufactured. I do not disagree with him, but I merely want to know how electricians regard it, if you will oblige me.

Janesville, Wis. T. L. F.

Answer.—That very question has incidentally been before courts for settlement. Judge Simonton, at Harrisburg, Pa., in deciding a case involving the taxation of electric light property adheres to the opinion that producing electric light is not a species of manufacture. He held that neither electricity nor electric light was a material substance; that there could be no manufacture unless some material substance was produced. Webster's definition of manufacture is "to make or fabricate from raw materials," etc. This harmonizes with Judge Simonton's interpretation of the word, and it would seem that authorities do not sanction the use of the word in this particular application.—Ed. ELECTRIC AGE.

FOREIGN TENDERS WANTED.—Tenders will be invited in August for the lighting of Sofia, Bulgaria, by electricity, using the water of the Boyana as the power.

DYNAMO.—A TWELVE-LIGHT ARC DYNAMO, with twelve single Lamps, all in good order. Price, $300 cash. T. R. PROCTOR, Utica, N. Y.

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Outfits to run INCANDESCENT LAMPS from 25 to 300 hours.

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T. F. CLOHESEY,

Electrical Engineer.

Southwestern Agent Detroit Motor Company.

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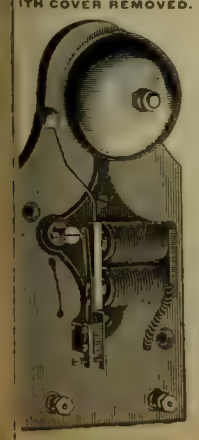
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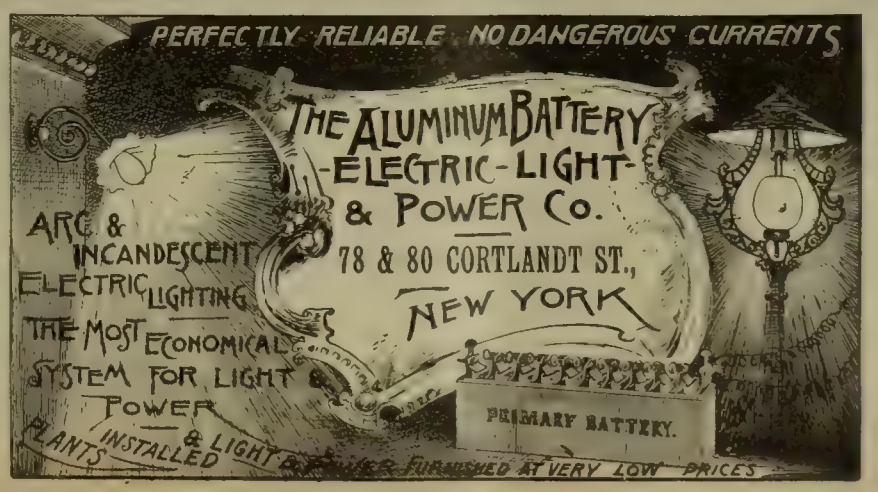
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IN THE SOUTH.

The industrial development in the South in ate years has been wonderful. The natural resources of that section are great and rich and very much Northern capital is finding its way here. Under the equalizing influence of industry the North and South are being more and more strongly united, and all sectional feeling is rapidly disappearing. Northern enterprise and capital is doing more to accomplish this result than any other factor. If politicians would only keep their hands off, the business men of the North and South could accomplish more to bring the two sections into closer relationship than any other power. Electricity is going to be a large factor in the permanent unification of the country. It has done more than any thing else to bind the nations of the world into closer fellowship, and surely, what it has accomplished for the world at large it can do for this great land.

The electric railway is rapidly extending its ramifications throughout the South. More speed and advanced methods are necessary to keep up with the North, and the North is doing its part by supplying the means and material to accomplish these things. The electric light is doing its share of work in the rapid development of the new South. We hear of the electric light being a necessity in saw mills, so that work can be carried on at night as well as during the day, so great is the demand for lumber. The people here have learned that it is the safest and best light in existence, and are anxious to have it more extensively used. The South offers a great field for electrical enterprise. Let it have all the electricity it wants.

ELECTRIC LIGHTING IN MASSACHUSETTS.—The Massachusetts Senate has passed a substitute to the bill reported by the Committee on Manufactures authorizing cities or towns to manufacture and furnish gas and electricity. The substitute provides that no city or town shall establish its own plant without first buying existing plants owned and operated by private persons or corporations. The discussion brought out a variety of sentiments on the subject of municipal lighting. One member contended that the municipal plan is not a success, and that statements to the contrary notwithstanding, when interest, loss of taxation, etc., are added to the accounts, it is found that the municipal plants cannot be run as cheaply as those of private companies; in fact, that they lose money every year. Another member asserted that the people are anxious for this move in order to escape the octopus clutches of those who are gobbling up the companies and forming these gigantic trusts.

TWO HUNDRED MILES AN HOUR.—Mr. Charles C. Burton, of Utica, New York, thinks he has solved the problem of rapid transit. Others have thought the same thing, only to find that in practice inventions do not work as well as they do on paper. Mr. Burton has evolved a system, so says a daily contemporary, in which trains can be made to run at the rate of 200 miles an hour, electricity being the motive power. According to the information at hand, electric current will be supplied from a large insulated "storage" cable. As is usual in all inventions of a gigantic nature the shape of a cigar is the basis of form for some part of the new structures. In this case the car is to be cigar shaped. The development of this wonderful invention will no doubt be watched with a great deal of interest. We think Mr. Burton may find it difficult to find any one willing to accompany him on his trips at such a speed as 200 miles an hour.

WHAT HE KNOWS ABOUT ELECTRIC TRACTION.—Dr. H. L. Bowker the other day told the 14th Ward Republican Club, of Boston, a good deal about electric railways that the club nor any one else ever knew before. He characterized the electric railway as "conceived in sin and born of iniquity," and generally condemned it, principally for the reason that it was a ruinously expensive luxury. Dr. Bowker must have made a mistake, and substituted the name "electric railway" for that of the opposite political party. If he meant to be severe on the electric railway he evidently was not very well posted as to facts and figures. But facts and figures are wonderfully elastic when presented to a political meeting. The electric railway, however, had a champion at the same meeting in F. J. Baxter, who took exceptions to Dr. Bowker's misleading statement.

QUITE CORRECT.—One of the many consequences of the general adoption of electric traction in the States, says the *Electrician*, of London, will apparently be the disappearance, at no distant date, of the tram car as at present known. Thus the ever progressive West End Street Railway Company of Boston, is about to place cars on its lines having from two to three times the passenger carrying capacity of the old horse cars. Heavier cars, combined with higher speeds, are in their turn bringing the question of more powerful brakes into prominence; and at Boston a Thomson-Houston electric "locomotive," equipped with a vacuum brake worked by a small motor, will shortly come into operation. Before long, in fact, the American tramways bid fair to fully justify their native appellation of "railways," since "trains" of two or three sixty passenger cars, drawn by powerful electric locomotives, running at a comparatively high speed, will contribute their quota to the liveliness of transatlantic streets.

WATER POWER.—The electric light plant at Hartford, Conn., which is to be run by water power, will be, in some respects, a remarkable one. The power will be obtained from the Farmington River, 10 miles from the city, and the electric pressure transmitted to the city, will be 3,000 volts, and there received by a 220 horse power motor. Details of this plant will be awaited with interest.

THE ELECTRIC WIRE QUESTION.—In this issue we publish the balance of the report of electrical expert F. W. Jones to the Committee on General Laws, on the electrical wire situation in New York State. As will be seen, Mr. Jones has handled the matter in a manner that shows his perfect familiarity with the subject. His discussion of the questions involved is rational and cannot fail to inspire a general feeling among those most interested, that his judgment is fair to all concerned. While more will be heard from Mr. Jones later, he outlines a plan of procedure, which, if carried out in good faith by both parties, cannot fail to accomplish the results desired.

MYSTERIOUS ELECTRIC LIGHTING.—Our Boston letter records a queer state of affairs in a neighboring town. Hingham has been lighted by electricity for some time and no one of the consumers has yet received any intimation that he was indebted for the use of the electric light. This is not all. The town, appointed a committee to make a contract with the light company for street lighting, but when the committee set out to perform its functions it could find no company to contract with. An investigating committee should now be appointed to find out where the electricity comes from. It must be an underground system.

COULOMB.—The date of this paper, June 14th, is the one hundred and fifty-fourth anniversary of the birth of Charles Augustin Coulomb. He died in August, 1806, and the greatest monument to his fame is the use of his name to designate an electrical unit. This honor was paid him at a late date, however, in recognition of his valuable services to science in his researches in electricity. It was he who, in 1777, invented the Torsion Balance, an instrument used to this day, and it was he who discovered the law of inverse squares. All honor to his name.

CONVERTING HEAT INTO ELECTRICITY.—An Eastern paper, with a great flourish of English, announces that a Maine inventor has invented an ideal method of converting heat into electricity without the intervention of steam-engine and dynamo. It would indeed be strange if some one away off in some corner of the land should carry off this prize, after which so many inventors of large knowledge and experience are striving.

SEVERE STORMS.—On June 6th there was a general and quite severe storm in this and the eastern States and Canada. It was accompanied by lightning, which in many places did a good deal of damage. A good deal of live stock at various places was killed, but so far as known there was no loss of human life. The electric display in this city was unusually vivid.

INSURANCE ENTERPRISE.—The indefatigable Captain Brophy, of Boston, is in the West examining electrical risks for the Electric Mutual Insurance Company. If other insurance companies would take hold of the electrical risk question in the same spirit as the above named company, electricity would not be so much looked upon as a "dangerous character," to be tabooed.

ELECTRIC ROADS IN LYNN.—On May 30th the Belt Line of electric street railway in Lynn, Mass., was opened amid much enthusiasm. The Thomson-Houston system is used, and the cars are equipped with two 15 horse power motors. The entire length of the line is not yet completed, but will be in a week or so.

EDUCATIONAL. — Electricial Engineering has been added to the curriculum of the University of Pennsylvania. The course has been established in the department of Mechanical Engineering, and will extend over parts of two years, beginning in the Senior year.

MR. F. J. SPRAGUE, of the Sprague Electric Railway and Motor Company, expects to spend a couple of months in Europe this summer, He will leave New York the latter part of July, and his trip will be mainly for recreation, and incidentally for business.

THE WESTINGHOUSE SYSTEM OF ARC LIGHTING.

The prominence which the Westinghouse system of electric lighting by alternating currents has attained is phenomenal. A few years ago it was unknown to the public, and the direct current systems had the entire field to themselves. To-day, however, the latter have a very powerful rival in the alternating current system as represented by the Westinghouse Company. The latest development in alternating current lighting by the Westinghouse Company, is the arc lamp, which presents some new and valuable features. A general description of the system, with particular reference to the new arc lamp will, be of interest. The Westinghouse Electric Company are constantly making improvements in their system, and continually increasing its efficiency. The illustrations given herewith represent the latest improvements in the mechanical part of the system, and show in a very clear manner the details of construction. The alternating arc light dynamo closely resembles the alternating incandescent machine. It generates an alternating current, which is constant in quantity but variable in potential, thus adapting it to the supply of arc lamps arranged in series.

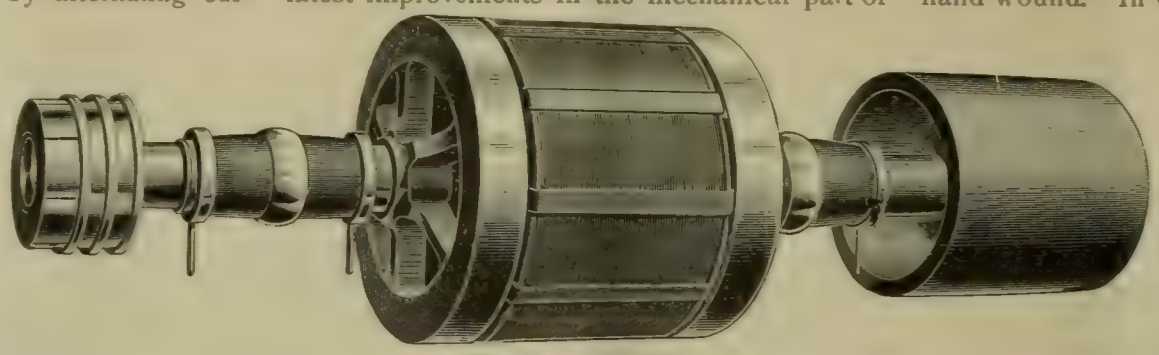


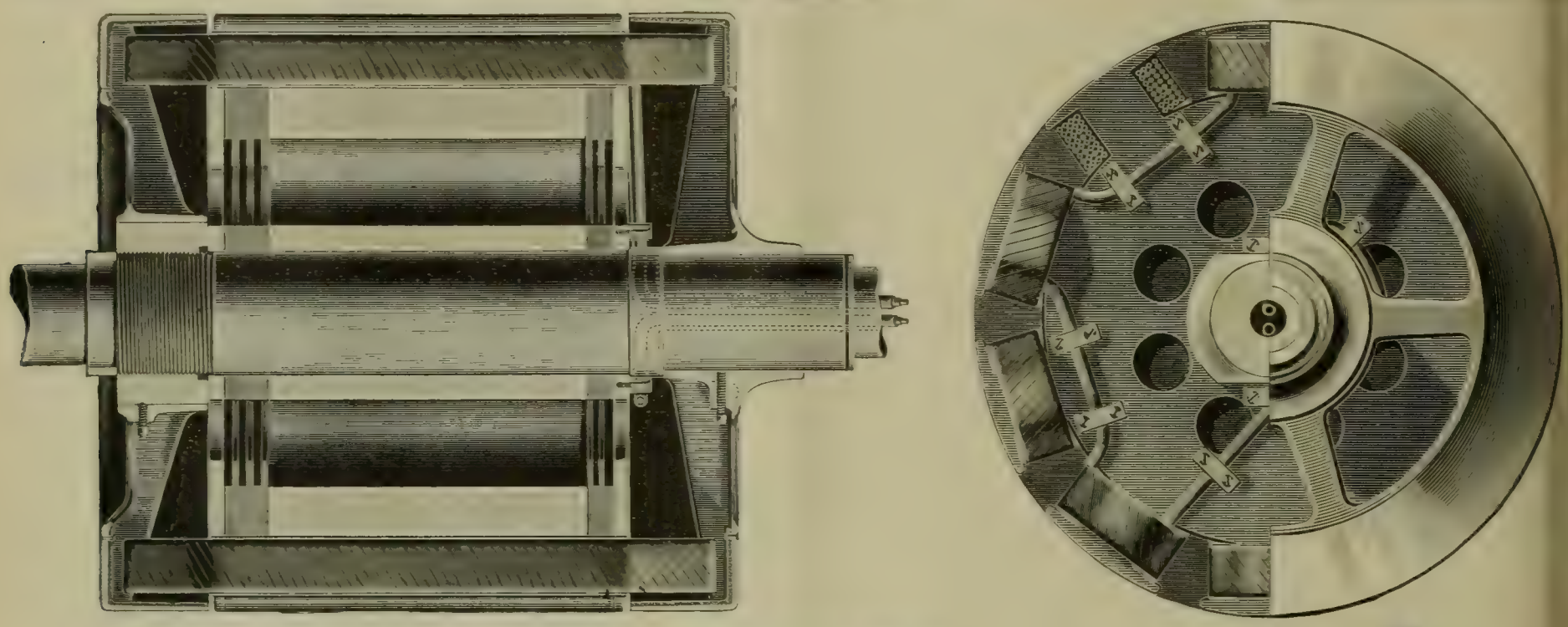
FIG. 1.—ARMATURE.

The field is composed of a series of radial pole pieces having alternating polarity, the co es of which are cast solid with the base and cap, respectively. On the cores are a series of bobbins, each independent of all the others, which are wound on shells, and can be readily replaced if injured. The field may be charged from a separate exciter, or the machine can be furnished self exciting.

Fig. 1 is a perspective view of the armature complete, and Figs. 2 and 3 show the details of construction. The body or core is of laminated iron plates, punched out of sheet metal in such form that, when clamped together, deep channels are left across the face for the reception of the armature coils. By the same construction the armature is freely ventilated. The ribs of metal, which separate the channels, carry the armature coils. These coils are independent and detachable and are securely held in place. The necessity of exterior insulation and the wrapping of the armature by binding wire, is entirely avoided. The absence of surface winding makes it impossible to run the armature much closer to the field poles. The effect of this, within certain limits, is to increase the efficiency of the dynamo.

Fig. 4 shows a single coil of the armature in detail. The coils are lathe wound instead of hand wound. In winding a coil on a lathe, the wire is straightened and laid wholly by a tension brought upon it as it is reeled from the spool. The insulation, therefore, is unaffected and in perfect condition when the coil is completed.

The regulation of the alternating current arc dynamo is a strong point of the system. The self regulation is wholly attained by the effects of self induction and the reaction between armature and field due to a peculiar form of the construction and winding. In other words, alternating current dynamo regulation is naturally inherent, and is self regulating over its entire range. Thus, a No. 2 dynamo, while carrying its full capacity of 125 lights, may be cut down to a single light in circuit, or to any other number of lights without any effect whatever on the dynamo or the remainder of the lamps.



FIGS. 2 AND 3.—DETAILS OF ARMATURE.



FIG. 6.—SHORT LAMP.

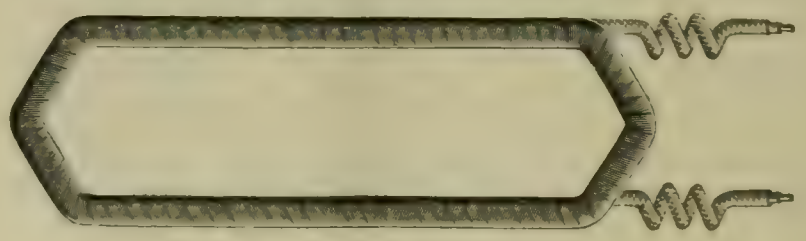


FIG. 4.—ARMATURE COIL.

The arc lamp, which has recently been introduced, is illus-



FIG. 5.—STANDARD LAMP.

ated in Figures 5 and 6. Figure 5 shows .e standard lamp, and Figure 6 the short mp, both ready for use. The lamps contain o springs of any character, its feed being due ıtirely to gravity, and transmitted by a posi- ve rack mechanism. The coils of the lamp :e wound entirely on fibiite, which is a non- ɔnducting material and entirely impervious to ıoisture. The use of paper for this purpose is :trimental to insulation, as the paper in time ɔsorbs moisture. The frames of these lamps :e so insulated that they can be handled with- it danger to the trimmer. The great commer- al advantage of the alternating current arc mp is in the fact that it is a single carbon forty ɔur lamp. The carbons in each lamp are of ual length, presenting knife edges to each her. Both carbons are consumed alike, and e arc is maintained with extreme steadiness, d traverses from side to side of the carbon, nsuming it uniformly. The life of the carbon forty hours. With the alternating current ere is, of course, no crater formed in either rbon. Its range of diffusion is consequently eater.

TELEPHONE MATTERS.

Gen. C. H. Barney, secretary ot the National elephone Exchange Association, in the Asso- ation's *News Lett.r* for the month of May says: The executive committee of this associa- ɔn, to whom was referred the fixing of the ıte for the next annual meeting, have decided at it shall commence on Tuesday, Sept. 9th, ext. The place, of course, will be the city of etroit, Mich., which was selected by the asso- ation itself at the Minneapolis meeting. The ɔtel selected as headquarters, and other details the arrangements for the convention, will be nounced in future numbers of the *News Let- .*"

In the same periodical we find the following ems which will be of interest to telephone ople: "The English syndicate have author- ed the Inter-continental Telephone Company draw for the purchase money, and these nds will be disbursed to the Tropical American lephone Company and the other shareholders. he Tropical American Telephone Company s closed a contract with the Governor Gen- al of Cuba for 100 sets of instruments and a ge lot of supplies, the Cuban government ving taken over the telephone business for- erly operated by the Compania Electrica de ba. An order for 500 complete sets has also en received from Rio de Janeiro. This ex- rt business thus far in 1890 is more than uble that of any previous year."

"In the United States Circuit Court, at Bos- n, before Judge Colt, on the 20th of May, otions were heard in the case of the United ates against the American Bell Telephone Com- ny. A motion was made on behalf of the aintiffs to extend the time for taking testimony August 1st. Mr. Roberts, who had charge of e case before the examiners, stated that the ndition of his health was such that it would e impossible for him to do any work in July August. The Court thereupon extended the ne to October 1st, with the restriction that no stimony should be taken from July 15th to ugust 30th, inclusive."

"It is understood that the Providence Tele- hone Company will stop work upon the recon- ruction of its lines in Newport, R. I., over hich so much opposition has been developed, d will seek compensation from the city for amages already suffered through lack of police otection."

"The Southern Bell Telegraph and Telephone ɔmpany have recently purchased property in tlanta, on corner of Forsyth and Poplar streets d intend erecting a large building in which ill be located their central office with new and nproved apparatus, which will completely fill l they want in their fast increasing business this section."

During the present month, the Secretary intends to send out the blank forms of questions regarding the information necessary to enable him to compile the usual statistical report. He would esteem it a favor to the association and himself, if members would send to him promptly, any suggestions that may occur to them, as to modification of the questions asked in the blanks of last year; also, suggestions as to any *new* questions, or the dropping out of any of those which have been used without much change for several years past. It is very probable that some changes may be suggested that will make the statistical report of more interest and value.

AN IMPROVED CEILING ROSE.

Messrs. Pool & White, Cheapside, London, E. C., have brought out a patent divided wire ceiling rose and pulley attachment, the description and illustration of which we reproduce from the London *Electrician*:

This is a ceiling rose especially designed to

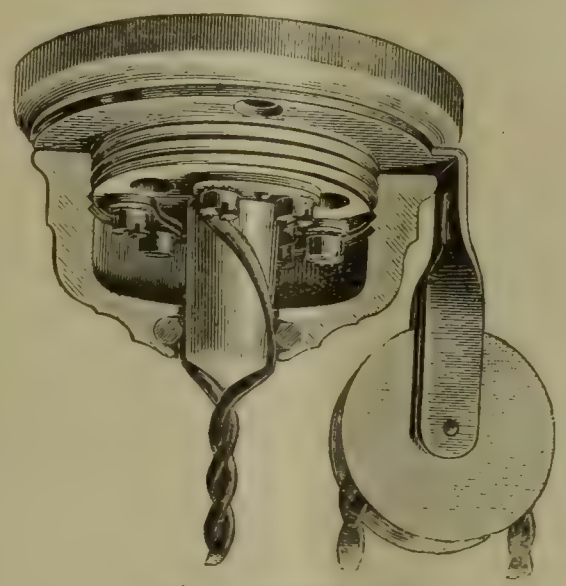


FIG. 1.—CEILING ROSE.

avoid any possible chance of the wires getting short-circuited inside the cover. The base and cover are made entirely of porcelain. A conical pillar stands up from the base, and is part of the base itself, and is also made of porcelain; on opposite sides of this pillar are two spiral grooves cut in the porcelain, and running from the base to the top of the pillar; in these grooves the

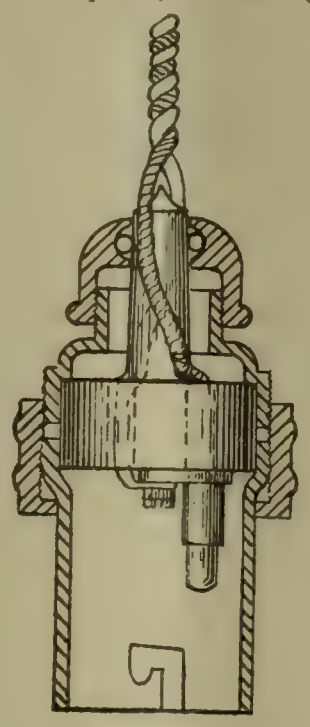


FIG. 2.—SUSPENSION HOLDER.

branch wires leading off to the lamp are laid, and are held in place by means of a rubber ring, which fits in the hollow left for it in the cover, as will be seen by Fig. 1. The same device of a conical pillar and rubber ring is also applied to suspension holders for the same purpose as in the ceiling rose as shown in Fig. 2. The special advantages claimed by the makers are that by this means the wires are kept quite separate until after they have left the ceiling rose or holder; that there is absolute'y no weight on the terminals; and that no dust whatever can get inside, as the rubber ring grips the wire tightly, and so takes all the weight and keeps out the dust. The pulley attachment shown in Fig. 1 is a cheap means of attaching a pulley to a ceilingrose; the pulley holder itself being made of a brass stamping, and bent up as shown in the illustration.

LARGE CROWDS SUCCESSFULLY CARRIED.

Last week clearly demonstrated the ability of the electric system of street car propulsion to take care of enormous loads. In the cities the amount of travel imposed upon the electric cars was far in excess of that for which they were intended, but in spite of the enormous loads carried, in each case the operation of the cars was successful in every particular.

At Cleveland, on May 30th, occurred the ceremonies connected with the dedication of the Garfield Memorial, and the city was crowded with strangers, who took the electric cars to the park. The greater part of these people were carried by the Sprague electric cars on the East Cleveland Street Railway, though many passed over the line of the other two street railways in Cleveland. The cars on all three lines were crowded with passengers. Many of the cars ran trailers, and both motor car and trailer were taxed to their uttermost capacity.

In Buffalo, on the following Sunday, the four electric cars in operation on the Buffalo Street Railway, ran all day long, drawing one or two trailers each, and are credited with carrying in all 15,000 passengers.

It is said that the managers of the roads in both of these cities are very enthusiastic over the operation of the cars, and the press of the city has spoken in the highest terms of the performance under the most trying conditions.

ELECTRIC LIGHTS IN THE SOUTH.—The South offers better opportunities for the introduction of electric light plants than any other portion of the country, says the *Southern Lumberman*, as all the mills have an unusually large supply of logs, and will necessarily be compelled to run day and night throughout the season. The old system of operating at night by the light of coal-oil lamps was extremely unsatisfactory, much of the lumber being miscut or otherwise badly manufactured. Mill men that have operated by electric light claim that lumber can be as perfectly manufactured at night as in day time, and with most Southern mills electric lights will in future become a necessity. There are also in the South many new towns that will put in electric light plants and street car motors, and, altogether, the South offers a wide field for the sale of all kinds of electrical appliances.

UTICA ELECTRIC RAILWAY.—The work on the electrical equipment of the Utica and Mohawk Electric Railway, at Utica, N. Y., is being carried forward as rapidly as possible, and it will not be long before the cars will be ready for operation. The motors and line equipment have already been shipped, and the final shipment of station equipment is expected to be made in a few days. Each car will be equipped with two fifteen horse power Sprague improved electric motors, with all the latest improvements and devices upon any of the Sprague roads.

THE WENSTROM DYNAMO.—Messrs. Chadbourne, Hazelton & Co., of Philadelphia, have just issued a neatly gotten up pamphlet, in reference to the Wenstrom Dynamo. This firm have arranged to handle all the electrical apparatus and machinery manufactured by the Wenstrom Consolidated Dynamo and Motor Company, of Baltimore, Md.

PERSONAL.—S. Katogi, of Tokio, Japan, paid his respects to this paper a few days ago. He returns to Japan June 8th.

ON PROF. ELIHU THOMSON'S ELECTRO-MAGNETIC INDUCTION EXPERIMENTS.*

BY J. A. FLEMING, M. A., D. SC., M. I. E. E.

In the Paris Exhibition of 1889, and in the United States Court, many present will, perhaps, recollect to have seen a collection of electrical appratus, contributed by Prof. Elihu Thomson as his private exhibit. These pieces of experimental apparatus constituted the appliances for illustrating some highly remarkable and interesting facts in electro-magnetic induction. It is more than probable that very many persons interested in electrical discovery either did not find, or did not happen to see in action these instruments, or perhaps had not the opportunity to see them at all. By the kindness of Prof. Elihu Thomson, to whom I am indebted for the loan of the apparatus, it is in my power to repeat some of these experiments before you to-night; and my obligations are likewise especially due to Mr. Ernst Thurnauer, the engineer of the European Thomson-Houston Electric Light Company, for affording me his valuable aid in bringing them before you, and to Mr. Garfield, of the Thomson Electric Welding Company, for assisting me in the preparation of the experiments. A few introductory remarks will be essential, in order that I may carry the whole of my audience with me in subsequent explanations; and these remarks will refer to that which is so very familiar a subject to every electrician, viz., the mutual induction of electric circuits. Before me lies a very large bobbin, or spool, wound over with two insulated copper wires. These wires were wound on the spool together, and for convenience sake we will distinguish them by calling them A and B (see Fig. 1). Bear in mind that the wires or circuits are

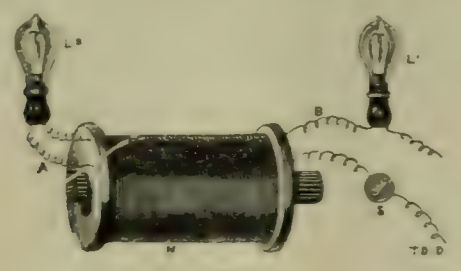


FIG. 1.

insulated from each other throughout their entire length, but lie closely adjacent on the bobbin. I can at pleasure insert a large bundle of soft iron wires tied up together, into the hollow split brass tube which forms the body of the spool. The ends of one wire, say A, are connected to the terminals of a glow lamp, and I can pass or interrupt an electric current which traversers the other circuit, B, and a second glow lamp in series with it. You will note at once what happens when I start or stop the electric current in the circuit B. The lamp connected to circuit A flashes up momentarily at the instant when the current *begins* to flow in circuit B, and also when it *ceases* to flow; but whilst the current flows steadily in the circuit B and illuminates the lamp in series with it, the lamp in series with circuit A is not illuminated at all. We have here a lecture experiment illustrating the familiar classical discovery of Faraday of the mutual induction of two electric circuits, viz., that the starting or stopping of an electric current in one circuit induces at the instant of commencement or cessation a brief secondary current in another closed adjacent circuit. I shall not take up time by dwelling on the historical details of this fundamental fact. You know them well. If instead of starting and stopping a continuously flowing electric current through the circuit B, and observing at each "make" or "break" a brief secondary current in circuit A, we supply the circuit B with an *alternating* electric current, one of which the direction is rapidly reversed many times in a second, and connect as before a glow lamp in series with circuit A, we find that this lamp glows continuously whilst the alternating current flows in circuit B. This also is familiar to us all. If in our first experiment we had employed, as a current detector in the secondary circuit, not an incandescent lamp, but some kind of galvanometer capable of indicating the direction of the induced electric current, we could easily have established for ourselves the fact that at the instant when the continuous electric current *begins* to flow in the circuit B it generates an oppositely directed induced secondary current in the circuit A, which is merely a transient current. At the instant when the continuous current is interrupted in circuit B it gives rise to a similarly directed transient induced electric current in the circuit A. These momentary currents in A are called the *inverse* and *direct* secondary currents, induced by the commencement of cessation of the continuous primary current in circuit B. If the primary current is rapidly reversed, as in the case of an

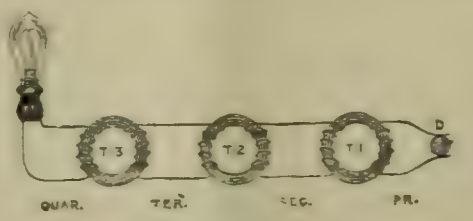


FIG. 2.

alternating current, then the secondary current consists likewise of a rapid succession of currents alternating in direction. In most of our experiments this evening we shall employ an alternaing current having a "frequency" of 90 per second—that is to say, changed in direction in the circuit 180 times in a second—and provided for us by the kindness of the London Electric Supply Company. If such an alternating current traverses a primary circuit it induces a secondary alternating current of the same frequency in an adjacent secondary circuit, and this secondary periodic current may be made to induce in another circuit a tertiary current of like frequency, and this again a quaternary current, and so on; the successive orders of induced currents being, as it were, the children, grandchildren and great-grandchildren of the primary parent current to which they owe their birth (see Fig. 2).

The same large spool of insulated wire will

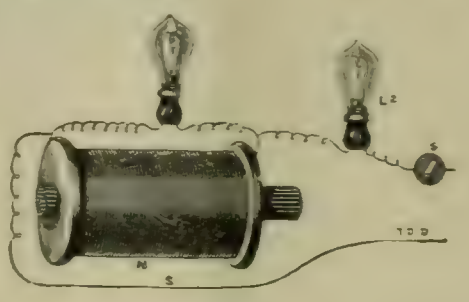


FIG. 3.

provide us with the means of illustrating another important fact. I join up the two wires A and B into one length, so as to form one continuous bobbin of wire, and connect this great spiral of wire with a couple of glow lamps, one being in series with the wire spiral, and the other being in parallel with it (see Fig. 3). On sending a steady current through the system, it divides between the wire spiral S and the lamp L_1, and I adjust the strength of this current so that the lamp L_1 is barely visibly red-hot. On interrupting suddenly this electric current, the lamp L_1 flashes up for a moment. We recognize that we have here to consider an inertia effect familiar to us as the effect of "self-induction" in the long coil of wire. Audiences in this room have been so carefully informed on many past occasions by brilliant and capable teachers that I may spare you a reiteration of elementary facts concerning the self-induction or inductance of conducting circuits, and take it for granted that everyone here is intimately acquainted with them, and that you will recall to your recollections that when an electromotive force acts upon any closed electric circuit generating in it an electric current, this self-induction exhibits itself by delaying or retarding the rise of the current strength to its full orits maximum value; and that, similarly, when the electromotive force is withdrawn, it operates to give the current a resistence or to retard the rate of reduction of the current strength. The convenient term "time-constant" of a circuit is employed to denote that time, expressed in fractions of a second or any other unit, which must elapse before a current rises to a certain definite fraction of its full vaiue, when a steady electromotive force acts upon that circuit. I will next beg you to turn a moment's attention to the electro-dynamic actions or forces which are brought into play when a circuit of any kind is subjected to electro-magnetic induction in a magnetic field. Consider, for instance, a ring of copper hanging in front of the pole of an electro-magnet (see Fig. 4) having the plane of the ring perpendicular to the lines of magnetic force proceeding out from the pole. Let the magnet be an electro-magnet, and let the pole be suddenly made a north or marked pole. Lines of magnetic force are thrust into the aperture of the ring. This magnetic flux, in accordance with a well-known law, generates an inductive electromotive force which causes a transient current to flow round the ring in a counter-clockwise direction, as looked at *from* the worth magnetic pole. The ring becomes virtually a *magnetic shell*, having a north pole facing the north of the exciting magnet. By the fundamental laws of action, between currents and magnets established by ampère, the ring experiences a slight repulsive force, due to the electro-dynamic action between the current in the ring and the mag

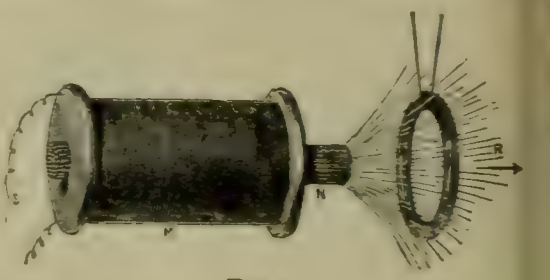


FIG 4.

netic poles. The generation of the momentary induced current in the ring is accompanied by an electro-dynamic impulse tending to thrust it away from the pole. Suppose, next, that the electro-magnet is demagnetized. The ring has generated in it a reverse induced current flowing in the same direction as the hands of a clock move when looked at from the magnetic pole. This is also accompanied by an electro-dynamic attraction of the ring towards the pole, but which is much more feeble than the previous repulsion. These attractions and repulsions are well seen when small disks of copper or aluminium are suspended in front of the poles of a powerful electro-magnet, which is alternating "made" and "broken." They have been particularly investigated by Mr. C. V. Boys.

I will now ask you to consider what would happen if the coils of the electro-magnet were traversed by an alternating current? Furthermore, we shall first suppose that the copper ring has a zero time-constant; that is to say, the induced currents in the ring rise up and sink down in strength in exact synchronism with the changes in the inductive electromotive force acting on the ring. If the current flowing in the coils of the electro-magnet is represented as to changes in strength by a simple periodic curve we may suppose that the magnetism of the core and the magnetic induction through the ring follow a similar law. It is very easy, then, to show that the induced electromotive force acting in the ring circuit, and hence the current in the ring, follows a similar law of fluctuation, but that the instant of maximum current in the ring coincides with the instant of reversal of magnetism in the electro-magnet.

(To be continued.)

* A paper read before the London Society of Arts, May 14, 1890.

STORING THE ALTERNATING CURRENT.

The following is the concluding portion of the paper read by Dr. A. Foeppl, of Leipzig, before the Berlin Electro-technical Association, on the subject of storing alternating currents, the first part of which was published on page 5, of our issue of June 7th :

The nearest means for effecting the introductions described would consist in a series of plates fixed upon an insulating support, upon which impinge two contact pieces corresponding to the points C and D, and set in oscillatory movement by means of a crank. The single plates would have to be connected by means of conducting wires with points of the battery suitably selected (fig. 4).

An improvement on this most simple arrangement would be effected by coiling the series of plates of fig. 4 upon a cylinder, and putting ordinary brushes in place of the contact pieces. In order to obtain the same introductions as in fig. 4 by means of a simple rotatory movement of both brushes, it is merely necessary to coil the same series of plates twice upon the circumference of the same cylinder, so that each series of plates takes up one-half of the circumference of the cylinder, and both are coiled in the opposite direction ; the corresponding terminal plates are then common to both series. The brushes are placed diametrically opposite to each other. Fig. 5 represents this arrangement. The one-half of the circumference of the commutator formed in this manner is taken up by the series of laminæ *l*, the other by the series *g*. The arrows point towards the positive pole of each series. This may be expressed in a very intelligible and very characteristic manner by saying that the battery is projected twice on the circumference of the commutator. This statement includes the intimation what points of the battery are to be connected with each commutator plate when the curve of plant tensions, fig. 1, is to form a pure sine line. I will not, in the meantime, delay with a more detailed explanation, as it will be seen at once that it may be adapted to any given curve by a suitable choice of the points of connection.

In the arrangement of fig. 5 the rotating brushes must turn once for every two changes of the poles or for an entire period of the alternating current. This movement can be effected either by mechanical means, *e. g.*, by means of toothed wheels derived from the movement of the axle of the armature of the alternating current machine, or by a small synchronic auxiliary motor. Of course the brushes may be fixed and the commutator may be caused to revolve, as it depends merely on the relative motion of both. The connection of the commutator plates with the part of the battery thereto pertainining would then be effected by means of sliding rings.

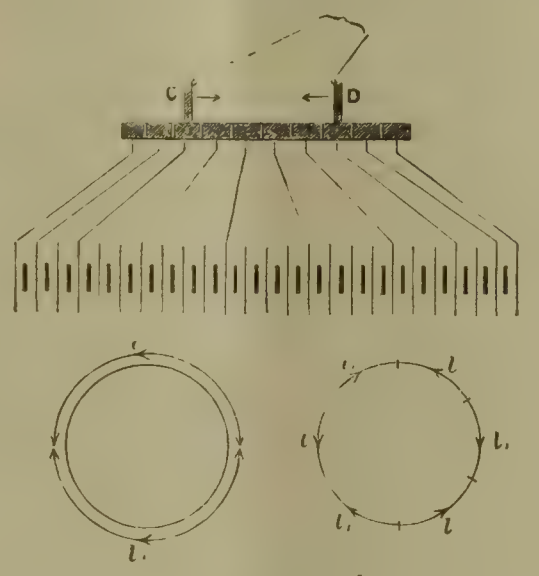
In order to reduce the speed of rotation of the brushes (or of the commutator), the battery may be projected four times, six times, or two *n* times on the circumference of the commutator, as is shown in fig. 6. The speed of rotation of the commutator would in the case of fig. 6 with 6,000 polar changes every minute amount to 1,000 turns. The brushes would form with each other an angle of about 60°, as is known from the construction of commutators for continuous current machines.

It will be seen at once that such a manifold commutator may be at once directly attached to the circumference of the armature of the alternating current machine in a similar manner to what takes place in the recent large internal pole continuous current machines.

In the above I believe that I have given a sufficiently clear representation of the general arrangement of my apparatus. It would take me too far were I to enter upon a full description of the course of the current in the various positions ; the reader will, with little trouble, be able to convince himself that, in fact, the insertions described in the first part of this discourse, and of the corresponding course of the current, will be as there described.

Of the objections or scruples which may be raised against the above-described mechanisms, I will submit those which I consider the weightiest to a brief review.

The first refers to the production of sparks at the commutator. For a clear comprehension of the question it will be useful if I first call attention to the close relation between this case and that of the commutator of an ordinary continuous current machine. Fig. 7*a* shows the series of laminæ of the commutator of a continuous current machine uncoiled. Every two successive plates are connected with each other by the interposed armature bobbin, S, which is the seat of an induced electromotive force. As the brush passes between two laminæ the bobbin, S, concerned is short circuited, and the current in the latter is reversed. Fig. 7*b* gives the series of laminæ of the apparatus here described and its



FIGS. 4, 5 AND 6.

connection to the battery. On the transit of the brush, a momentary short circuit of the part of the battery between two laminæ cannot be avoided, and the current vanishes in one of the connecting wires whilst it appears in the other. The close relation of both cases is here evident.

It is known that by a clever utilization of an induced force which the reversal of the current effects in the short circuited bobbin, the problem in question is well solved for Fig. 7*a*. We might then hope to arrive in a similar manner at the solution for Fig. 7*b*. However, the difficulty of avoiding sparks for Fig. 7*b* seems smaller than it originally was for the commutator of the continuous current machine. Whilst in the latter the self-induction of the bobbin to be re-introduced increases the difficulty of the question, this in Fig. 7*b* is practically null. We may therefore

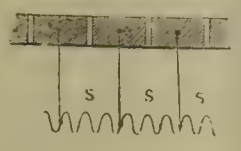


FIG. 7*a*.

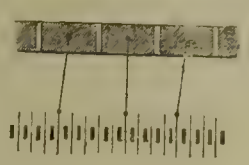


FIG. 7*b*.

obtain our object with simpler means, of which I merely mention here double brushes and a gradual cutting out by the interposition of resistance free from induction.

Of course, we can arrive at final results on such details of construction only by experiments on a large scale. Such experiments are now in progress, but I am not yet justified in communicating the results.

The second objection refers to the consideration that the curve of clamp tensions, Fig. 1, may vary with different loads. If the battery is connected with the commutator so as to correspond to a certain form of this curve, irregularities may easily occur in consequence of a change in its form. But we may readily satisfy ourselves that when the principal work of the machine consists in charging the battery, the self-induction of the alternating current machine helps us over this difficulty. In other cases, indeed, a partial discharge of the battery may occur, so that single cells may be charged to a higher tension than others until a new state of equilibrium has been reached. But this does not involve any injurious results. The battery can adapt itself to such fluctuations, and, on the other hand, it may prescribe up to a certain degree of the clamp tension a normal form for the main lead. It produces in this respect a more stable condition of the current. It must be remarked that even when the curve of clamp tensions becomes distinctly unsymmetrical (in consequence of a strong reaction of the armature) this may be met by projecting the battery upon *l* in Fig. 5 in a different manner (*i. e*, seeking different points of connection) than at *g*.

It remains for me merely to point to the applications which the new procedure may find in practice. In my opinion, it is likely to perform for the technics of the alternating current still more important services than the use of accumulators has afforded in continuous current technics.

In the first place, the storage of the alternating current can be carried out in the same manner and for the same purposes as in continuous current installations. This manner of application is so simple that it requires no further description. But, in addition, there are other applications possible, of which I will briefly describe the two most important.

The first is the question of alternating current motors. Suppose that in any part of a city supplied with the alternating current a large alternating motor current is to be installed. Instead of feeding it directly from the main lead we arrange, in the first place, an alternating current battery which is set in action by a small synchronic auxiliary motor. The main motor carries likewise a commutator at the circumference of its armature which receives the known introduction from the alternating current battery. We perceive at once that in this arrangement the main motor is not limited to the conditions of synchronism. It can be driven at any desired speed, bears as much over-loading as does a continuous current motor, and behaves in every respect like the latter. The accession of the alternating current battery certainly complicates the arrangement a little, but it involves other decided advantages.

The other application is in the erection of alternating central stations. I figure to myself, in the first place, at such a station the construction of a main battery. Upon this work all the alternating current generators of the station, each of which is furnished for this purpose with a commutator at its armature. It must also be noted that the excitement of the field magnets can be easily effected from the battery.

The alternating current to be given off outwards will be derived, independently of the machines, from the battery by means of the rotating apparatus above described.

We perceive at once that in this arrangement every machine works independently of the others. The question of parallel introduction is completely solved. Every machine can run with a different speed, and each can at any given moment be in a different phase. The introduction of a new machine is effected in exactly the same manner as with a continuous current central.

You may object that it is not suitable first to store up energy in a battery, and then draw it out again. In practice the case is different. In normal working, *i. e*, when the machines produce exactly as much current as is used in the outer circuit, the battery forms merely an apparatus for introduction. At each moment there exists a series of ramifications which allow the chief part of the alternating current supplied by machines in parallel insertion to flow off at once directly into the external leads without having been previously transformed into chemical

energy. Only a small fraction of the entire energy undergoes a temporary storage. This fraction is the smaller the larger the number of the alternating current machines working upon the battery, and the greater at the same time is the number of the apparatus for taking up the current.

An important advantage of this arrangement seems to be in the circumstance that in the construction of the alternating current machines we are not limited to any large prescribed number of polar changes. It may, at pleasure, be made smaller than formerly, and hence a better utilization of the magnetic field is obtained. Hence we may expect an increase of the useful effect of the machines, which may to a great extent compensate for the losses occasioned by the arrangement for introduction.

In order to obtain the prescribed number of polar changes in the exterior not only the apparatus for taking up the current must rotate at a very high speed. We may say that with the arrangement above described the battery constitutes a transformer of a new kind. It transforms alternating currents of various and low numbers of alternations which flow from the machines into others of an accurately determined and higher number of alternations which flows off outwards.

I hope that these indications will suffice in order to give in general outline a picture of the manifold applicability of the new procedure. I may conjecture that this process will be of great scope for the future development of electrotechnics.

Finally I remark that I am fully conscious that a final decision as to the practical value of my method can be obtained only by means of extended experiments. I have not waited for the completion of these experiments and have come before the public because I wished to discriminate between that which is my exclusive mental property and that which has been derived—and which will be derived in future—from the execution of the experiments and the practical carrying out of the idea and which will be in great part due to the merits of others.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, June 7, 1890.

BEATRICE, NEB., has made arrangements for an electric street railway.

THE PEORIA GAS AND ELECTRIC LIGHT CO. has been formed at Peoria, Ill. ; capital stock, $750,000.

MR. S. W. TRAWICK, formerly of the Excelsior Electric Co., has accepted a position with the Westinghouse Electric Co.

WM. R. LITTLEFIELD, formerly with Chandler & Farquhar, of Boston, is now with the Chicago office of Chas. A. Schieren & Co.

MR. W. R. MOLINARD, of the Baxter Electric Motor Company, was in the city some days this week, arranging for the sale of their motors in this part of the country.

IT IS REPORTED that a syndicate of Eastern capitalists have perfected arrangements for purchasing the Salina, Kan , street car lines and changing them into electric lines.

THE ATCHISON (KAN.) ELECTRIC STREET RAILWAY Company has been formed with capital stock of $40,000. Directors: W. W. Hetherington, George Storck, W. L. Challis and others.

THE QUINCY GAS AND ELECTRIC LIGHT CO. has been formed at Quincy, Ill. ; capital stock, $400,000. The incorporators of both companies are F. C. Crowley, W. C. Baine and Marion Pickett.

GARDEN CITY ELECTRIC LIGHTING AND POWER Company has been formed at Chicago, to operate an electric light plant; capital stock, $25,000. Incorporators: Charles A. Buell, Douglas V. Bussie, Hosea W. Wells.

THE CHICAGO OFFICE of the Edison General Company report business more active than usual at this time of the year. The business done through this office, during the past month, amounted to upwards of $80,000.

THE DENVER (COL.) CITY COUNCIL passed a bill on May 31st accepting the offer of the Denver Consolidated Electric Company to enter into a five years' contract with the city to furnish arc street and bridge lights for the sum of $11.50 per lamp per month.

J. H. MUNSON & COMPANY is the name of a new firm located at Evanston, Ill., for the manufacture of electrical apparatus Their specialty will be an incandescent lamp invented by Mr. Munson, which is said to have been passed favorably upon by high scientific authority.

MR. C. H. CONE, Chicago, has secured the Western agency for the Baxter Arc Motors and will push their sale in Chicago and other cities. Mr. Cone has the agency for the goods manufactured by the Findly Glass and Carbon Co., and mentions some fine sales of that company's batteries during the past week.

MR. FOREE BAIN has just returned from a trip to Iowa, made with a view to putting in coal mining machinery. Mr. Bain is now building in his works an eighty horse power generator, after the pattern of the Motor Dynamo, illustrated in the ELECTRIC AGE of May 31, for furnishing current to operate coal mining machinery.

THE electric lights were turned on in the Washington street tunnel this week, and the work of completing the tunnel is being carried on at night by their aid. Fifty arc lights of the Sperry system are employed, and the plant was installed by the National Electric Construction Company, of this city.

AN EXAMPLE of what facilities the West affords in the electrical supply line is seen in the remarkably rapid growth of the Central Electric Company of this city. They are carrying larger stocks than ever of all kinds of electrical specialties and seem to be again crowded for room, although it is but a few months since they moved into their present large building. The open-handed patronage this company receives from all parts of the country, and the good feeling existing with its customers, is evidence of the personal popularity of the officers of the company as well as the high standing of the goods they turn out. Since taking the general western agency for the Burnley dry battery they report sales reaching up into the thousands. The enormous demand for okonite wire remains unabated.

A NEW ELECTRICAL COMPANY.—The merchandise business of the Sprague Electric Equipment Company, Rialto Building, Chicago, has been purchased by a new corporation called the Electric Merchandise Company, whose offices hereafter will be at No. 11 Adams street, opposite the Pullman Building. This company, in addition to continuing the merchandise business of the old company, will also manufacture and sell electric railway appliances for station, car and line work of all kinds, *irrespective of system.* Their experience in the Equipment Company has been such that they are peculiarly well fitted to recommend material which has been found by practical use to be the most satisfactory. Such connections have been made with eastern manufacturers that in most cases goods can be bought at the same prices of the Merchandise Company as direct from the factory, time and freight being saved, as all goods will be carried in stock. Catalogues will be furnished on application. Mr. W. R. Mason has been appointed general manager.

F. M. I.

UNDERGROUND TELEPHONE WIRES.—New York City has the greatest mileage of underground telephone wires in the United States. Boston ranks second.

NEW YORK NOTES.

THE BISHOP GUTTA PERCHA COMPANY reports sales this month heavier than during any one month the past year.

PAGET AND KINTNER, Electrical Experts and Electrical Engineers, 45 Broadway, on the 3d instant, dissolved partnership. The business of the late firm will be continued by Mr. Chas. J. Kintner, at the same address.

THE LONG DISTANCE TELEPHONE COMPANY is making rapid progress in the building of its line between Syracuse, N. Y., and Scranton, Pa. When this line is completed it will give an additional entrance to New York from the West, via Reading and Philadelphia. The Company's lines extend as far west as Dunkirk, N. Y., and to Niagara Falls.

THE EMPIRE CITY ELECTRIC COMPANY, of 15 Dey street, have just issued a circular descriptive of the Mason Primary Battery and accessories. This Company made no mistake when they took the agency for this battery. The reputation it is acquiring is based on real merit, and is not dependent upon speculative enterprise. The result is that the battery is making a name that must be the source of a great deal of pride to the inventor.

ONE DAY LAST WEEK a telegraph or telephone wire crossing Broadway diagonally from the Astor House towards Fulton street broke and fell across the line of electric light wires which runs along the west side of Broadway. Some well-meaning person fastened the dangling end of the broken wire to the top of a dismantled lamp post in front of St. Paul's Church, the intention being, of course, to get the wire out of reach where passers-by could not come in contact with it. The wire was drawn taut over the electric light wires, and had the state of affairs not been noticed before dark it is likely that some one would have, at least, got seriously shocked in case of accidental contact with the lamp post after the current was turned on. The attention of a policeman was called to it, however, and he was informed of the danger that might arise. He at once took steps to remove the broken wire from the electric light wires.

THE METROPOLITAN TELEGRAPH AND TELEPHONE COMPANY'S new building on 38th street, is completed, and is now being wired and fitted up for Exchange use. The building was run throughout with the Interior Conduit and Insulation Company's conduits, in which all of the wiring will be done. These interior conduits have given great satisfaction, owing to the ease with which the wiring is accomplished. The same company have started a new Exchange on Spring street, and are preparing to erect one on Broad street. All of these buildings will be fireproof. The Company is determined to give their patrons the most reliable service possible, and with fireproof exchanges and reliable underground cables, New York's telephone service promises to approach the ideal.

GENERAL MANAGER SABIN, of the Pacific Coast Telephone Company, is in the city, accompanied by Mr. E. M. Jackson, that Company's Superintendent of the underground system. These gentlemen have been in Boston, Philadelphia and Baltimore examining the underground systems in those cities. They are much interested in the New York methods of laying wires underground. A large amount of underground work is soon to be done in San Francisco, and these gentlemen came East for the purpose of informing themselves on the practice in the different eastern cities, so that they may at the outset lay their wires at home underground in a manner that they will know will give satisfactory results. It is only now that data anywhere near reliable can be settled upon regarding underground work, and the experimental stage may be considered quite past.

R. J. G.

ELECTRICAL SAFETY COMPANY,
SOLE MANUFACTURERS OF THE
Cartwright Electrical Protectors and Safety Devices.
The only Safety Device that can be used on fire alarm and other metallic circuits. Approved by the Boston Fire Underwriters' Union and the New England Insurance Exchange.
Room 21.——146 FRANKLIN STREET.——Boston, Mass.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
ROOM 10, COOK BUILDING,
BOSTON, June 6, 1890.

Colonel Ransom, of *Modern Light and Heat*, who has been seriously ill, is very much improved and is on a fair way to recovery.

The Nantasket Electric Light and Power Co. has been organized with a capital of $10,000. G. E. Davis, President; Elisha Thayer, Treasurer.

Mr. E. Caldwell, Technical Editor of *Modern Light and Heat*, will soon resign his position on that paper to accept a similar one with a contemporary.

Edward Paul and Edward H. Butcher were arrested in Boston, last Saturday evening, charged with stealing copper wire from the poles of the Somerville Electric Light Company in Arlington.

The Beverly Electric Light and Power Company will soon commence the erection of a brick station. The plant is being run to its utmost capacity and an enlargement is an imperative necessity.

At a meeting of the subscribers of the stock of the Johnston Train Signal Company, held Wednesday evening, at the Board of Trade, Woburn, J. B. McDonald and H. C. Buck were chosen directors.

Captain Brophy is making an extended trip through the West, examining electrical risks for the Electric Mutual. His trip has covered a period of over six weeks, and he has inspected over fifty stations.

The Gas Light Company, at Warren, R. I., has sold out, a majority of its stock having changed hands. This change, it is thought, involves the question of electric lights at least in the streets and mills.

Mr. H. C. Spaulding, of the Thomson-Houston Electric Co., has been elected treasurer and secretary of the New England Electric Exchange, *vice* H. H. Fairbanks, of Worcester, resigned. Mr. Fairbanks takes the seat at the board vacated by Mr. Spaulding in his acceptance of the treasurership.

There is not the least question but that the privilege of controlling the electric subways in the city of Providence for twenty-five years, which was given away by the city council, could have been sold for the benefit of the city for $100,000 or more, and the citizens are very indignant.

By the breaking of a counter shaft at the works of the Lowell Electric Light Company, last Saturday night, about two tons of metal was precipitated among the dynamos making a serious wreck. The damage will amount to quite a large sum. Temporary repairs were made and the service was resumed on Sunday night.

Dr. H. L. Bowker delivered an address on Street Transportation before the Ward 14 Republican Club. last Monday evening. The Doctor condemned the electric motor system, which he said was "conceived in sin and brought forth in iniquity," and that its great cost would soon ruin the West End Railway Company. A general discussion followed, in which exceptions were taken to some of Dr. Bowker's statements by F. J. Baxter, who claimed that the electric system was a decided success, and sincerely hoped that the system would be introduced in South Boston in the near future.

The employés of the Thomson-Houston Electric Co. and the Thomson Electric Co. have contributed $632.20 towards the maintenance of the Lynn Hospital, which amount was handed over to the treasurer of that institution by A. L. Rohrer, of the T.-H. E. Co., last week.

The new power company that is to use the power of the Farmington River for generating electricity for the Hartford electric light station has been duly organized. The undertaking is an extensive one as it is proposed to transmit a 3,000 volt current ten miles to a 250 horse power motor in the electric light station at Hartford.

The Directors of the Lowell and Dracut Street Railway Company, think of erecting an indpendent electric plant, to furnish power for running their cars. This course has been suggested by the frequent delays and inconveniences to which the road has been subjected by reason of accident at the electric light station.

In the Newton board of aldermen, last Monday evening, hearings were granted, on petitions asking for locations, to the Newton Central Street Railway and Garden City Street Railway for Wednesday evening, June 18th. The Newton Street Railway was given until July 1 to complete its system and have it in running order.

At a meeting of the Salem aldermen, last Monday evening, a hearing was given on the petition of the Essex Electric Street Railway Company for permission to maintain an overhead trolley system. There was no opposition. This company has purchased the Derby wharf property at Salem, on private terms, and will erect a power station there for their road.

Geo. Horn, a boy seven years old, while attempting to cross in front of an electric car on Shawmut avenue between West Springfield street and Chester Park, last Monday night, was knocked down and run over. The wheels did not pass over his body, but he received injuries from which he died an hour later. No blame is attached to the railway employes.

The formal transfer of the Naumkeag Street Railway to the new owners was made at Salem on Wednesday last. The new owners will at once equip the road with the Sprague system. Joseph F. Hickey, the former clerk and treasurer, will be manager under the new arrangement. The company has purchased land in Beverly for a power house, the erection of which will be commenced immediately.

At the annual meeting of the Franklin Telegraph Company, held in the office of the Western Union Telegraph Co., on State street, this city, last Tuesday, the following officers were elected: Directors: Jay Gould, Norvin Green, Charles A. Tinker, Thomas T. Eckert, Fred. L. Ames, Jno. Van Horne, A. R. Brewer, Joseph F. Greenough, Thos. Roche; Treasurer, R. H. Rochester; Secretary, Thomas Roche.

The electric plant at Brocton supplies about 150 motors scattered throughout the shoe factories, stores and shops. It also supplies current for the electric railway, besides 110 arc lights and 500 incandescents. The equipment is a 150 horse power dynamo for the motors, three arc light machines and two incandescent dynamos. The station is admirably protected against fire and lightning, and the entire structure is supplied with Grinnell automatic sprinklers. There is also a stand pipe on the second floor ordinarily used in connection with the boiler, to which a hose may be attached in case of fire.

At the annual meeting of the stockholders of the Beverly and Danvers Street Railroad, held in Beverly, last Tuesday, the following officers were elected: Directors, Hon. John I. Baker, President, Peter E. Clark, Samuel J. Foster, Sidney W. Winslow, Perry Collier, Henry W. Foster, of Beverly; Calvin Putnam, Gilbert A. Tapley, Charles W. Emerson, of Danvers; Peter E. Clark, Treasurer; John S. Baker, Clerk and Superintendent.

The matter of electric lighting in Hingham, is in a queer state. Many stores and houses are using the lights, and have been using them since last November, but no one has yet received a bill. No one knows how much, or when, he is to pay. The town, in March, voted $4,000 for lighting the streets with electricity, and appointed a committee of five to make a contract with the Weymouth Light and Power Company. The streets, or many of them are lighted, but thus far the committee has been unable to find any company to make a contract with.

While Mr. Charles W. Holtzer, the well-known electrician, and his wife were returning in their carriage from the County Club races at Clyde Park, Brookline, on Saturday afternoon last, they were run into on Walnut street by a dog-cart, driven by two women, and both were thrown out. Mrs. Holtzer fortunately escaped injury, but Mr. Holtzer had his hip badly hurt and was internally injured, and last night he was unconscious. The women in the dog-cart did not even stop to inquire if the others were injured, but continued on their way as if nothing had happened.

The Woburn Electric Light Co. disconnected its wires to Stoneham, last Thursday, and the town will be left in darkness. The town paid the company $2,700 for lighting during the past year, and the latter wants $3,000 to renew the contract for a term of years with the additional lights required. The Selectmen have voted unanimously not to pay over $2,700. They have ascertained that Melrose pays only sixty cents per light for all night, while Stoneham has been paying ninety cents per light to 12.30 A. M. The Selectmen propose to get the town to build an electric light plant, and it is understood that if the town declines, there are gentlemen who stand ready to do so.

The conversion of heat directly into electricity, without the intervention of steam boilers, engines or dynamos, is said to have been accomplished by a young Maine inventor, H. B. Cox, and his experiments have proved so successful as to lead Boston and Hartford capitalists to organize a company with a capital of a million dollars to put the discovery into practical operation. The company includes Francis A. Pratt, of the Pratt & Whitney Company, as President, R. N. Pratt, of the Pratt & Cady Company, as Vice-President, Ernest Cady, of the same company, as Treasurer, and E. Henry Hyde as legal adviser. If the claims of Mr. Cox prove just, the value of his discovery is enormous, but as yet the experiments have been only on a small scale. His method of changing heat to electricity is as simple as the changing of water to steam, the current coming direct from the glowing coals of a furnace without the aid of any machine. No power has ever been discovered that is half so cheap as would be electricity obtained by his process He has experimented with a furnace at his home, using a number of electric lights, and it now remains to be seen whether his experiments will hold on a large scale.

W. J. P.

THE ELECTRIC WIRE INVESTIGATION.

(Continued from page 5, issue June 7th, 1890.)

We give herewith the concluding portion of the report of Mr. F. W. Jones to the Senate Committee on General Laws in reference to the situation regarding the use of electric wires in the State of New York, and the legislation necessary for the better protection of life and property by such use. The report says :

The telephone was introduced in 1877 and for about ten years was mostly confined to urban or suburban use. Since then, however, it has extended it lines between New York and Philadelphia, New York and Boston, New York and Buffalo, and I am informed is rapidly pushing forward to more distant points. The patents of Bell have so far prevented the competition for telephone business that has prevailed more or less in telegraphy for many years. This monopoly is likely to continue many years longer under various subsidiary patents for improvements having dates later than Bell's of 1876 and 1877.

The various electric systems employing currents of high pressure and moderate volume, and of low pressure and large volume, have been fully described to your honorable committee during the investigation at Hotel Metropole.

Notwithstanding the progress made in New York city towards clearing the streets of unsightly and dangerous wires, a vast network yet remains to be provided for. The electric light and power wires are still far from being as safe as desired, and all classes of wires are threaded in and through each other in confusion.

Conductors carrying enormous currents or high pressure are being operated in thousands of stores and dwellings subject only to the conditions of safety dictated by the commercial instinct of the producers, which instinct is notably weak as was evidenced by the bare wires and splices produced by Mr. S. S. Wheeler, expert of the Board of Electrical Control during your investigation. It is obvious that the large number of laborers employed to put up these wires must be largely composed of uninstructed persons whose every act requires the intelligent supervision of a trained inspector.

The time will shortly arrive (in fact has arrived as to one or two streets) when the subways at present constructed in New York city will hold no more wires. An important matter to be decided will be the provisions necessary to meet the requirements of electrical companies serving the public for a reasonable time in the future. To allow the present electrical interests to fill and control the subways without any plans for the accommodation of other persons desiring to compete for business would be equivalent to establishing an offensive monopoly ; on the other hand it is not feasible to permit all applicants to tear up the streets at all times to put down new pipes. The city has not been properly laid out to accommodate the enormous traffic and commercial enterprise that at present prevail, and as time goes on many great inconveniences must be encountered. Already the narrow streets are gorged with vehicles, and crossing a busy street on foot is a slow and dangerous proceeding. Gas, steam, electric and pneumatic tubes run beneath the surface of the principal thoroughfares without any regard for each other's convenience and safety, and no room left for future development. On account of the very economical and piecemeal character of the work done in the streets by street railroads and the other companies already named, the pavements are continually torn up greatly to the discomfort of the public and impedence of traffic.

Running nearly the entire length of the city, from south to north, are three lines of elevated railroad, and in the southern part of the city for long distances there are four parallel roads. Judge Walton, in the case of W. U. Tel. Co. *vs.* the Mayor of New York City, decided April 12, 1889, says : "That railway (the elevated) is an independent post road of the United States, in legal contemplation carved out of the streets upon which its structures are erected, and State legislation, under whatever form it may be classified, is impotent to destroy the privilege given by the act of Congress." Here we have the anomaly of one post road on top of another, or what might be termed a duplexed post road. There can be no contradiction of the statement that the structures of the elevated road offer unsurpassed facilities for carrying electric wires and ærial cables.

The underground cables have a much greater first cost than those necessary for use on the elevated structures, besides they are not so accessible of repairs, renewals, nor for the distribution of wires to points along the route. It is easy to see that the elevated railroad companies can permit a monopoly of the privilege to place wires on its structure by objecting to a second applicant on the ground that any further weight would exceed the limits of safety and jeopardize the lives of passengers.

I am of the opinion that the subways in New York City, as now constructed, are well adapted for the purpose, and are far preferable to tunnels or sewers. The troubles due to steam, heat and gas, are not chargeable to the subway system but outside defects which should be remedied by the companies responsible for them.

I have no doubt but that the contract made by the State with the Subway Company is in every way entirely fair and wise. It should be so guarded that the company shall not receive ten per cent. on fictitious capital, and that one subway company is not given all the main thoroughfares where wires are thickest and consequently will yield a greater revenue to the exclusion of another subway company employed to lay subways in streets having fewer wires. The cost of putting down and pipe being nearly as great as to put down several in the same trench, the charge for the use of these pipes should be entirely regulated by the State, so that the very great threatened injustice to users may be averted. Unless this is done, the high rates of rental, the costly nature of the copper cables and difficulties of getting to and from the subways will have the tendency to create monopolies and render electric light and power service so expensive as to react unfavorably on both the producer, the consumer and the city.

The various cities, towns and villages throughout the States have their streets and housetops filled with poles and wires, in a manner anything but satisfactory to the residents. Fine avenues are marred by disgraceful poles. No order or symmetry is observed, and altogether the confusion is beyond toleration, and danger stalks forth from the spider's web of wires, at noonday.

No serious question can be entertained but that the recent development of the electrical industry, and methods of telegraphic and telephonic communication has been so great as to entirely outgrow all the laws which, from time to time, have been enacted for their control. Some of these laws at present in force are over forty years old. No wonder, then, that the public gets dissatisfied, particularly with the operation of the telegraphs, and, through its representatives, clamor for a governmental system. Neither the United States nor the individual States, up to the present time, have exercised a proper control over these important agents enjoying public franchises, rights of way, and corporate existence. As before intimated, they have been allowed to run riot, either charging discriminating rates on telegrams and treating the public with indifference, or else allowed to engage in wars of extermination which, whilst affording temporary benefit to the public, resulted in the impoverishment of many innocent investors and in the occupancy of public streets with miserable plants never intended for permanency.

If my views and statements have foundation in fact, it is obvious that some radical legislation is necessary, and that such legislation should be broad and comprehensive enough to thoroughly protect public interests on the one hand without stunting the growth of a very promising industry on the other.

State law should regulate telegraph and telephone interurban lines, and municipal law should not be allowed to interfere except on well-defined local details. New telegraph and telephone companies should apply to the proper authorities for permission to build lines over public highways and across or under rivers or bridges of the State, and such lines should be constructed entirely in conformity with the rules and regulations of the State. The size and distance apart of the poles, their exact location and their height, strength and character of the fixtures to bear the intended weight of wires, the height of wires at all railroad and other crossings, and their location with reference to poles and wires previously put up. These regulations should extend to the poles, wires and cables in every village, town and city, which should not be permitted to embarrass within their limits very important commercial enterprises affecting the country at large.

During the investigation of your Honorable Committee it was developed, through the testimony of Mr. G. A. Hamilton, Mr. Wm. Maver, Jr., and the article of Sir William Thomson, gentlemen that thoroughly understood the subject, that to put telephone wires underground resulted in limiting the distances to which articulation of the voice could be produced ; also, that the efficiency of the Wheatstone automatic system would be entirely destroyed if the wires on which it was intended to be operated were carried underground beyond a very limited distance. Looking to the future of the telegraph it seems to me inevitable that the vast increase of telegrams must be provided for by some system similar to Wheatstone's which automatically carries from two hundred to twelve hundred or more words per minute over one wire according to its length, rather than by using the Morse system, which is limited even by use of the quadruplex apparatus, to one hundred words per minute, and on a single Morse system to twenty-five or thirty words. It becomes apparent, then, that so far as the telegraph and telephone wires are concerned that it would be disastrous to those systems and consequently react ultimately to the detriment of the public to permit, without limit, the numerous towns, villages and cities to enforce local ordinances requiring such wires to be buried in the earth indiscriminately. As to the use of electric lights, electric power and electric railroads where duly chartered corporations confine their operations entirely within the limits of any municipality that the State should interfere no further than is necessary to secure safety to persons and property and to prevent any monopoly or action repugnant to the interests of the people of the State, provided, of course, that wires of said corporations are not allowed to be constructed in violation of regulations of the State, in other respects the mutual interests of the residents of such municipality and the corporations will naturally adjust themselves to each other.

The State should enact general laws to determine what wires shall or shall not be placed underground ; the distances between telegraph, telephone and electric light and power wires ; the minimum insulation to be allowed per volt on every conductor ; under what conditions wires carrying dangerous currents may be used on highways between villages, towns or cities ; the size of poles or fixtures, their strength and distance apart, together with every important feature.

It may be feasible and appropriate to so reconstruct the Department of the State Engineer and Surveyor, as to secure through it the necessary inspection of all electric plants and wires, and the proper enforcement of such regulations as the Legislature, in its wisdom, may enact. The regulation of gas and steam pipes and steam

oilers could also be effected in the same manner. The Governor, by and with the advice of he Senate, could appoint an electrical expert to eport to the State Engineer and Surveyor. The Board of Commissioners of the Land Office hould be charged with the responsibility of the whole subject, and any rules or regulations of ny kind that may prove necessary, in addition o those enacted in a general law, should be put n operation only after receiving the approval of majority of the Commissioners above mentioned. The delegation of the law making power to any person or persons not responsible o the people, is not in accord with my views of propriety, and I think the existence of the unauthorized laws of the Board of Fire Underwriters, and those absurd ones of the Board of Electrical Control, and of the Consolidated Telegraph and Electrical Subway Company, only need be brought to the notice of your Honorable Committee to insure their speedy extinguishment so soon as the Legislature can adopt proper ones in their stead.

The State Electrical Engineer should select, subject to approval of the Governor and Senate, or of the Commissioners of the Land Office, as may be deemed best, such assistants as are necessary to make inspections at least once in each year, of the plant of every company doing an electric light or power business in the State, including their wires and cables, stations, dynamos, batteries, etc., and securing an observance of all the regulations pertaining thereto.

As the interests involved in these undertakings are already large, and may, in the near future, run into the hundreds of millions of dollars, the duties of such Engineers and Inspectors should be guarded in such a way as to insure absolutely impartial discharge without fear or favor.

Experts, if employed by the State, should be under the direction of executive officers, who are responsible to the people. Under the plan as outlined and advised, there seems no reasonable objection to the operation of Section 5, Chapter 716, Subway Act of 1887, as it should not be necessary to maintain three State Commissioners in New York City, at a large expense, to perform a service for which the city is properly responsible.

As to whether the supervision of the subways in New York City should be given to the Commissioners of the Sinking Fund in the City of New York, or to the Department of Public Works, is a matter for your consideration. In many cases it may promote harmony, so far as the pavements and street incumbrances are concerned, to have the Board of Public Works responsible.

I suggest the propriety of the State Engineer and Surveyor keeping a set of maps and books, showing the location of all poles and wires on public highways, the names of the owners thereof, and such detailed information as may be useful for record or statistical information.

Also that all new companies, desiring to construct lines, shall have such lines definitely located by the Commissioners of the Land Office, unless the lines are to be erected upon private property acquired by such companies, in which case permission must be had to cross highways and rivers, the route fully described, and all the rules of the deparment observed.

Referring to the control and inspection of steam boilers, the idea suggests itself that a joint arrangement might be profitably effected between the State Commissioners of Lands and the Secretary of the Treasury of the United States, whereby the services of the Supervising Inspectors of Steamboats could be secured to regulate the use of steam within the State, and thus obviate the expense of a duality of officers and officials. At present I believe railroad engineers require no certificate beyond that exacted by the employers, and I do not think railway locomotives and steam heating apparatus of cars have any inspection by public inspectors, the commercial instinct here prevails, and it is gratifying to say that wonderful immunity from accidents has been enjoyed.

I am of the belief that the system of boiler inspection in New York City is very defective. Inspectors depend on the commercial instinct of the makers, and on the word of the man in charge, feeling that self preservation on his part is a sufficient guarantee against the use of defective appliances.

I am unable at this moment to outline the laws and regulations that should be made to control the use of wires carrying dangerous currents. Certainly it is confessed that there are many such in every day use all over the country, and the danger is of such a character that it is not manifest to any of the senses of hearing, smell, taste, sight or feeling as a forewarning, and therefore the more carefully to be guarded.

The subject requires a little time for study and comparison of my ideas with those contained in the record of your investigation, and any error made should be on the side of safety.

If it is your desire, I will be happy to pursue the subject further as early as practicable, and make such suggestions of an electrical character as I think may prove of service to you.

Yours very respectfully,
F. W. Jones.

[Note.—For some reason chap. 512, Laws of 1879, excludes Kings County and the City of Brooklyn from the benefits of its provisions.—Ed. Electric Age.]

ELECTRICITY IN JAPAN.

Mr. S. N. Katogi, a Japanese electrician who was educated by Prof. W. E. Ayrton, at the Engineering College, in Tokio, Japan, and who for more than ten years was employed in the telegraph department of the government, during which time he had charge of everything pertaining to telegraphy, has been in Boston the past week. He came to this country last spring to investigate telephonic matters, and studied practically at the works of the Western Electric Co., in New York, and is now thoroughly acquainted with the telephone switch board and all its workings. He was the first man to introduce the telephone for practical work in his country. He makes a specialty of reading and writing on telephonic subjects for the daily and scientific papers in Japan, and some time ago he translated the book of T. D. Lockwood, Electrician for the American Bell Telephone Co., entitled "Practical Information for Telephonists," into the Japanese language, a copy of which he presented to Mr. Lockwood. Many young Japanese electricians have visited this country of late to study electrical matters, but few have done so in a practical manner, and Mr. Katogi feels proud of the fact that he was not ashamed to put on a pair of overalls and go into the workshop and learn his business thoroughly. He is paying great attention to matters pertaining to fire alarm, police signals, electric cars, printing telegraphs, and other electrical devices, with a view of adopting them in Japan. Under escort of Mr. Desmond, of the Municipal Signal Co., he was shown the working of the police signals at the various station houses. Mr. Katogi, in speaking of electrical matters in Japan, says that companies are not allowed to maintain a telegraph system, and that it is entirely a government enterprise. The Morse ink writer system is used throughout the country, the telephone being used of late in small stations. Many years ago sounders were used, but were abandoned and are not used at all now. The operators are nearly all males, who underwent a special course of instruction for more than a year. In small stations the wife of the operator is allowed as assistant clerk. The batteries used are of the square form of Daniels cell, and the lines are built of No. 8 galvanized iron wires. The poles, which are very straight, are made of a wood called "sugi," which resembles the pine of this country. The first telephone exchange in the country is about to be opened in Tokio. Private telephone lines have been in use for a long time, nearly all government offices, banks, and police stations, being connected in that manner. But, until now nothing in the way of an exchange has been attempted. The lines are built of hard drawn copper wire manufactured in that country from their own copper ore. The telephone, like the telegraph, is also a government enterprise. Nearly all cities and towns are lighted by electricity, the Thomson-Houston, Brush, Westinghouse and Edison systems being used. In many places gas has never been introduced, so there is a good chance for the introduction of electricity. The fire alarm is being tried in Tokio, but is not yet complete. This system is especially necessary in Tokio as the houses are all built of wood and it is frequently visited by large fires. The electric cars are as yet an experiment to be tried, a car with the Sprague system being shown at an exhibition now holding in Tokio. There are a number of manufactories in Tokio at which all kinds of electrical apparatus are made by Japanese mechanics. Mr. Katogi is to return to his country in about one month and will no doubt be successful in introducing a large number of the electrical devices he has seen while here.

Electric Lighting of a Russian Palace.—The Russian Imperial "House Ministry" last month resolved to light all the buildings at Zarskoe-Selo, belonging to the Department of the Imperial Palaces, by electricity, and on April 5th, the machines and apparatus for the erection of a central station were ordered to be supplied by the machinery works of M. Podobedoff at St. Petersburg. The central station will, in the first place, be constructed with a capacity of 50,000 watts, and is to serve for lighting the palace, some outbuildings, and the hospital. For this purpose an alternating current machine of the type A_5, with an exciter dynamo of Ganz's type A_1 will be set up. The main primary lead will be carried to a distance of two kilometers as an aerial conductor of 6 mm. in diameter, and from it the leads to the various buildings will branch off at eleven places, for which three transformers of 7,500 watts each, four of 3,750 each, and four of 1,875 each, will come into use and convert the primary current of 2,000 volts into a secondary current of 110 volts. A second alternating current machine will be procured as a reserve, and ultimately the electric light will be extended by means of a third machine to the entire imperial domain Zarskoe-Selo. The order for this installation of transformers was given in consequence of the very satisfactory results which the Imperial Court Inspectors had obtained after a year's experimental working at St. Petersburg.

Municipal Lighting in Massachusetts.—In response to a request from the Massachusetts House of Representatives made a few days since, as to the manufacture and sale of gas and electric light by cities and towns, the supreme court of that state has sent in an opinion overruling that of the attorney-general who decided that municipalities could not furnish such light. The court says: We have no doubt that if the furnishing of gas and electricity for illuminating purposes is a public service the performance of this service can be delegated by the legislature to cities and towns for the benefit of themselves and their inhabitants, and that such cities and towns can be authorized to impose taxes for this purpose upon the inhabitants and to establish reasonable rates which the inhabitants who use gas and electricity may be compelled to pay. The fundamental question is whether the manufacture and distribution of gas or electricity to be used by cities and towns for illuminating purposes is a public service, and it is decided in the affirmative.

Barcelona.—Messrs. Siemens and Halske have applied for permission to erect a central station in Barcelona.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED JUNE 3, 1890.

429,107. Electro-Magnetic Locomotive. Richard N. Allen, Cleveland, Ohio. Filed Jan. 24, 1890.

429,109. Apparatus for Rectifying Electric Currents. Frank Anderson, Peekskill, N. Y. Filed Nov. 20, 1889.

429,113. Trolley Carrier. Benjamin F. Brown, Boston, Mass. Filed March 14, 1890.

429,115. Printing-Telegraph. John Burry, Boston, Mass., assignor of one-half to Aloys Wirsching, New York, N. Y. Filed July 25, 1889.

429,129. Magneto-Telephone. Noel B. Ginochio, New York, N. Y., assignor of one half to Elias M. Green, same place. Filed Aug. 6, 1889.

429,133. Fuse-Box. Carl E. Kammeyer, Eau Claire, Wis. Filed April 1, 1890.

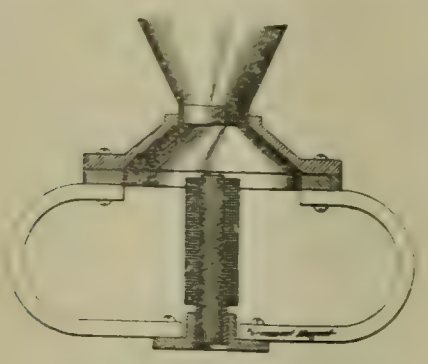
429,172. Portable Electric Lamp. John H. Irwin, Morton, Pa. Filed June 30, 1881.

429,199. Electric Railway System. William D. MacQuesten, New York, N. Y. Filed Sept. 28, 1889.

429,233. Multiple Telegraphy. Edward N. Dickerson, Jr., New York, N. Y., assignor to the Westen Union Telegraph Company, same place. Filed May 22, 1877.

429,251. Cover for Electric Subways. John Stafford, New York, N. Y. Filed Mar. 19, 1890.

429,272. Electrode for Secondary Batteries. Carl Hering, Philadelphia, Pa. Filed Feb. 11, 1889.



NO. 429,129.—MAGNETO TELEPHONE.

429,273. Secondary Battery. Carl Hering, Philadelphia, Pa. Filed May 24, 1889.

429,274. Electrode for Secondary Batteries. Carl Hering, Philadelphia, Pa. Filed May 24, 1889. Renewed Apr. 18, 1890.

429,277. Electric Tramway and Car. Alexander L. Lineff, Chiswick, County of Middlesex, England. Filed Mar. 6, 1890.

429,286. Apparatus for Detecting Leaks in Pipes. William W. Rosenfield, Brooklyn, assignor to Anthony Rosenfield, New York, N. Y. Filed Sept. 4, 1886.

429,304. Electric Conductor. Henry B. Cobb, Wilmington, Del., assignor to the Cobb Vulcanite Wire Company, of Delaware. Filed Nov. 8, 1889.

429,305. Electric Conductor. Henry B. Cobb, Wilmington, Del., assignor to the Cobb Vulcanite Wire Company, of Delaware. Filed Nov. 8, 1889.

429,306. Joint for Electric Conductors. Henry B. Cobb, Wilmington, Del., assignor to the Cobb Vulcanite Wire Company, of Delaware. Filed Nov. 8, 1889.

429,307. Underground Conduit for Electric Wires. Henry B. Cobb, Wilmington, Del., assignor to the Cobb Vulcanite Wire Company, of Delaware. Filed Nov. 8, 1889.

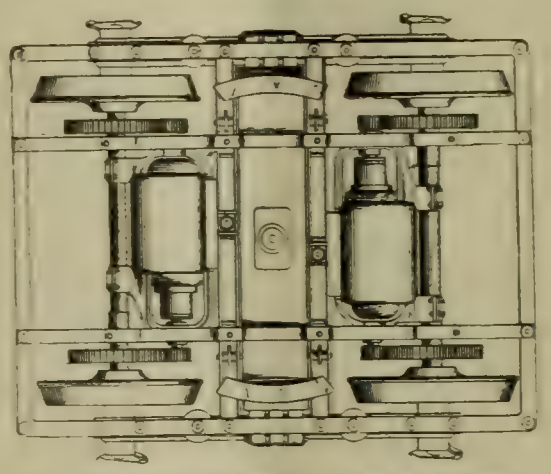
429,314. Continuously Operated Electric Motor. William D. MacQuesten, New York, N. Y., assignor to Charles L. Edgar, trustee, Boston, Mass. Filed July 8, 1889.

429,315. Insulator for Electric Railways. William D. MacQuesten, New York, N. Y., assignor to Charles L. Edgar, trustee, Boston, Mass. Filed July 15, 1889.

429,316. Tension-Bracket for Trolley-Wires. William D. MacQuesten, New York, N. Y., assignor to Charles L. Edgar, trustee, Boston, Mass. Filed Oct. 9, 1889.

429,318. Electric Fire Alarm and Extinguishing Apparatus. Charles E. Ongley, Yonkers, assignor to himself and Thomas W. Robertson, New York, N. Y. Filed Dec. 27, 1889.

429,327. Electric-Railway Motor. Frank J. Sprague, New York, N. Y., assignor to the Sprague Electric Railway and Motor Company, same place. Filed Oct. 31, 1889.



NO. 429,327.—ELECTRIC RAILWAY MOTOR.

429,330. Electric Call and Voting Apparatus. Turney M. Wilkins, Miller, S. D., and Axel. H. Reed, Glencoe, Minn. Filed Jan. 16, 1890.

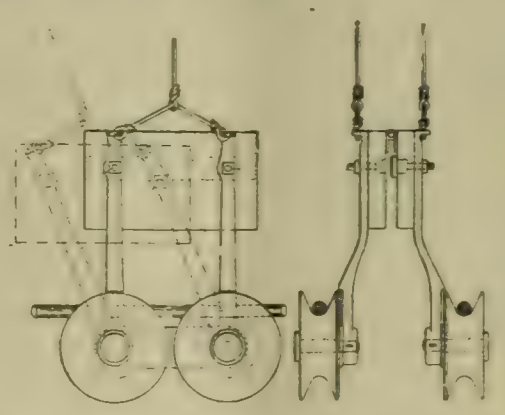
429,333. Process of Maintaining a Uniform Current in Electric Circuits. Julien M. Bradford, Portland, Me. Filed Sept. 22, 1888.

429,377. Telegraphy. Shirley M. English, New Orleans, La., assignor of one-half to Alexander F. Wark, same place. Filed Feb. 4, 1890.

429,386. Process of Separating Metallic Impurities from Graphite. Myron W. Parrish, Detroit, Mich., assignor to the Graphite Electric Company, same place, and John Hutchinson, Jackson, Mich. Filed Dec. 2, 1889.

429,396. Electrical Clock-Winding Mechanism. Charles A. Ward, Waterbury, Conn. Filed Aug. 26, 1889.

429,413. Trolley for Electric Railways. Warren S. Blauvelt, Asbury Park, N. J., assignor to the Sea-Shore Electric Railway Company, same place. Filed Oct. 9, 1889.



NO. 429,413.—TROLLEY FOR ELECTRIC RAILWAYS.

429,447. Medical Battery. Franklin P. Hoeneman, William A. Hoeneman, New York, N. Y. Filed Nov. 18, 1889.

429,483. Electric Railway Signaling Apparatus. Chas. H. Rudd, Evanston, Ill., assignor of one half to James W. White, James Clarence White, and Henry M. Lewis, trustees, Philadelphia, Pa. Filed March 24, 1890.

429,490. Field-Magnet for Dynamos. Edmund Wagemann, Little Rock, Ark., assignor of six-sevenths to John D. Adams, Dean Adams, Oscar Davis, John W. Davis, Horace G. Allis, and John B. Jones, all of same place. Filed Sept. 16, 1889.

429,534. Manufacture of Carbon Filaments. Achill s de Khotinsky, Gelnhausen, Prussia, Germany. Filed Feb. 3, 1890.

429,535. Manufacture of Carbon Filaments. Achilles de Khotinsky, Gelnhausen, Prussia, Germany. Filed Feb. 3, 1890.

429,559. Electric-Heating Apparatus. Charles E. Carpenter, Minneapolis, Minn., assignor by direct and mesne assignments, to the Carpenter-Nevens Electro-Heating Company, same place. Filed Dec. 17, 1889.

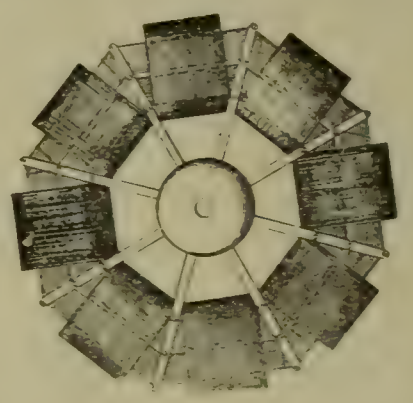
429,560. Electric-Heating Apparatus. Charles E. Carpenter, Minneapolis, Minn., assignor by direct and mesne assignments, to the Carpenter-Nevens Electro-Heating Company, same place. Filed Dec. 17, 1889.

429,561. Electric Soldering-Iron. Charles E. Carpenter, Minneapolis, Minn., assignor, by direct and mesne assignments, to the Carpenter-Nevens Electro-Heating Company, same place. Filed March 18, 1890.

429,562. Method of Electric Heating. Chas. E. Carpenter, Minneapolis, Minn., assignor, by direct and mesne assignments, to the Carpenter-Nevens Electro-Heating Company, same place. Filed March 18, 1890.

429,573. Electric-Arc Lamp. Chauncy F. Keller, Lima, Ohio, assignor of one-half to Frank Buchanan, same place. Filed Jan. 11, 1890.

429,576. Printing-Telegraph. Andrew T. McCoy, Boston, Mass., assignor to John Anderson, New York, N. Y. Filed Oct. 17, 1887.



NO. 429,583.—ELECTRICAL CONVERTER.

429,577. Printing-Telegraph. Andrew T. McCoy, Boston, Mass., assignor to John Anderson, New York, N. Y. Filed Oct 17, 1887.

429,582. Electric Railway-Signal. Homer A. Parrish, Jackson, assignor to the Parrish Electric Track Signal Company, Detroit, Mich. Filed Feb. 19, 1890.

429,583. Electrical Converter. Gustav Pfannkuche, Cleveland, Ohio. Filed Sept. 28, 1889.

429,584. Fuse Box. Nathan S. Possons, Cleveland, Ohio, assignor to the Brush Electric Company, same place. Filed May 22, 1889.

THE ELECTROMOTOR ELECTRICAL WORKS.—At the Heaton Works of Messrs. C. A. Parsons & Co., the whole of the machinery has now for some time past been run by an electromotor, the current for which is obtained from dynamo machines and engines that are running for test purposes, and the exhaust steam of which is employed to heat the shops. The economy of this arrangement is obvious.—*London Electrician.*

THE TELEPHONE IN MELBOURNE.—The Australian papers state that shortly direct telephone communication will be established between the headquarters of the Melbourne and Suburban Fire Brigades' Association and every suburb.

ELECTRIC LIGHTING ACTIVITY IN LONDON.—The Highways Committee of the London Council report that there are applications for the laying of mains in no less than 152 streets, all west of the law courts.

ANSWERS TO INQUIRIES.

Editor ELECTRIC AGE: Will you please state, rough your valuable paper, what is the cause light in an electric lamp, and oblige
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Answer: Whenever resistance to electric ac-on, or in other words, to the free passage of e electric current is interposed in a circuit, eat is developed at that point. If the current large enough light will be produced. Heat always precedes light. Electric resistance, or friction, is analogous to mechanical friction. Heat is developed in either case, and the greater the friction the greater the heat, and finally, light will be produced.—Ed. ELECTRIC AGE.

D. W. M. asks what is the meaning of "magnetic lag?"

Answer: It means the inability of a magnet core to instantly lose or acquire magnetism: it is magnetic inertia.—Ed. ELECTRIC AGE.

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SPECIAL NOTICE.

VOL. VII and VIII,

PROCEEDINGS OF THE

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Held at Niagara Falls and Kansas City,

Will be published in July (in book form, cloth bound). It has been decided to accept a few pages of appropriate advertising. This matter has been placed in charge of the

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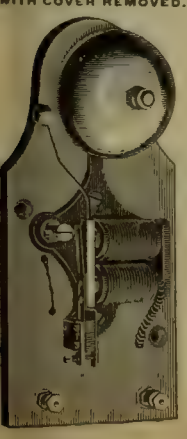
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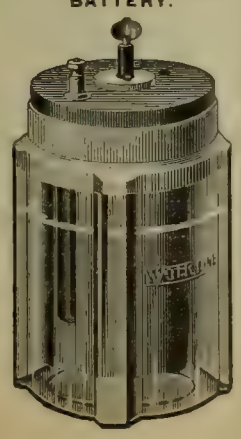
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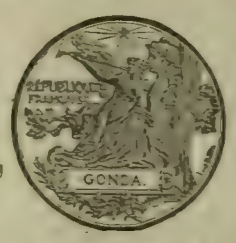
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NEW YORK, JUNE 21, 1890.

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THE PHONOGRAPH.

Recently a latest improved phonograph was placed in the office of this paper, and it is doing very good service in the way of lightening the burdens of clerical work. It is unquestionably a very valuable instrument for the use of business men, as it will save a vast amount of valuable time to the user. It will find its greatest use, of course, among those who have large correspondence, or a great deal of writing to do. It is always ready to receive any matter that requires dictation, and the typewriter can copy from it at any time. It will readily be understood how convenient this is to a business man.

We find the use of the phonograph largely extending among business houses. One firm of brokers down town are using no less than five. The possibilities of the phonograph as a means of intercommunication of knowledge have been discussed in every newspaper. One of the great features in the use of the machine is that the business man can have a phonograph at his home. In the evening he can dictate his correspondence into it at home, and in the morning carry the cylinders to his place of business. There the typewriter can transcribe the correspondence.

This is just one instance of how the phonograph can be used to save much time. Many others will readily suggest themselves.

Mr. Milton F. Adams is a special agent of the phonograph company, and he is the right kind of a man to acquaint business men with its value. The phonograph is a practical thing for business men, and we predict that before very long they will be as common in business houses as telephones now are.

Not only is it valuable for the uses outlined above, but there is another field in which it promises to play an important part. It is destined to become an important adjunct of the telephone, and it will be possible, no doubt before very long, to connect the phonograph with the telephone, and receive a record of the conversation on the wax cylinder. The value of such an arrangement to a business man could not be estimated, and the two great inventions harnessed together are going to perform wonders that were never dreamed of.

Storms.—Sergeant Dunn, the signal service officer in this city, on June 9, told the members of the Academy of Sciences in Hamilton Hall, Columbia College, in a lecture, why our climate is changing. In his opinion the switching off of storms from the vicinity of New York is due to the irrigation of the Western lands. "All storms," says Sergeant Dunn, "like electric currents, follow a path of the least atmospheric resistance. An increase of moisture offers extra attraction." This simple statement will enable many to obtain a better understanding of the apparent freaks of storms. It is a well-known fact that storms do follow a water course, and this accounts for their branching off when they seem to be coming or going straight ahead in our path. This fact is frequently illustrated in our own observation. Frequently storms have come from the east and as soon as they strike the waters of New York Bay they seem to either divide or turn off and follow the water. It not infrequently happens that Staten Island will receive a drenching rain and sometimes a severe storm, while in New York City not a drop of rain will fall, nor are there any other atmospheric disturbances. It was in such a storm as this that Commodore Garner and his wife lost their lives a few years ago by the capsizing of their yacht, the "Mohawk," which was caught in a squall off Staten Island. This storm was seen from New York but not felt in the least. Sergeant Dunn is quite an expert at weather guessing which is about the most uncertain kind of guess work known to man. There is a vast amount to learn yet about storms—their origin, probable violence, etc., and it is safe to say that if we could have more such men as the Sergeant we would know a great deal more about atmospheric disturbances.

National Electric Light Association.—Mr. Allan V. Garratt, Secretary and Treasurer of the National Electric Light Association, has sent out two circulars to members in reference to matters connected with the next convention of this association. Two classes of questions are asked in the circulars:

1. Are you willing to furnish a paper for the August Convention, to be held at Cape May? If so, on what subject?

What subject would you suggest for the committee to endeavor to secure a paper on?

Who would you suggest as most desirable to furnish a paper on the above subject?

2. Are you operating electric light or power through underground conductors?

Are you willing to furnish this Association information about same? (Names to be kept private, if so desired.)

Papers must be in the hands of the Committees on Papers and Underground Conduits and Conductors by July 3d next.

Mr. J. E. Lockwood, 21 Rowland street, Detroit, Mich., is the chairman of both committees, to whom replies to the questions should be sent in order to save time.

The Interior Conduit and Insulation Company.—We print elsewhere in this issue an interesting article concerning the above named company. As is already well-known this company manufactures tubing or conduits for electric wires, of material that is at once insulating, heat resisting and waterproof. There can be no question that a building wired through this tubing is as safely protected against all dangers attending the use of large electric currents as it is possible to make it. It is a fact that it is an absolute impossibility to fire a building designedly or accidently when the wires are run through these tubes. The inventors indeed struck a happy thought when they conceived this conduit system of wiring, and insurance companies will appreciate its valuable features. Last February its value was practically demonstrated in this city before a body of fire underwriters from Boston, Philadelphia and other places. The impression then made was very favorable. Very many of the modern buildings are conduited by this system, and they are safe for all time against fire from abnormal currents. The time is coming when electricity will be used as much as gas for domestic lighting, as well as for street and store lighting and the various other purposes. To secure complete immunity from fire, it is quite necessary to avail of the protection afforded by the use of conduits of this class. The conducting wires may fuse within the tube, or become red hot, but the danger that might otherwise result, is in this case wholly confined to the interior of the tubing and cannot in any possible way be communicated to the building itself. The ease with which wires can be withdrawn from the tubes and re-run is another great feature of the system. The system is based on common sense principles, and on account of its simplicity it would be very natural to ask why it had not been thought of before. But the reply to that is, it was invented when there was need for it. Necessity was the mother of this invention, as in all others.

Convention of Railroad Telegraph Superintendents.—An important Convention of Railroad Telegraph Superintendents began on Wednesday last, June 18th, at Niagara Falls. A full report of the proceedings will be published in our next issue. Railroad telegraph superintendents are wide-awake gentlemen and are always on the lookout for anything new and valuable in their line. The roads they represent are not slow in taking hold of any electrical or mechanical invention that has merit. There are many mechanical problems in railroad operations to be solved, and managers generally look to electrical engineers for the solution of these difficulties. The simplification of the movement of trains is one of these, and it is by the knowledge and experience of the telegraph superintendents that the value of these inventions is passed upon. Everything new, that has real merit, should be brought to their attention.

Welding Machines.—It is generally supposed that when the government orders a thing it is after that thing has been tested and found to meet all requirements. The Thomson electric welding machines come within this category. The Thomson-Houston Electric Company of Lynn, Mass., have just closed contracts with the government for welding machines for the New York and Norfolk navy yards. The Pennsylvania Railroad has also closed a contract for such a machine for their West Philadelphia shops. It is only a matter of time when electric welding machines will be found in every well-regulated foundry and iron working establishment.

Works Shut Down.—The Graphophone Works at Colt's factory, Bridgeport, Ct., are now entirely shut down. This is due to the recent purchase by the Edison Phonograph Company. The machinery is being taken out, and will be divided among the different factories of the Edison Phonograph Works. Of the seventy men who were employed, some have found situations at Colt's, others at Pratt & Whitney's, the Hartford Machine Screw Company and other places.

Water-Power.—The Falls of Montmorency, nine miles below Quebec, supplies the power to drive Thomson-Houston arc dynamos and alternating current incandescent machines used in lighting the city.

Belting.—At a recent meeting of belting manufacturers held in Chicago, it was decided to increase the price of belting. The new list will go into effect July 1st next.

THE GAYNOR FIRE ALARM SIGNAL SYSTEM.

The larger a community grows the greater becomes the necessity for adequate protection against the ravages of fire. Much thought has been given to this subject, and various methods of accomplishing the desired end, have been the result. Fires cannot be prevented in any community, no matter how careful the inhabitants are. This being so, it simply remains for us to devise means to extinguish fires as quickly as possible, to prevent loss of property, and, perchance, loss of life. The Fire Department found in most all small places and in all large places is maintained for this purpose, and one of the great adjuncts of a fire department is the telegraph.

The sending of fire alarms by telegraph is one of the most valuable uses electricity was ever put to. Many systems have been devised to accomplish this result in as reliable and simple manner as possible. One of the most reliable and efficient of these is the Gaynor Fire Alarm Signal System, represented by the Gaynor Electric Company, of Louisville, Ky.

A fire alarm system, to be efficient, must be rapid, accurate and reliable. The Gaynor system possesses all of these meritorious points, and it is claimed for it that it is the most perfect system produced.

The signal box used in this system is a model of its kind, and possesses a very valuable feature. The act of inserting the key into the door to unlock it causes the alarm to be sent in. This, it will be easily understood, frequently saves a great deal of valuable time, particularly if the person who is undertaking to send in the alarm is unfamiliar with the operation of the system, and performs his task with a good deal of hesitation for fear he is not doing the thing right.

Figure 1 shows the internal mechanism of the box. Instantly the detent lever, shown just below the round movement case, is pressed downward, the whole mechanism is set in operation, the bell is automatically cut into circuit, ringing its box number, that the person giving the alarm may know that it is properly acting, the circuit wheel revolves and thereby transmits the number of the box four times in rapid succession, the Spring Tension Indicator turns, showing another alarm has been sent in from that box, the detent lever resets itself, and in doing so shunts the bell. Thus the box is again ready for its work. The train runs rapidly, consuming but little time in accurately transmitting to the department the box number. An efficient lightning arrester is provided which protects the mechanism against damage from lightning.



PIG. 1.—GAYNOR FIRE ALARM SIGNAL SYSTEM—INTERIOR VIEW OF SIGNAL BOX.

Fig. 2 shows the register, on which the signals are received. The number of the box from which the signal comes is registered on the tape. The register can be connected to one, two, three or four circuits, and will properly record the box numbers even if two or more alarms are sent in simultaneously.

Fig. 3 illustrates the combined gong and indicator. Double blows and missed strokes are evils ordinarily met with, but this instrument is perfectly reliable in this respect, and has a larger range of action. It will sound equally reliably fast or slow signals.

(*To be continued*).

AUTOMATIC WIRE CALCULATOR.

One of the most important problems engrossing the every day attention of the practical wireman is the proportioning of the size of the wire necessary to be used both in the interior of buildings and outside, to carry safely and economically the amount of current requisite for a given number of incandescent lamps.

Most of the wire houses have issued a chart of some character to help the wire-man in this difficult part of his vocation, but the charts for the most part are large and cumbersome, cannot readily be handled, and fail to fill completely the wants in this direction.

In order to meet the demand for an Automatic Wire Calculator, one that can be readily carried in a small space in the pocket, handled quickly, and conveniently in most any position, and one which will make an infallible calculation, The E. S. Greeley & Company of New York have issued such a device, which consists of two discs of stiff cardboard of unequal size, the smaller one being mounted in the centre of the larger and made to revolve thereon. On the back of the larger cardboard are full directions for the use of this unique and useful tool. The one shown in the accompanying illustrations is arranged for the calculation of wire for a current of 110 volts, and we understand that there is also another one in preparation arranged for 55 volts.

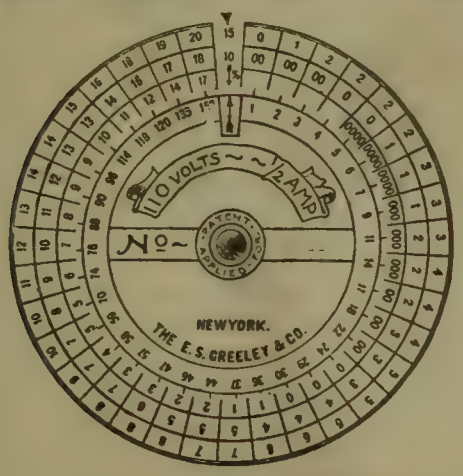


FIG. I. NORMAL POSITION.

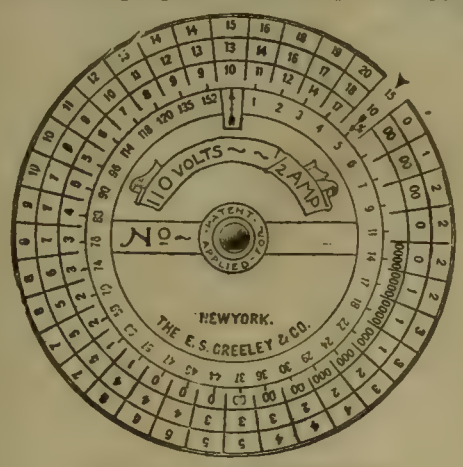


FIG. 2. CALCULATION MADE.

The process of calculation is shown in the illustrations, figure 1 showing the two discs in their normal position, and figure 2 showing the calculation determining the size of wire suitable for use to carry a current 5,000 lamp feet. The lamp feet are obtained by multiplying the foot distance by the number of lamps; that is, 50 lamps at 100 feet, or 10 lamps at 500 feet, or 500 lamps at 10 feet, when multiplied one with the other give 5,000 lamp feet. It is then only necessary to turn the inside dial until the figure five on the scale of the inside disc comes opposite the arrow which is upon the outside disc, which operation is shown in figure two of our illustrations. When this has been done the arrow upon the inside disc will point to the size of wire which it is desirable to use and which in the accompanying illustration is shown to be No. 10 for a 5 per cent. drop, No. 13 for a 10 per cent. drop, and No. 14 for a 15 per cent. drop.

We do not see how this ready and accurate calculator can fail to be of the greatest use to the practical wire man.

THE DIAMOND (K) COMBINATION SWITCH AND FUSE BOX.

This instrument is specially adapted for alternating systems, cutting out the converters from the primaries for the purpose of fusing or making repairs, also secondary circuits for tests or other purposes.

As will be seen by the cuts, this device is

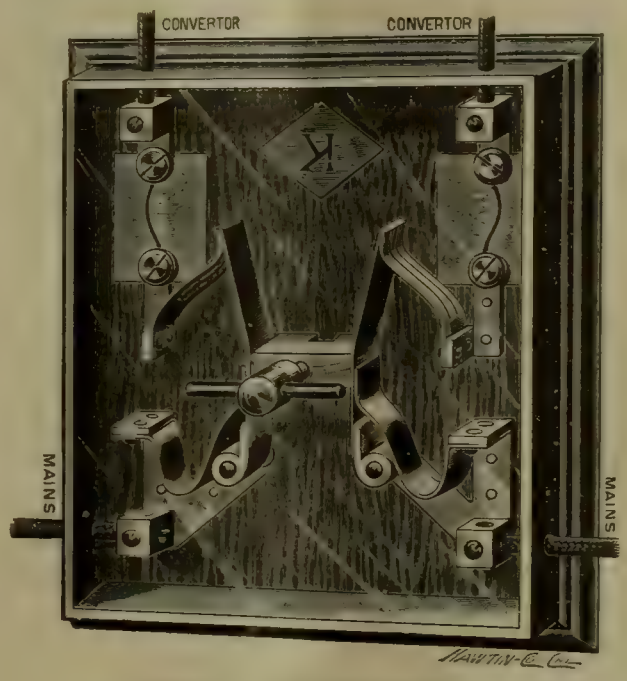


FIG. 1. CONVERTER CUT IN.

double pole, and the springs so arranged and quick in their action that it is impossible to get a spark between the contact points when cutting in or out a converter.

The fusing attachments are located below the lower contacts of the switch, and when the switch is thrown off removes all danger to fusing primary circuits, especially in bad weather, and where the converters are located outside or in bad places, as this device is placed between the converter and the main circuits.

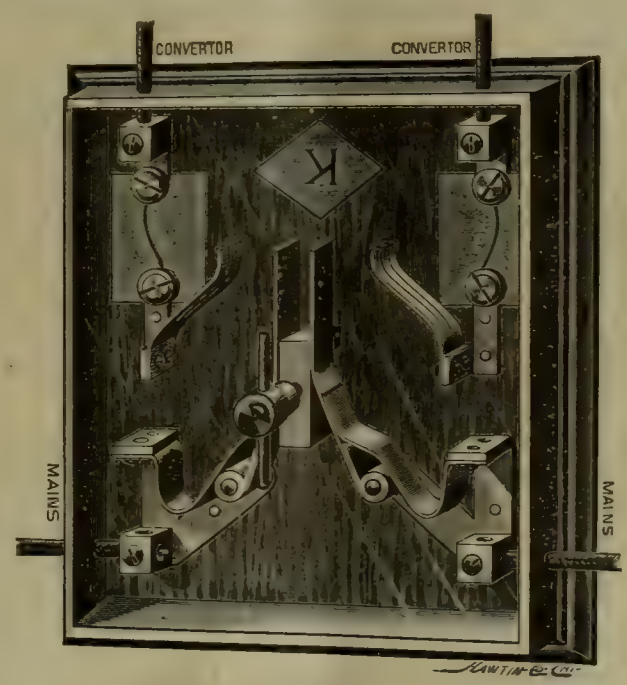


FIG. 2. CONVERTER CUT OUT.

The same style of switch is made in different sizes, so that it can be applied to all kinds of electrical work. For outside work the converter switch is placed in a water-tight iron box, and the key so arranged that it can be removed if necessary. Another feature is that this device can be operated right or left, and the sliding contact points prevent any accumulation of dirt.

The Knapp Electrical Works of Chicago have arranged to handle this device.

GAS EXPLOSION—SUBWAYS RUINED.

About half past two on the morning of June 12th an explosion of gas took place at the corner of Broadway and Fulton street, doing considerable damage to the subways at that point, and to the street itself. For a week or so prior to that time workmen had been engaged in making some repairs to the steam heating pipes, and for that purpose had dug a trench in which they could carry on their work, and which was boarded over so as to not interfere with the street traffic. During their work a gas main sprang a leak and filled the subway manholes on the northeast and northwest corners of Broadway and Fulton street with gas. A workman then accidentally upset a lamp and ignited the escaping gas. Instantly there was an explosion, ruining completely both manholes and causing a pillar of flame to shoot several feet in the air. The trench belched forth flame all day and it was not until evening that the fire was extinguished. The fire burned all the electric wires in the nearest manhole, and in the other the force of the explosion wrecked everything. Cables, paving stones and brick formed a jumbled-up mass at the bottom. The subway on the east side of Broadway contained electric light wires all of which were burned. The west side subway contained telephone and telegraph wires. These were not burned at all but were damaged by the debris.

Owing to the intense heat travel on Broadway and Fulton street at their intersection was suspended a good part of the day. Wagons were turned into the lateral streets which are not wide enough for their normal traffic, and with the addition of the Broadway tide a great deal of confusion and delay ensued. It was fortunate that the upheaval occurred at an hour when few people are on the streets. Had it occurred during the day time there is no telling what damage would have been done. The corner nearest to the spot where this accident occurred is the busiest spot in America. More people pass this point in a given time than at any other spot in the country.

THE UNITED EDISON MANUFACTURING CO.—The United Edison Manufacturing Co. has just issued a pamphlet illustrating the Edison Electric Light System. The company sent to many concerns operating Edison light plants throughout the country a series of questions bearing on the efficiency of the same. The replies as well as the questions are all given in this pamphlet, all of which constitute data invaluable to electric light operators. The replies indicate that general satisfaction is being derived in the use of the Edison System. The system in general is fully described and illustrated, and much valuable information is given. Apart from the value of its contents, the pamphlet is truly a work of art and is one of the handsomest typographical productions we have ever seen.

NEW CATALOGUE.—We have received the new illustrated catalogue of Day's Kerite wires and cables, for which concern Mr. George B. Prescott, jr., is general agent. The catalogue is full of interesting information and tables concerning copper and iron wire. Several of the tables are new, and great pains have evidently been taken in getting up the catalogue. It is profusely illustrated, and will be of much use and value to the electrical trade and profession generally.

C. & C. MOTOR IN CHURCHES.—The C. & C. Electric Motor Company of this city have just issued a pamphlet describing and illustrating the application of their motors to church organ work. The electric motor gives greater satisfaction in pumping organ blowers than any other power that was ever used, and this pamphlet, of artistic design, tells all about how this work is done in some of the prominent churches in this city.

STANDARD SPECIFICATIONS FOR ELECTRIC LIGHTING.

The following are the Standard Specifications of the United Edison Manufacturing Company for Electrical Plants. From the fact that they are the result of long experience, they will be of much value to everyone interested in electric lighting.

Dynamos.—The dynamo must be of such type and must be so connected as to operate with the highest economy, either separately or in multiple arc (in case there be more than one dynamo), and so that in such case the load may be shifted from one machine to another up to the limit of its full load without in any way affecting the candle power of the lamps. The dynamo must be capable of being operated for ten hours continuously under conditions of full rated load without injurious heating of any part of the dynamo and without sparking. The dynamo must be of such design that the increase in power required to operate it from least load to full load shall be proportional to the number of lamps in operation. The dynamos must have a commercial efficiency under full load of not less than eighty-five per cent. in dynamo, requiring three (3) horse power in belt, and of not less than ninety-two per cent. in dynamo, requiring one hundred (100) horse power, and dynamos of intermediate size shall have an efficiency proportional to the efficiencies quoted. The commercial efficiency of the dynamo under conditions of one-quarter load shall not vary more than eight per cent. from that at full load. Each dynamo must be provided with a belt tightener, so that the tension of the belt may be altered at will while machine is in operation. The armature of the dynamo shall be perfectly balanced, so as to run at its rated speed without appreciable jar. There shall be at least two brushes on each side of the commutator. The insulation resistance between the armature and field coils and the base of the machine must be at least 200,000 ohms. Each dynamo must be placed on a solid wooden base, and must be thoroughly insulated electrically. When operated continuously for three hours under conditions of full load, the temperature of no insulated wire or other electrical portion of the dynamo shall rise in temperature more than eighty degrees C. above the temperature of the surrounding air. All dynamos shall be provided with self oiling bearings which, under normal conditions, shall not require attention, except when the dynamo is started.

Instruments.—Each dynamo must be provided with an amperé meter in circuit with it, which shall show continuously the current said dynamo is producing. These amperé meters must be constant, unaffected by any normal change in temperature and unaffected in their readings by being placed at a distance of six feet or more from the dynamo. The amperé meters must be accurate within three per cent.

A pressure indicator shall be furnished for each dynamo or set of dynamos operating in multiple arc. This pressure indicator must be connected so as to indicate directly and continuously the electrical pressure at the point to which it is connected. It must be constant in its readings, unaffected by normal changes of temperature, unaffected in its readings by magnetic influence at a distance of ten feet from a dynamo, and must be so constructed that a variation of one volt will cause a deflection of the pointer upon the scale readily noticeable at a distance of ten feet from the indicator.

A ground detector shall be provided which will indicate continuously the condition of each pole of the system as regards insulation to ground.

Incandescent Lamps.—Lamps furnished must be guaranteed to have an average life of six hundred (600) hours and a corresponding economy of fifteen (15) lamps to the electrical horse power. All lamps shall be of such uniformity when new that when operated at the voltage for which they are intended, both the power required and the candle power of the lamp shall be within ten (10) per cent. of the rating. All lamps which give out from any fault within the first ten hours of the operation of the plant, shall be replaced by others without charge. All breakage of lamps beyond this, under normal operation of the plant, shall be considered under the guarantee as to average life. Lamps shall be furnished varying in candle power from sixteen (16) to one hundred (100), there being at least three (3) different candle powers between sixteen (16) and one hundred (100). Lamps of different candle power shall require power in proportion to their candle power.

Pole Line.—The pole line shall be composed of straight, select, shaved poles. All poles must be set perpendicularly, and must be thoroughly guyed, whenever necessary, to insure this result. They must be set one-sixth of their length below the surface of the ground. All poles must measure, at least, five inches in diameter at top, and where more than one cross-arm is required, they must measure not less than six inches in diameter. They must be housed and gained. All cross-arms shall be thoroughly seasoned and free from knots, and painted. All cross-arms must be secured to poles in substantial manner, so that they shall be at right angles with line of pole and parallel with each other, and accurately fitted into gains. All poles where cutouts are placed shall be stepped. The poles shall not under any circumstances be set further apart than one hundred and fifty (150) feet, and in heavy line work they shall not be set more than one hundred (100) feet apart.

Overhead Conductors.—The overhead conductors shall be of bare copper in systems using less than five hundred (500) volts. The pressure lines and service lines shall be insulated by weather-proof insulation. Whenever the conductors are likely to make contact with other materials than the insulators or poles (except leaves) the conductors shall be properly insulated therefrom. No overhead wire having a span of over ten feet shall be run in closer proximity to any other wire than ten (10) inches. All joints shall be made in substantial manner, so that no movement of the two ends relative to each other is possible, and so that the joint is as strong as the wire itself and makes thorough contact. All joints must be soldered, all overhead conductors exposed to influence of atmospheric electricity shall be protected therefrom by suitable lightning arresters.

In all cases where other wires are run above the conductors under consideration, a guard wire must be run to protect the latter from contact with the former.

Wiring and Wiring Devices.—For convenience in reference the wiring will be treated under two heads, the supply wires and the distributing wires.

No distributing circuit shall carry more than five (5) ampères. The distributing circuit shall lead from the distributing cut-outs, which shall be grouped together in cut out cabinets at various distributing points in the building. Any doors, locks, hinges, etc., if desired for these distributing cut-outs, shall not be furnished by this contractor, but the cut-out cabinet shall be prepared ready for them by the contractor. The maximum loss in any distributing circuit not to exceed two (2) per cent. The cut-outs at each distributing point to be supplied by mains, which mains shall be so proportioned that under any conditions of normal load there shall not be a variation of pressure throughout the mains to exceed two (2) per cent. The connection to the distributing cut-outs from the mains shall be made through double pole fusible cut-outs of proper dimensions. In case current be supplied to the mains through feeders, there shall be fusible cut-outs placed at the points where the feeders join the mains, such cut-outs being placed both at the terminal of the feeder and upon the main immediately on both sides of the feeding point. All lines leaving the dynamo rooms shall be protected by fusible cut-outs, and in addition thereto any wire leaving dynamo room and carrying a current of more than five (5) ampères shall have switch in circuit with it. In all moulded or concealed wiring where the insulation of the wire makes contact with material other than special insulating material designed for the purpose, a wire of following makes, or equally as good grade and acceptable to the purchaser, shall be used: Edison Machine Works, Grade 3, Habirshaw, Okonite, Grimshaw, Kerite, Clark Safety Insulator. In the case of cleated work, where the wire will never, under normal conditions, be exposed to any moisture, an insulation of the quality known as weather-proof can be used, such as the following or their equivalent: Edison Machine Works, Grade 1, P. & B., K. K., Roebling's Weather-proof, Ansonia Brass and Bronze Co.'s Weather proof. In all work in connection with the wiring, the wire must invariably be handled so that if the wire were bare the insulation would be the highest possible under the conditions. In other words, the insulation must not be relied upon any more than is absolutely necessary. No wire smaller than No. 18 Birmingham Wire Gauge, or No. 16, Brown & Sharp's Gauge, shall be used. In all cases the ampère capacity of the conducting wires must be carefully determined, and the size of the wires so proportioned that the maximum current carried by them under normal conditions shall not occasion a rise in temperature exceeding sixty (60) degrees Fahrenheit. The wiring must be done in such a manner that in case a different system be used from that originally contemplated, there will be the least possible expense involved in changing the wiring to adapt it to any other system. All joints must be made in substantial manner, so that no movement of the two ends relative to each other is possible, and so that the cross-section of contact is at least twice the cross-section of the conductor. All joints, except when surfaces are held into contact by strong pressure, such as by screws, shall be well soldered and well taped. In all cases where the wire is concealed from view the joints shall be thoroughly covered with some first-class water proof compound before being taped. All wires that pass through floors or that rest against any metal work shall be protected by a tubing of hard rubber extending at least one inch in each direction beyond such floor or metal work. With all safety devices open, the insulation of any single section of the wiring shall be not less than 100,000 ohms. The combined insulation resistance, when all sections are connected up for service, shall be the highest obtainable when each section measures 100,000 ohms. Metallic staples for fastening wires shall not be used unless there be placed between the insulation of the wire and the staple some insulating and non-combustible material. Electric light fixtures or gas fixtures carrying electric light wires, if attached to gas pipes, must be insulated therefrom by insulating joint or other suitable means, so that there shall be a high electrical resistance between such electric light wiring, such fixtures and the system of gas pipes. The wiring must be so proportioned that the maximum variation of electrical pressure at the lamps in different parts of the building under any normal conditions shall not exceed two (2) per cent. All wiring must be neat in its mechanical appearance and arrangement. All points in regard to wiring not above specified shall conform strictly to the requirements of the National Board of Fire Underwriters. All cut-outs shall be made of insulating and non-combustible material, such as porcelain, glass, etc., and shall be double poled. All switches shall be mounted upon insulating and non-combustible bases, and if covered, shall be so designed that the switch is merely set by hand ready for the break in contact, and the actual breaking of contact shall be done automatically and beyond hand control. The act of making and breaking contact in all switches shall cause the surfaces in contact to be subjected to sliding friction in order to keep such surfaces of contact clean. All sockets shall be of same dimensions relative to the base of the lamp, so that any Standard Edison lamp of any candle power will fit any socket. The socket shall be of substantial workmanlike construction, and all portions of the shell and key shall be thoroughly insulated

THE INTERIOR CONDUIT AND INSULATION COMPANY.

The prospectus of this company, just issued, contains much valuable and interesting information.

The Interior Conduit and Insulation Company incorporated under the laws of the State of New York, Manufacturing Act of 1848. Organized for the purpose of introducing as a new article of manufacture an insulated conduit or tube and auxiliary devices constituting a new and complete system of insulating and installing electric conducting wires in buildings and mines, on railways and marine craft, in underground conduits, and in all other locations in which wires are employed for the purpose of distributing electricity; and for any and all other purposes for which such tubes may be applicable.

This company is the owner of Letters Patent of the United States, covering fundamentally and in detail:

A. Methods and devices useful in protecting electrical wires by means of a cheap insulating, waterproof and heat resisting pipe or tube.

B. A special twin conductor employing a new principle effective of safety in electrical distribution.

C. Methods of distribution of interior circuits now universally accepted as the best practice in electric wiring for securing economy and uniformity of candle power.

D. Methods of treating porous or fibrous materials to render them water and fireproof, and to give them high insulating properties.

E. Methods of securing freedom from moisture, gases and other deleterious elements in underground conduits.

Other patents further protecting the company's new methods are being acquired from time to time as improvements are developed.

In the work of developing the comparatively new but already extensive electrical industry, first importance has been given to economical considerations. The generating machines have attained a degree of efficiency which places them in the very front rank of economical apparatus. The art of distribution has become so familiar as to be recognized as one of the exact sciences. The details of regulation, measurement and convenient location of wires, switches, lamps, etc., have all received extraordinary attention and attained a high degree of excellence. In consequence of the progress thus made the public is to-day enabled to secure electric light at approximately the price of gas. It can obtain electrical power at a cost which, in many cases, is less than that of steam or other motive power. The successful application of electricity to street railway propulsion has been so phenomenal as to attract the attention of the industrial world, and the application to mining machinery, now being inaugurated, promises even quicker and more universal acceptance. It will be readily surmised that in distributing the hundreds of thousands of horse-power of electric energy requisite to perform all this work, the aggregate mileage of interior conducting wires employed must assume enormous proportions, and that in consequence the superficial area of inflammable property traversed by them must represent a risk area so great as to justify the expectation of daily recorded fires of more or less magnitude. That this anticipation is, as a matter of fact, not realized; and that electricity really originates so few destructive fires, is, in view of the newness of the industry and the necessarily imperfect training of the labor at command, but evidence that electricity possesses an extraordinary high factor of safety, far higher in fact than any other force with which we are familiar. To appreciate this we have only to imagine the results that would follow an equally sudden and vast expansion of the industry of steam or gas distribution at a like initial stage and with a like paucity of skilled labor. The peculiar property possessed by electricity which thus undoubtedly minimizes the chances of serious results is its celerity of action. Time is a requisite to ignition in the case of a great majority of inflammable materials; electrical action resulting from derangement is generally so instantaneous as to practically eliminate time, hence ignition becomes the exception rather than the rule. Were it otherwise the record of disastrous fires would be much augmented. Nevertheless, there are conditions of derangement under which the electrical action will afford this element of time, which may in fact permit of a prolonged presence of the consequent heat; when these conditions prevail, serious consequences generally ensue, to which fact is due that suspicion and prejudice which is the sole barrier to the general adoption of electricity to all purposes to which it is applicable. If all electrical action were made instantaneous and the comparatively innocent effects of such action were localized where they could be safeguarded, this prejudice would at once disappear, and the industrial world would recognize their command of an absolutely safe force equal to their every requirement. To the end that we may demonstrate intelligently that this is not only feasible, but that it is an accomplished fact, we will review the art of insulation and compare the past practice with the new method.

Prior to the inauguration of what may be termed the new electric era, electricity was used almost solely for the purpose of transmitting intelligence; the telegraph, the telephone, the fire-alarm, the various signaling systems and kindred applications are examples of such use. In these industries the insulation of the wires has but one function, viz: That of maintaining an effective service. If the insulation fails, the service fails; no other untoward result follows for the reason that the currents employed are so weak as to be incapable of developing any considerable degree of heat. With the inauguration of the new era involving new applications, as for example, electric lighting, electric motive power, and kindred uses, employing electricity under high pressure and in vast quantity, there was imposed upon insulation an additional duty, viz: that of protecting life and property. If herein the insulation fails, not only does the service fail, but life and property are at once seriously jeopardized. That this risk is not an imaginary one is abundantly attested by the numerous recorded accidents which have occurred during the past two or three years. That the remedy for these occurrences is not to be found in an improvement in the quality of insulation is equally well attested by the fact that, in spite of all the manifold so called "perfected insulations," accidents continue to occur. *As a matter of fact, the one branch of electrical science which has not advanced in line with the new demands is this safeguarding of property from contact with the always-possible abnormal heat in the wires.* It has been assumed by some, that inasmuch as electricity was inherently safer than other mediums of lighting, the element of danger was practically absent, and by others that the danger could be sufficiently avoided by improvement in the *quality* of the insulation, hence the evolution of a host of "improved insulations;" many of which doubtless possess great virtue, but unfortunately they all follow one principle, viz.: *That of affixing the insulation to, or drawing it upon the wire itself.* This is the fatal error. The logic of all the relating facts in the art is against such practice. Modern electrical service is nothing more or less than a service for the distribution of *heat.* True, economical considerations demand, and physical laws permit, that the conductors conveying this heat shall be so arranged and so proportioned as to remain cool, and therefore safe while doing the calculated duty demanded of them. But the proportions and conditions thus pre-arranged and determined to secure safety are peculiarly liable to accidental derangement, thereby imposing a duty for which they were not calculated; in this event the conditions of safety are gone, and heat is at once developed in such proportion and in such place as the extent and the nature of the derangement may determine. It is apparent, therefore, that any system of insulation which aims to secure absolute protection must take cognizance of, and provide against, the effect of this always possible development of heat. Experience has demonstrated that the practice of affixing the insulation to the wires does not do this. All insulations which can be so affixed are of necessity compounded of oils, gums, or other flexible and adhesive materials, all of which are readily affected by heat. Vain efforts have been made to find a new elementary material or to compound known materials which shall have the multifold property of high insulation, great resistance to heat, extreme flexibility and proof against acids, gas, etc. The great value to the art of an insulation possessing these naturally diverse qualities has been of late years so keenly appreciated as to concentrate the inventive mind on the line of its pursuit to the exclusion of any consideration of other methods of protecting the wires. This is the only explanation of the failure of the inventors to evolve a natural and effective solution of the problem. Necessity has been well said to be "The Mother of Invention," and it was by virtue of the necessities of himself and the numerous friends who depended upon him for advice in such matters that Mr. Edward H. Johnson was led to suggest the total abandonment of the old practice, and the substitution therefor of an enclosure tube, separate from, but forming a channel for conducting wires, continuous throughout their every ramification, thus fully protecting every inch of wire and rendering it accessible for periodic inspection or renewal, and by the same means *absolutely confining within the safe limits of a non-inflammable channel* the possible heat development.

The practical efficiency of such a method scarcely needs to be supported by argument or demonstration. Its very simplicity appeals at once and alike to the intelligence of the expert and the layman.

The elimination of the element of *extreme flexibility* as an essential requisite of insulation simplifies the problem, and permits of the employment of a variety of materials not at all available in the practice of affixing the insulation to the wires. Thus the door is opened and the inventor now comes forward to provide the requisite perfection of detail. In this respect the industry is extremely fortunate in the chance which has brought to its aid Mr. Edwin T. Greenfield, a man of wider experience in the old method, and therefore more keenly appreciative of its weakness, than any man in this or any other country; to the thoroughness with which Mr. Greenfield has done and is doing his work is due the already high perfection of the new method and the guarantee that it will at once afford superlatively the elements of safety, economy, durability and convenience.

In further pursuance of the conditions of safety, Mr. Johnson has incorporated with the new system a special conductor upon which he has been at work for some years, the function of which is to convert conditions favorable to a prolonged heat presence into conditions of instantaneous action hereinbefore described as a factor of safety.

This conductor is so constructed as to convert all defects which may develop in the wires, such, for illustration, as a break, a leak, an imperfect union or other faults common to all systems of energy distribution, into that one defect or fault which is peculiar to electrical distribution and which is technically known as a "short circuit." This is a fault which develops instantaneously an abnormal concentration of energy and in consequence effects the immediate destruction of the weakest link in the chain which supports the current. Much has been said and written of the device known as the "safety fuse" and rules and regulations enforcing its use are universal. It is introduced as a link in every electrical chain and is designedly

made the weakest link therein—hence a "short circuit" simply means the destruction or giving way of this link, thus insuring by the breaking of the chain the total and absolute cessation of the electric current previously supported thereby. This weak link is, of course, located within safe pockets where the somewhat violent results of its disruption are smothered or otherwise rendered abortive.

Contrary, however, to popular belief, this device does not provide absolute protection. Its failure to do so arises from the fact that it is only affected by an *overloading* of the chain.

It is, of course, apparent that a partial break, an imperfect union or a leakage of the current may develop a sufficient degree of heat to effect the ignition of inflammable materials, and yet not sufficiently increase the current strength to overload and fuse the safety link.

The object of the special conductor herein alluded to is to convert with absolute certainty *all defects*, whether a break, a leak or other fault into a "short circuit" and the consequent overloading and fusing of the safety link.

The effect of a "short circuit" is generally apparent at the point of its occurrence in the form of an instantaneous flash, hereinbefore alluded to as ineffective of much damage because of its brief duration

It is possible, however, to have present conditions of extreme inflammability, as for instance gases, inflammable powder, as in a flour mill, lace or other delicate fabrics, or even the insulation of the wires themselves.

It therefore becomes a matter of considerable importance to safely localize even this flash, and it is obvious that the inclosing tube does this to perfection, in that every inch of the wire is completely encased within the safe confines of its fireproof interior.

The Interior Conduit and Insulation Company now enters the field with this new method of insulation, and claims that it is able to effect, not partially and imperfectly, but completely and absolutely that safety which is the one essential to the general adoption of electricity. That this claim is not unsupported is attested by the endorsement the system has already received by architects, electricians, fire underwriters, municipal and other authorities interested in the matter of safeguarding property, and the extraordinary rapidity with which it has been accepted by the public.

In finding a solution of the problem of insulating and protecting wires for interior use, the equally vexed problem of protecting and insulating wires underground has also been solved, demonstrating that the problem of electrical distribution, whether Interior, Aerial or Underground, is one and the same, and may all be comprehended in two words, viz.: *Insulation* and *Accessibility*. The high insulation, low cost, great durability and flexible character of the company's safety tubes, suggested at once their fitness for forming ducts for underground conduits, whereupon a special size and weight of tube was made and at the same time a system of laying and sealing them so as to completely exclude moisture, gases, etc., was thoroughly worked out. The system thus devised has met with high approval and prompt acceptance, and is being rapidly introduced throughout the country. It is confidently believed that the insulation of the tube itself, combined with the means employed to prevent access of moisture and gases, will sufficiently protect the conductors to enable the customary insulation employed on underground cables to be entirely dispensed with. This belief is so strong that large installations are now being made in which the wires are entirely devoid of insulation, other than that afforded by the tube itself. Whether this practice will be found generally satisfactory or not, it is certain that a comparatively light insulation will suffice, and that the costly and cumbersome insulations and lead sheathing heretofore employed will henceforth be wholly unnecessary. The great evil of condensation so destructive of all wire insulations, and which is at its maximun in metal conduits, is scarcely a factor in these insulating tubes. It is certainly reduced to a minimun, and is thus within the easy reach of the corrective means which are employed in conjunction with the system. The provision for protecting the conduits from moisture and gases, also prevents the accumulation of gases in the manholes, and consequently avoids the dangers of explosion which attend other systems. The absence of metal sheathing of any kind is an important advantage, as in all systems of electrical distribution which are partly aerial and partly underground, lightning is apt to reach the underground from the the aerial wires, and is almost certain to pierce the insulation to get at the metal sheathing, for which it has a great affinity.

As the length of cable section which may be drawn into the ducts, and the consequent frequency of manholes in any conduit, is determined by the weight and size of the cables to be drawn in, it becomes a matter of considerable importance to eliminate from the cable all material other than the copper itself, thereby permitting less frequent manholes with a conductor of a given capacity, or the use of conductors of greater capacity with a like number of manholes than is possible with cables employing thick insulations and heavy metalic sheathing.

Furthermore, if a cable consists only of copper, its withdrawal and substitution by a larger one, does not result in its consignment to "Scrap" as in the case of insulated cables. It is in fact just as valuable then as it was originally and may be at once employed in lighter service elsewhere; a fact which materially heightens the economic value of the Insulated Conduits.

A feature of considerable value is the facility with which a conduit may be given individual ducts of various sizes, thus offering greater accommodations for single conductors and small cables than is possible in conduits in which ducts of uniform sizes only are employed.

It is not too much to expect in view of these manifold advantages that the present quick hold the system has taken upon the trade will become a permanent firm grasp upon the entire conduit industry.

It is apparent that a cheap and indestructible tube such as this company manufactures, may be used for many purposes not at all connected with the electric industry. As a matter of fact many such avenues for the disposition of the company's manufactures are already opening, and in some instances promise a market equal to that offered by the underground electrical work.

The entire system and details have been and are being protected by Letters Patent, which secure to the company practical immunity from competition. It is not intended, however, to exploit the business in reliance upon patents, but to establish it upon a sound commercial basis, recognizing the force and value of competition precisely as if the patents did not exist. It is the intention of the company to supply the trade at large upon equal terms and solely upon a manufacturing basis, not handicapping the business with royalty charges or excessive profits. The demand is large, and it is intended to supply it at a price which, while netting the stockholders fair profits, will insure satisfaction to its customers and minimize the incentive to infringe the company's patents.

To accommodate the rapid growth already achieved, new and enlarged factory facilities have been provided, and the company thereby becomes equipped to promptly and satisfactorily supply the future, as well as the already considerable demand.

The officers of the company are:

President,	Edward H. Johnson.
Vice-President,	Sigmund Bergmann.
Secretary and Treasurer,	W. A. Willard.
Comptroller,	John H. McClement.
Electrician,	Edwin T. Greenfield.
General Counsel,	Eaton & Lewis.

MINE LIGHTING.

In the present mining methods, not only is there great lack of ability to make good use of advantages presented by the existence in the vicinity of natural resources of energy, but there are introduced in mining operations many agencies of danger and loss that can be, and should be avoided.

As it is assumed that most mines are equipped with a surplus of boiler power, the cost of installing an electric light plant is considerably reduced and the cost of attendance should not practically be taken into consideration, as the engineer in charge would be fully able to take care of the plant without any further assistance.

The ancient method of lighting mines which in spite of the great care exercised is fraught with danger, is exemplified by the frightful accidents both to life and property that occur with startling frequency throughout the mines, not only in this country, but those of foreign lands. Even in non gaseous mines the heat and smoke generated by the use of naked lights causes a vitiated atmosphere which tells a tale in the life of the miner, sowing the seeds of consumption, which soon carries him off to an early grave. Any one who has lived in a mining town knows this full well. The use of electricity removes these evils, rendering the lighting devoid of danger, and without vitiation of the atmosphere. By the use of steam or compressed air-pipes, that are required for the various engines for pumping and hoisting operations, the air is made foul and the timbering of the gangways is soon rotted. The copper conductor conveying the energy for all these varied uses can be laid in any direction or angle required at an outlay of time, trouble and expense greatly less than by the use of steam and compressed air.

The Edison Company have given considerable attention to this particular class of electric lighting and has spared no pains in preparing and designing fittings most suitable. A point of considerable interest to mine owners is the now feasible method of using arc lamps on the same incandescent circuit so that the interior of the pit or mine is illuminated with incandescent lamps of 16 c. p. whilst the pit mouth, the coal shoots, and screens, are provided with arc lamps of 1,200 to 2,000 c. p. giving a brilliant lighting over a large space. The arc lamps on an incandescent circuit are absolutely harmless to life, a fact which miners will greatly appreciate; they burn steadily and with a soft bright light.

Many of the largest mines in England and Belgium are now lighted entirely by electricity even in those that are termed "firery" the undertaking has met with complete success and no accident has so far been reported.

As is well known, incandescent lamps are incompetent to cause explosions because the filament is destroyed immediately the glass is broken.

Edison Exhibits at the Railroad Telegraph Superintendents' Convention.—The Edison-Lalande Battery will be on exhibition at the Railroad Telegraph Superintendent's Convention at Niagara Falls this week. The Edison Manufacturing Company, who make this battery, will be represented by A. O. Tate and James F. Kelly. Mr. W. S. Logue will represent the Edison Phonoplex Company, and incidently will do all he can to push the Edison-Lalande Battery, which has had so much to do with the success of the Phonoplex system. Mr. A. O. Tate, electrician of the Edison Manufacturing Co., strongly advocates the use of the Edison Phonoplex system of telegraphy for dispatchers in the movement of trains; for should the regular Morse wires become useless from any cause whatever, the phonoplex system can always be relied upon. Mr. Tate will be on hand to explain his system in detail to the superintendents who are now unfamiliar with its functions. The system is now in successful and regular operation on the Pennsylvania, Baltimore and Ohio, Erie, and other railways.

ELECTRICAL SAFETY COMPANY,
SOLE MANUFACTURERS OF THE
Cartwright Electrical Protectors and Safety Devices.
The only Safety Device that can be used on fire alarm and other metallic circuits. Approved by the Boston Fire Underwriters' Union and the New England Insurance Exchange.
Room 21.——146 FRANKLIN STREET.——Boston, Mass.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
ROOM 10, COOK BUILDING,

BOSTON, June 13, 1890.

The Manet Street Railway Company have een given leave by the selectmen of Quincy to ange the location of their tracks.

The Shelton, Conn.. gas company has decided remove the electric light plant to Birmingham. new and powerful dynamo will be added.

The Waltham Electric Clock Co., located at atick, Mass., and having a capital stock of 10,000, has applied for a license to do busi- ss in the State of New Hampshire and paid the quired fees for the privilege.

The American Bell Telephone Company have eclared a regular quarterly dividend of three per ent. and an extra of six per cent., nine per cent. all, payable July 15th. to stock of July 1st; e books will reopen on July 16.

During the thunder shower last Friday night iss Steele, the telephone operator at New Brit- in, Conn., received a severe shock by which he was rendered unconscious for a time, and e ill effects of which she felt all day Saturday.

E. P. Shaw of Newburyport was in Haverhill st Monday in the interest of an electric street ilroad from North Andover to Haverhill, by ay of Bradford. The amount of stock already bscribed makes the building of the road a robable success.

The electric light company, at Holyoke, will ll for plans and specifications for their new ation as soon as representatives of the com- any have looked over model plants in some of e large cities. Such a tour will be made the iddle of next month.

The syndicate which has recently purchased e Merrimac Valley Horse Railway contem- lates, in connection with the electric road from orth Andover, the purchase of the Haverhill, raveland and West Newbury Street Railway lant, thereby gaining a line to the sea.

The Union Street Railway Co. of New Bed- rd is making necessary repairs previous to perating cars by electricity. No poles have een set as yet. The work of laying the ground ires between the rails is progressing. Five ew box cars, fitted with motors, have arrived.

At the annual meeting of the Southwestern elegraph & Telephone Company the above offi- ers were elected, with the exception of Mr. IcKinstry, and in addition John E. Hudson and en. Thomas Sherwin as directors, they repre- enting the interests of the American Bell Tele- hone Company.

The electric road between Whitman and Broc- n is given up for a time, and nothing will be one in carrying out the plans this year. The ouble lies mainly in the slowness of the select- en in granting a franchise. The road will robably be finished some time next spring in rder to start up for the summer travel.

The Essick Printing Telegraph Company, on hursday of last week conducted a test between eir Boston and Washington office, dropping a essage in New York on the way. The instru- ent worked perfectly despite the fact that a evere thunder shower was in progress at the me. Several prominent officers were present t the Washington end and expressed themselves s very much pleased with its workings.

The annual meeting of the stockholders of the Erie Telegraph & Telephone Company was held in New York, June 9th, President Levi Sprague in the chair. A ballot for directors resulted in the election of the old board. The directors organized by the choice of Levi Sprague, president; Charles J. Glidden, secretary and treasurer; J. P. McKinstry, general manager.

The Thomson Electric Welding Company have just made contracts with the Roeblings, of Trenton, N. J., to supply seven welding machines in addition to those already there. Also with the United States Government to install welding plants at the navy yards, at New York and Norfolk, Va., and with the Pennsylvania R. R. Co., for a large welding plant at the company's works in West Philadelphia.

The foundation for the new electric light station in Concord, N. H., has been started. The building will be of brick, one story in height, the main part 68 x 90 feet, with engine-room in L. A chimney, 100 feet high, will be erected. The power will be supplied by two new steel boilers and one additional engine will be put in besides several new dynamos. The work will be pushed rapidly, and it is expected to have the plant ready for occupancy by Sept. 15.

At an adjourned meeting of the Beverly and Danvers electric road, held in Beverly, it was voted to ask the railroad commissioners for permission to increase their capital stock $13,000, making a total of $25,000. The directors were instructed to petition the Selectmen of Danvers for permission to connect with and run over the tracks of the Naumkeag Street Railroad from Danversport to the plains. The directors were authorized to lease the road if they thought expedient.

Prof. Elihu Thomson has just patented a guard wire protection and lightning arrester for electric railways. The guard wire runs just a few inches above the trolley wire, and if a telephone wire falls upon it it is kept from the trolley wire, and if it happens to touch the trolley wire the current will burn it through. The guard wire is also connected with a device in the side posts by a branch to the earth which will carry off a static discharge without its coming in contact with the trolley wire.

Mayor Barker of Providence has vetoed the resolution providing for contract with the Narragansett Electric Lighting Company for building of electric subways, basing his objections upon the form of the resolution and upon the absence of certain provisions which appears to him to be necessary. The directors of the lighting company presented a letter to the mayor defending their action from the charge of improper or corrupt influence imputed to them in securing the legislation. The veto was sustained in Common Council by a vote of 36 to 0 with four members absent.

The justices of the supreme judicial court have sent a communication to the House of Representatives, expressing their desire to be excused from giving an opinion on the order adopted May 27th, as to whether cities and towns have the right under existing laws to manufacture gas or electric light for use in the public streets and buildings or for sale to the citizens of such cities and towns. In making this request the court believes the occasion has not arisen contemplated by the constitution, in which its opinion may probably be recognized, since the question proposed affects only the construction of existing statutes which the legislature can amend or appeal as it sees fit.

Major J. C. Paul, late general manager of the Woodruff Sleeping Car Company and Supt. of Equipment of Pullman Car Company, has been appointed Vice-President of the American Steel Car Company of Boston and will have the general charge of the sales department with his office at 115 Broadway, New York. Mr. A. W. Field, late with the Thomson-Houston Electric Co. Railway Department and formerly general agent for the Frank H. Andrews Car Wheel Co., has also connected himself with this company and will give his personal attention to the sale of wheels for street railway service.

The Municipal Signal Company, of Boston, has been awarded the contract for equipping the precinct of Georgetown, Washington, D. C., with its patrol system. Almost a year ago the commissioners advertised for proposals, the specifications being prepared by the Electrician of the District. It was found that the specifications were so drawn as to exclude all systems save the Gamewell, the one at present in use. The commissioners, however, decided to allow other companies to bid, and, accordingly, the Municipal Company submitted a bid. These bids were rejected, and proposals again invited. The Gamewell Company put in a bid for $3,750, the Municipal for $3,600. After an investigation by Captain Russell, assistant to the engineer commissioner, as to the relative merits of the two systems, the contract was awarded to the Municipal Company.

The long expected transfer of the plant and franchises of the Naumkeag Street Railway Company, of Salem, to the New York syndicate of ten persons, its new purchasers, was finally consummated in Boston, June 7th, between the president and directors of the Naumkeag Company and Benjamin Orne and R. T. McCabe, of New

PHILADELPHIA, Fifth Month, 20, 1890.

Our constantly increasing business has necessitated taking the large and commodious four-story building, No. 1030 Arch Street, with twelve thousand feet of floor space, where we shall keep a largely-increased stock of all materials for the needs of the professional and amateur photographer.

Our greatly-increased facilities will enable us to promptly fill orders for Permanent Photographic Enlargements by the use of the electric and solar lights. We make the printing of Silver, Bromide and Blue Prints from amateurs' negatives a specialty, and give careful attention to the development of the Kodak and other negatives.

Our house is one of the oldest established in the country (1858), with over thirty years' experience, which gives us the advantage in knowing just the needs of the profession. With enlarged facilities, long experience, and young blood, we shall continue to study the interests of those who have dealt with us for so many years. We also expect to see many new customers, who may be sure of prompt and fair dealing, thus making it to their interest to deal with us.

We also manufacture Blue Print Paper, and make blue prints from architects' and draughtsmen's tracings,

Respectfully,

THOS. H. McCOLLIN & CO.

Manufacturers, Importers and Dealers in Photographic Supplies.

York, representing the syndicate. The price paid was $125 per share, amounting, it is said, to $312,500. The Naumkeag system of street railways, covering lines from Salem to Peabody, Danvers Asylum, Beverly, Wenham, Asbury Grove, Beverly Cove and Fort Sewall, Marblehead, is stated to be the third largest and one of the most prosperous in the New England States, the stock having paid 8 per cent. dividends for years. The officers of the new company are: Benjamin Orne, of New York, President; Joseph F. Hickey, of Salem, Treasurer and General Manager, and John H. Bickford, Electrical Engineer. There will be a board of seven directors. The system is equipped with first-class rolling stock, and has 31¾ miles of track to be equipped for electric motive power, which will be furnished by the Sprague Electric Company. The large electric cars to seat 34 persons each in those of the box pattern will have 30 horse power motor trucks. There will be 35 of these cars, and each car will have sufficient power to pull an additional car, thus making the aggregate of motor cars and tenders 70. There will be 26,670 rail joints connected by wire to give the necessary "ground," and 363,627 feet of copper wire to be used for feeders for the trolleys. There will also be 37 miles of silicon and bronze wires for the trolleys. The tracks cross 18 steam railroad crossings, and there are 87 single track curves and seven double track curves. Upward of $100,000 will be expended for wires. The Willows branch will be equipped at once.

The Johnston Electric Train Signal Co. have purchased a valuable property in Woburn, Mass., which they will occupy and utilize immediately as a factory. The building is four stories in height, has a frontage of about 100 feet and is upward of 200 feet long. It is located near the railroad and its facilities are excellent. The company will set up its machinery at once and it is expected that a hundred mechanics will be at work within a month. The purpose of the concern is to manufacture not only the train signal but push buttons of all descriptions and several electric hardware appliances.

The American Life Insurance Company is defendant in a case which came before the Dauphin County (Penna.) Court, June 12th, on a petition from the Thomson-Houston Electric Company, of Connecticut, asking for leave to bring suit against the Macon City and Suburban Street Railway Company, of Georgia, to recover bonds amounting to $130,000, issued to and held by the American Life Insurance Company. Judge Simonton decreed that the Thomson-Houston company should have leave to bring suit in any court having jurisdiction in the case.

Superintendent E. W. Rice, Jr., of the Thomson-Houston Company, has just patented a new method of measuring electric currents, which is novel and interesting. He does it by heating two expansible rods, bars or pieces of solid material by the agency of an electric current flowing alternately in two circuits, automatically switching the current from one branch to another by the movement of the expansible bars as they alternately heat or cool, and registering or counting the number of movements of expansion and contraction.

At a meeting of the Ware business men held in Ware, last Thursday afternoon, the Ware Power and Improvement Co. was organized with a capital stock of $10,000. Over $6,000 is already taken. W. H. Hyde is treasurer; R. H. Loomis, secretary. E. H. Gilbert, Dr. W. W. Minor, and Andrew Boyson, directors. The object of the company is to furnish light and power for the town.

In the opinion of Corporation Counsel Richardson, the city council cannot by ordinance require electric cars running in the City of Boston to be provided with fenders, as the power to reach such a case had been given to the board of railroad commissioners by a legislative act passed at the present session.

At the Edison Electric Light Works, at Newport, R. I., a bed is being laid for a new boiler, which gives them a battery of five boilers. An additional engine is to be used in driving dynamos on a proposed long distance lighting circuit. The new street railway generators are ready for use as soon as the necessary belting arrives.

The Suburban Light and Power Company are taking out all the arc lamps that are on the alternating circuits and will replace them with regular arc lamps supplied with current from a Waterhouse machine.

Lightning burned out about 75 telephones, rendered the telegraph and fire alarms useless, and destroyed a good portion of the telephone switchboard in Salem last Thursday night.

At a stockholders meeting of the Duralite Manufacturing Company, held in their office at 85 Water street, last Wednesday, Mr L. F. Jordan was elected treasurer. W. J. P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, June 14, 1890.

NEW COMPANIES.—Adams Company, at Chicago, to purchase or control patents for, or construct electric and elevated railroads. Capital stock, $200,000; incorporators, J. W. Adams, G. W. Griggs, G. M. Harris.

Morton Electric Boot Blacking and Novelty Manufacturing Company, at Waukegan, Ill. Capital stock, $1,000; incorporators, F. G. Morton, H. F. Morton, J. F. Lindsay.

The Electric Transmitter Company, at Chicago; to manufacture electric transmitters. Capital stock, $1,000,000; incorporators, Wm. F. Sherman, Wm S. Brewster, Stephen P. Gardner.

Primary Battery Company, of East St. Louis, Ill. Capital stock, $500,000; incorporators, Frank Stillwell, W. M. Steele, E. A. Cheney.

American District Telegraph Company, of Minnesota, with principal office at Duluth, Minn. Capital stock, $50,000; incorporators, Henry C. Hope, Wm. H. S. Wright, James B. King, Samuel B. McConnell, and others.

The work of the Edison Electric Company, in Milwaukee, Wis., is being pushed rapidly. The system of distribution is entirely underground, and the conduits and mains are being laid throughout the east and west side. A canvass is being made of the south side with a view to laying mains there, also if there is a sufficient demand for the light. Work on the power house on River street will be commenced at once. The company say they will make this the model Edison electric light station.

MR. G. A. EDWARD KOHLER, Chicago, the western representative of the Eddy Electric Motor Company, reports excellent progress made in that company's interests in this city. An electrotyping machine of large capacity, sold to Yungblut & Co., 202 Clark st., for $550, is among sales reported this week.

MILWAUKEE, WIS.—The consolidation of the Milwaukee City with the Cream City street railway lines is reported to have taken place. The Edison-Villard combination, who are said to have had control for some time of the Milwaukee City railway, are reported to be behind the present deal.

THE A. H. BAKER WOOLEN CO., of Fairfield, Ill., are enlarging their factory, and will put in an electric light plant. They expect to furnish light to the city as well as light their own buildings.

MR. THOS. G. GRIER, of the National Engineering Bureau, Chicago, was initiated into Loyal Legion at the annual meeting of that Order, held at Kinsley's on June 12th.

THE SHEBOYGAN (WIS.) ELECTRIC LIGHTING CO. started their plant on the 6th with good results. The system consists of 100 Thomson-Houston arc lights and the lamps burn all night.

MR. M. E. BAIRD, general agent of the Eddy Electric Motor Company, was in the World's Fair city some days this week.

F. M. L.

NEW YORK NOTES.

IN TWO OR THREE WEEKS a novel exhibition of the working of the Long Distance Telephone will take place. A large steam yacht, belonging to a prominent business man of this city, is to be anchored off shore, and will be placed in communication with the shore by an electric cable which will contain two conductors. A long distance telephone is to be placed on board, and connected with the shore through the cable, and a party of invited guests on board will be entertained by Thomas's Orchestra, opera in New York and opera in Philadelphia all by telephone. The circuit will be metallic, and the ship end of the cable will be attached to a float, so that the connections will be readily accessible. The entertainment will certainly be unique, and we can imagine how the surroundings will greatly add to the effect of the music in the telephone.

IT IS GRATIFYING TO NOTE that the Mason primary battery is steadily going to the front. There is nothing to equal it for light power and lighting. Mr. Mason has recently brought out a small fan outfit which, operated by the Mason battery, gives a delightfully cool breeze. It is portable, and the whole outfit can be carried from room to room with very little inconvenience. There is hardly any excuse for not keeping cool indoors during the hot weather when such devices as this one can be obtained at low figures.

THE NEW YORK INSULATED WIRE COMPANY'S factory is taxed to its utmost capacity and is running night and day filling the immense number of orders on hand and we are informed that they have been compelled recently to refuse some very large orders. The demand for their wire is constantly increasing both in this country and abroad. A number of electric light companies are now adopting the competition line wire for all line services finding it to be the most durable and safest line to use.

MR. J. W. MARSH, Secretary of the Standard Underground Cable Company of Pittsburgh, Pa., has just received by election the additional title of Assistant General Manager. Mr. Marsh is well and favorably known among electrical people, particularly those in the electric cable business, and the news of his prosperity will be gratifying to his many friends.

THE SHAVER CORPORATION.—Prominent parties of Berlin Falls, N. H., have purchased the franchise for operating the Shaver Molecular Telephone within Coos County, N. H. The price received for the contract was at the rate of $41.0 per thousand inhabitants. An exchange of thirty subscribers has been ordered and will be put in operation this month.

The Morris Park race track has been fitted up with the Shaver Molecular Telephone; the same circuit is also utilized for registering the amount of water in the different tanks around the park.

R J. G.

IMPORTANT CONTRACT.—Contracts have been signed between the Brown Electric Protective Company, of New England, and the Gamewell Fire Alarm Telegraph Company, granting the latter company exclusive right for the use of the Brown Protector on all fire alarm and police signal boxes throughout the United States.

CAB LIGHTING.—Boston has a cab lighted by electricity.

A NEW STORAGE BATTERY.

The Carpenter Electric and Storage Company, of Denver, Col., are now manufacturing storage batteries that for capacity and durability are said to surpass any storage battery ever put before the public.

These cells consist of red lead and metallic lead, the former being enclosed within the latter, the dry red lead being packed around numerous steel rods projecting through the metal casing. The case or envelope is then sealed by burning the joints with a hydrogen flame; the steel rods are withdrawn and the result is a solid plate of dry red lead, encased with metallic lead and perforated with numerous small holes.

Heretofore storage batteries have been made by putting the active matter on the outside of the lead support, and herein lies one of the innovations and great points of superiority of the Carpenter battery over all others. The object sought by the inventor in encasing the red lead by its support, was to prevent the falling out of the active matter which so speedily diminishes the efficiency and life of all so-called pasted plates. The perforations in the Carpenter plate being uniform and numerous afford a greater surface for chemical action, and also makes each plate and cell almost identical in capacity and strength and therefore more reliable in action than any other form of cell now constructed. The short life, due to the active matter scaling from the support of the old pasted forms and their excess of dead weight over the necessary active matter, have rendered them less of a commercial success than they otherwise would have been. The Carpenter accumulator overcomes these two difficulties, and by actual demonstration brings the maximum of its active matter into use with the minimum weight necessary for efficient support. The limited space of time necessary to form and re-charge the Carpenter batteries is in marked contrast to most other batteries.

This type of cell will stand the strain and jarring that would cause any other type to collapse, and hence is adapted for all purposes of car traction and railway lighting, and will rapidly come into use for these important purposes so soon as the company begins their manufacture on a large scale, and the public becomes familiar with their merits. For the lighting of railway passenger cars, especially, the electric light must soon be adopted by all railroads, on account of its absolute safety, because the traveling public will demand it.

Some roads have tried other forms of storage batteries on their trains and have not found them sufficiently reliable to warrant their very general acceptance. Their life is only about twelve months, which makes their adoption a matter of much question, although they give a very good light. It seems that the jar of the cars causes a weakening of efficiency in about three months by the scaling off of the active matter, and from that time on new plates are constantly required to replace such as have become inefficient.

The Carpenter company are now successfully lighting a chair car in daily service between Denver and Chicago over the Union Pacific and Northwestern roads. The car is equipped with sixty cells and ten 16 candle power Perkins lamps. The battery cases and trays weigh 1,600 pounds and have sustained the lights for over sixty nights, lighting the car four nights on one charge, without a single hitch, and the returning car has always shown a considerable excess of light over the requirements for that length of service. There is not the slightest evidence of decay about these cells, but, on the contrary, they improve with use, and their construction renders scaling off an impossible thing, as would have been the case with pasted plates. Every fourth day, when on time, the car is switched to the works of the Carpenter Electric and Storage company, in the forenoon and in the afternoon is taken away equipped with sufficient light for the trip to Chicago and return, without any aid or attention except that it be turned off in the day time. Passengers and railway men are loud in their praises of the light furnished by the battery beneath this car which enables them to read with ease and comfort any print that they could see in daylight. For traction purposes the Carpenter company is perfecting a motor of its own which is believed to be superior to anything now in use, and specially designed for operation by the Carpenter Storage Battery, but it will be several months before public tests will be made.

THE HALIFAX-BERMUDAS CABLE.—The steamship "Westmeath," with the Halifax-Bermudas cable on board, left the Thames May 22nd. Capt. A. W. Stiffe will be in charge of the cable-laying operations, and it is expected that telegraphic communication between the two important naval stations of Halifax and Bermuda will be established within the next month or so. The total length of the cable is 874 knots, and its total weight is about 2,000 tons. The Halifax shore end weighs 9.4 tons to the mile. The Bermuda shore end, owing to the presence of coral reefs, has been made specially heavy, and weighs about 19 tons to the mile. The cable, which was manufactured for the Halifax and Bermudas Cable Company by W. T. Henley's Telegraph Works Company, was thoroughly tested before shipment by the Post Office authorites, who pronounced it satisfactory. Messrs. W. T. Henley's Telegraph Works Company, are just proceeding with the manufacture of another submarine telegraph cable, about 1,000 miles in length.

THE ELECTRIC LIGHT IN THE SUEZ CANAL.—In his last report to the Foreign Office the British Consul at Port Said gives the following interesting figures with regard to the application of the electric light to vessels navigating the Suez canal at night. In 1887, 395 steamers used the light; in 1888 the number rose to 1,611, and in 1889 a total of 2,445 vessels navigated the canal with its aid. The average time of transit has been reduced to 22½ hours. The shortest time taken by a steamer in passing through the canal in 1889 with the aid of the light was 14¾ hours.

THE ITALIAN EDISON COMPANY.—This company shows a net profit for 1889 of 205,463 lire (£5,125). The principal station at Milan had, at the close of the year, 565 arcs and 14,807 incandescents at work. This year additional plants are to be put down at Florence, Parma, and the Tarenti Arsenal; the negotiations for a station at Venice are pending. The company has also taken over the Risalto factory for making electric apparatus.

THE RENARD BATTERY AND AERIAL NAVIGATION.—According to *La Lumière Electrique* Commander Renard's light batteries are not likely to prove of much use for the purpose for which they were mainly designed, namely, aerial navigation. Our contemporary estimates that to maintain a moderately sized balloon in a stationary position for one hour against a breeze of average strength, one ton of Renard batteries would be required.

THE TELEPHONE IN GERMANY.—According to *Uhlands Wochenschrift* there were in Germany on October 1, 1889, no less than 179 towns with telephone exchanges. There were at the same date 39,876 telephones in use connected by 57,505 kilometres of wire; the average number of communications per diem being 581,839.

CLUB'S NEW HOME.—The Fort Wayne, Ind., Electric Club dedicated its new rooms, May 30. The entertainment consisted of music, addresses, etc. The officers of the Club are Chas. C. Miller, President; Harry McKinley, Vice-President; Eugene McLachlin, Secretary; Lewis Freyer, Treasurer.

THE PHONOGRAPH IN SOUTH AMERICA.—Frank Tracy, son of Secretary of the Navy, will shortly sail for South America, to represent, it is said, the Edison phonograph in various capitals. The phonograph people hope for great things as a result of his mission.

L'ELETTRICITA.—The editor of *l'Elettricità* has received a large number of replies in answer to the two questions recently propounded by him. There was a general consensus of opinion that Hertz's investigations were the most important of recent years, but opinions differed considerably as to what application of electricity would make the greatest progress during 1890.

MINUTES OF THE NATIONAL ELECTRIC LIGHT CONVENTION.—The proceedings of the recent conventions of the National Electric Light Association, held at Niagara Falls and Kansas City, will be published in book form early in July. They will comprise two volumes well printed and attractively bound in cloth. A limited portion of the books will be reserved for appropriate advertising, and those desiring representation should communicate at once with the Manufacturers Advertising Bureau & Press Agency, 111 Liberty street, New York, who, we are informed, have charge of this portion of the work.

ELECTRIC LIGHT AT CARLSBAD.—The municipal assembly of Carlsbad resolved recently to erect electrical works, adjacent to the water works, for lighting the town. The installation will have a capacity of 5,000 glow lamps of 16 candle power. Two proposals have been submitted to the municipality, the one by Siemens and Halske, of Berlin, and the other by Ganz & Co., both based upon the use of alternating current transformers. The latter offer was accepted. As a reason for the installation of the works, it is stated in the report of the council that Carlsbad, as a world-famed watering place, could not remain behind towns which have already introduced the electric light.

THE TELEPHONE'S EFFECT ON THE EAR.—A French aural surgeon has devoted considerable attention to the effect of the constant use of the telephone on the ear, and finds: First, that the constant use of the telephone seems to exert no bad effect upon sound ears, but that it is harmful for those which are already the subject of disease; 2d, that these affections consist especially of an impairment of hearing from fatigue of the auditory attention (buzzing, headache, vertigo, nervous excitability, and certain transient psychical disturbances); 3d, that these effects are often of brief duration and disappear as the auditory apparatus becomes accustomed to its work, and that in all cases they cease when telephone work is abandoned. His examinations were made on operators connected with the telephone central office.

DISCLAIMERS.—If a patentee makes a claim, which is not well founded, in the same patent with other claims which are well founded, he may disclaim, within a reasonable time, that which he had no right to claim, and then his patent will be as valid for the residue of its term as if it had originally issued only for valid claims.

If the patentee omits to disclaim and brings suit for violation of his patent, and it appears at the trial that he is entitled to protection in a portion of his claims (such as constitute a material part of his invention), but not in respect to another portion, he is entitled to damages for the violation of the valid portion of his claims, but he recovers no costs. If the jury are satisfied that there has been unreasonable negligence and delay on the part of the patentee in making a proper disclaimer as respects the invalid part of his patent, then the whole patent is inoperative.

"Unreasonable delay" in filing a disclaimer is a question of law for the court. The time, in reference to the delay, commences from the time when knowledge is brought home to the party that he is not the first inventor; or a court of competent jurisdiction has declared him not to be one.

If a patent has been previously assigned in part, and a disclaimer has been filed by the patentee alone, such disclaimer will not operate in favor of the assignee in any suit, either of law or equity, unless he has joined in it.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED JUNE 10TH.

429,596. Galvanic Battery. John Beattie, Jr., Fall River, Mass Filed Jan. 3, 1890.

429,599. Electric Annunciator. James D. Bishop, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb. 3, 1890.

429,608. Manufacture of Incandescent Electric Lamps. Richard N. Dyer, New York, N. Y. Filed June 5, 1884.

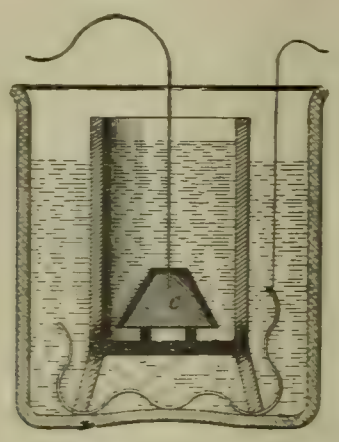
429,642. Lighting Device for Lamps. Lewis A. Roberts, Carbondale, and Thomas H. Watts, Scranton, Pa. Filed Dec. 18, 1889.

429,687. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Original application filed Mar. 24, 1887. Divided and this application filed Dec. 1, 1887.

429,703. Galvanic Battery. José Siliceo, Jr., Mexico, Mexico. Filed Feb. 19, 1887. Renewed Apr. 7, 1890. Patented in Mexico Dec. 29, 1884.

429,727. Lightning Arrester. Oliver J Lodge, Liverpool, County of Lancaster, England. Filed May 22, 1889.

429,729. Generator for Electrically-Reciprocated Tools. Harry N. Marvin, Syracuse, N. Y. Filed March 19, 1890.



NO. 429,596. GALVANIC BATTERY.

429,730. Electric Drill System. Harry N. Marvin, Syracuse, N. Y. Filed Mar. 19, 1890.

429,731. Electric Drill System. Harry N. Marvin, Syracuse, N. Y. Filed Mar. 19, 1890.

429,732. Generator for Electrically-Reciprocated Tools. Harry N. Marvin, Syracuse, N. Y. Filed Mar. 19, 1890.

429,736. Dynamo Electric Machine. Richard Pfund, Brooklyn, N. Y. Filed Feb. 24, 1890.

429,745. Electric Connection. Charles J. Van Depoele, Lynn, Mass. Filed Aug. 15, 1889.

429,746. Electric Railway Motor Truck. Charles J. Van Depoele, Lynn, Mass. Filed Aug. 15, 1889.

429,747. Telpher System. Charles J. Van Depoele, Chicago, Ill. Filed May 13, 1887.

429,751. Electric Meter. John H. Barnard, Asheville, N. C. Filed Apr. 4, 1890.

429,787. Electric Arc Lamp. Carl Coerper, Ehrenfeld, Germany, assignor to Helios Actien-Gasellschaft für Elektrisches Licht und Telegraphenbau, same place. Filed Jan. 25, 1889. Patented in England Dec. 14. 1888.

429,804. Telephone. William Vogel, Chicago, Ill., assignor of three-fourths to Gary G. Calkins and Adolph Gray, same place. Filed Aug. 19, 1889.

429,815. Cable Terminal. John C. Reilly, Brooklyn, N. Y. Filed Nov. 18, 1889.

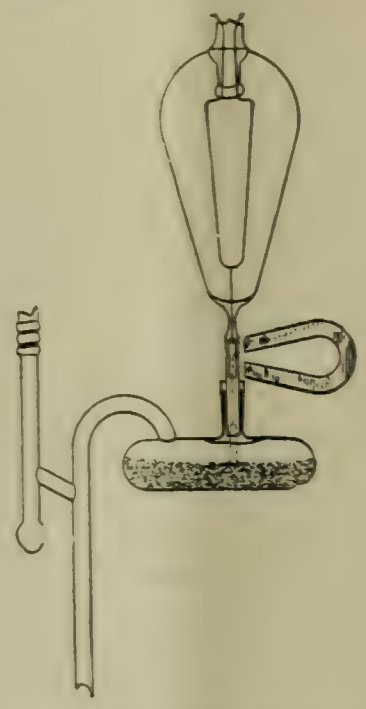
429,817. Electric Burglar Alarm. Harold C. Shubert, Chicago, Ill., assignor to Louis K. Curlett and James Rose, same place. Filed Mar. 8, 1890.

429,825. Electric Regulator. Edmund Wagemann, Little Rock, Ark., assignor of six-sevenths to John D. Adams, Dean Adams, Oscar Davis, John W. Davis, Horace G. Allis, and John B. Jones, all of same place. Filed Sept. 11, 1889.

429,827. Graphophone. John H. White, Washington, D. C. Filed April 9, 1889

429,895. Galvanic Battery. George H. Felt, New York, N. Y., assignor to the Felt Electrical Company, same place. Filed Nov. 13, 1889.

429,896. Electrode for Galvanic Batteries. George H. Felt, New York, N. Y., assignor to the Felt Electrical Company, same place. Filed Nov. 15, 1889.



NO. 429,608. MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS.

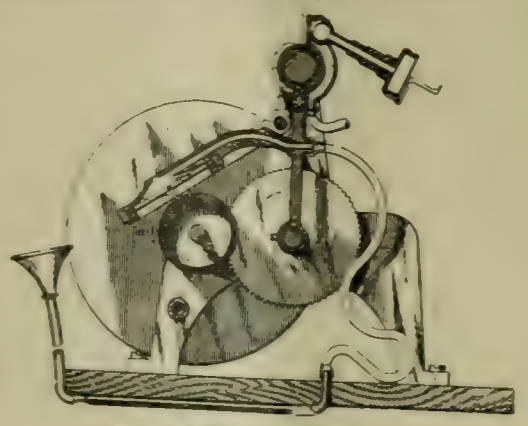
429,897. Porous Cell for Galvanic Batteries. George H. Felt, New York, N. Y., assignor to the Felt Electrical Company, same place. Filed Jan. 4, 1890.

429,898. Solution for Galvanic Batteries. George H. Felt, New York, N. Y., assignor to the Felt Electrical Company, same place. Filed Jan 13, 1890.

429,899. Railway Signal System. Leroy B. Firman, Chicago, Ill. Filed Aril 15, 1889.

429,912. Secondary Battery. Carl Hering, Philadelphia, Pa. Filed April 15, 1890.

429,913. Secondary Battery. Carl Hering, Philadelphia, Pa. Filed April 15, 1890.



NO. 429,827. GRAPHOPHONE.

429,914. Secondary Battery. Carl Hering, Philadelphia, Pa. Filed April 15, 1890.

429,981. Electric Railway Conductor System. Chas. J. Van Depoele, Lynn, Mass. Filed April 9, 1890.

429,982. Mechanical Telegraph Instrument. Eugene R. Waterhouse, St Louis, Mo., assignor of one-half to Hart A. Fisher, same place. Filed July 9, 1889.

430,010. Underground Electric Conduit. Henry Flad, St. Louis, Mo. Filed September 18, 1889.

430,025. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Original application filed Feb. 17, 1886. Divided and this application filed Sept. 13, 1888.

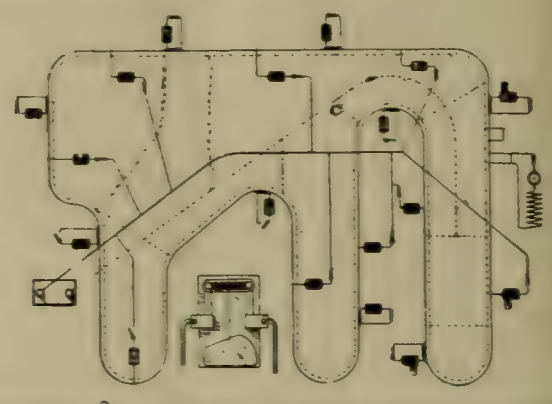
430,054. Switch Board. Johan M. Anderson, Boston, Mass., assignor of one-half to Albert Anderson, same place. Filed March 20, 1890.

430,058. Method of Separating Ores Magnetically. Clinton M Ball, Troy, N. Y., and Sheldon Norton, Hokendauqua, Pa., assignors to the Magnetic Separator Company, Watervliet, N. Y. Filed Oct. 16, 1889.

430,060. System of Electrical Distribution. Edward M. Bentley, Boston, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed April 2, 1890.

430,065 Key-Board Self-Playing Attachment. Joseph D. Case and Clark W. Evans, Plainfield, N J. Filed Sept. 10, 1886.

430,075. Galvanic Battery. Charles A. Hitchcock, North East, assignor of one half to Samuel A. Davenport, Erie, Pa. Filed May 23, 1889. Renewed Dec. 16, 1889.



NO. 429,981. ELECTRIC RAILWAY CONDUCTOR SYSTEM.

430,076. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor by mesne assignments to the Thomson-Houston Electric Company, Boston, Mass. Original application filed June 21, 1886 Divided and this application filed June 20, 1889.

430,096. Automatic Electric Cut-Out. Montgomery Waddell, New York, N. Y., assignor to the Waddell-Entz Electric Company, same place. Filed April 21, 1887.

11,083. Electric Railway. Walter H. Knight, Newton, Mass. Filed May 14, 1890. Original No. 424,888, dated April 1, 1890. Reissue.

11,084. Electric Railway. Walter H. Knight, Newton, Mass. Filed May 14, 1890. Original No. 424,887, dated Apr. 1, 1890. Reissue.

NEW CONTRACT OF THE SPRAGUE CO.—During the last month the amount of new business contracted for by the Sprague Electric Railway and Motor Company, has been very large, and includes nearly every section of the United States. Among the new roads which have ordered electrical appratus are the West End Railway of Denver, Colorado; the Belt Line Electric Railway of Port Townsend, Washington; Citizens Rapid Transit Railway of Nashville, Tenn.; Manet Street Railway of Quincy, Mass.; Capitol Hill Electric Railway of Denver, Colorado; Rapid Transit Street Railway of Newark, N. J.; and Keokuk Electric Railway of Keokuk, Iowa. In addition to these the Sprague Company has closed a large number of contracts for additional equipment with roads already in operation on the electric system. The use of electricity as a motive power seems to be extending rapidly, and the list which we publish each month of the new contracts awarded to the Sprague Company is indicative of the popularity of this systen.

SEIZURES OF ACCUMULATORS IN FRANCE.—In addition to its recent seizure of Laurent-Cély accumulators, the Société Française d'Accumulateurs Électriques has impounded some Julien and some Jarriant accumulators.

THE LAURENT-CELY ACCUMULATOR.—The special features of the Laurent-Cely accumulator, which is constructed by the Société Anonyme pour le travail Électrique des Métaux, consists, says *Engineering*, in the special nature of the lead paste employed, and in the manner in which it is applied to the plates. The active element is a mixture of chloride of lead and chloride of zinc. The fused chloride of lead has a density of 5·6; by incorporating chloride of zinc with it in certain proportions the density is reduced to 4·5. This mixture, brought to a state of fusion, is run into cast-iron moulds in the form of small buttons with rounded edges. After cooling, the buttons are washed to remove the chloride of zinc, and thus to render them somewhat porous. Their density then varies from 4·2 to 3·4. The buttons which serve for the manufacture of the negative plates are then arranged in a metallic mould, into which antimonial lead is run; this surrounds the buttons with a frame which holds them fixed in their positions. The negative plates are mounted in cells filled with acidulated water and provided with zinc electrodes. The composite and zinc plates are then short-circuited. The hydrogen which is disengaged upon the positive electrode reduces the chloride of lead, and there are thus obtained buttons of spongy lead of a density between 2·5 and 3·1, while that of ordinary lead is 11·35. The buttons used in the manufacture of the positive plates are first transformed into spongy lead, then heated in the air to oxidize them, and transformed into spongy litharge. They are fixed, like the negative buttons, in a frame of antimonial lead. The Laurent-Cely accumulator is employed for the lighting of *wagons lits* on the Chemin de Fer du Nord, and has also served to drive a motor working an electric capstan.

ANSWERS TO INQUIRIES.

Editor ELECTRIC AGE: Please explain what is the difference between a voltmeter and ammeter? I know the former is used to measure a current in volts, and the latter to measure the same in ampères—but what is the difference in the instruments?

Atlanta. W. K. A.

Answer: The difference is in the resistance and position of the instruments in the circuit. The voltmeter has high resistance and is placed in a derived circuit between the points whose difference of potential is to be measured; while the ammeter is of low resistance and is connected directly with the main circuit, the entire current passing through it.—Ed. ELECTRIC AGE.

Editor ELECTRIC AGE: What is a "Mho?" I notice it is spelled the reverse of ohm, and I infer from that that it must have an opposite significance, although I cannot find any explanation in any book I have at my command.

Albany, Ind. MICRO.

Answer: Mho is a term proposed by Sir Wm. Thomson to represent the practical unit of conductivity. Conductivity being the reciprocal of resistance the origin of the word is apparent.—Ed. ELECTRIC AGE.

ELECTRIC CARS IN BROOKLYN.—The Brooklyn City Railroad Company has asked permission to substitute electric motors for horses on its lines. The president of the company, Mr. Lewis, says, "It is the coming power, and we propose to utilize it. In all probability we shall have two power stations, so that we shall not be inconvenienced if one blows up. I am very strongly in favor of supplying power from one central station to all the roads that will use electric motors. That would reduce the cost to a minimum."

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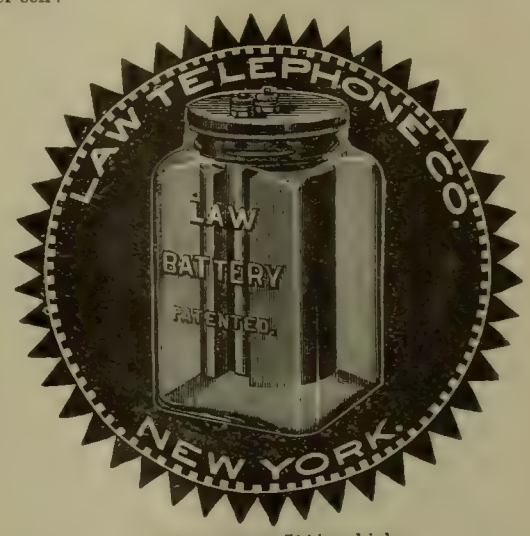
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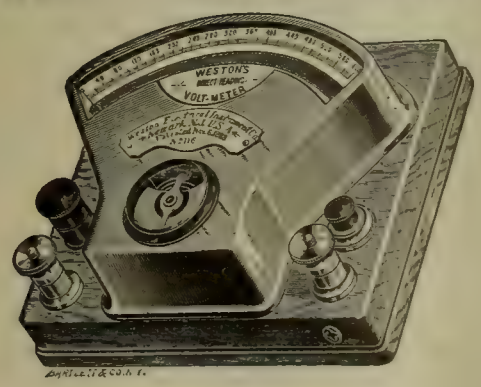
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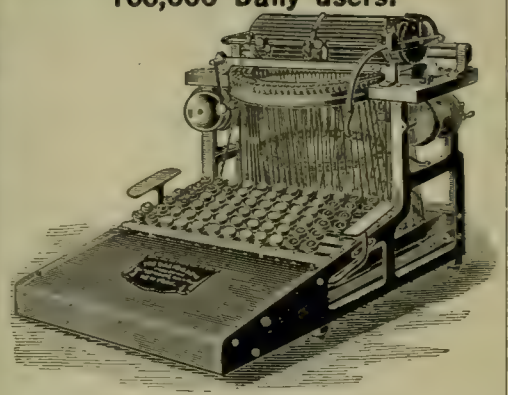
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NEW YORK, JUNE 28, 1890.

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AILROAD TELEGRAPH SUPERINTENDENTS IN CONVENTION.

The annual meeting of the Association of Railway Telegraph Superintendents, held at Niagara lls last week, was the most interesting and ccessful of all its eight predecessors. Everyng seemed to combine for the interest and asure of the members and their families and nds. The weather during the three days stay the Falls was most delightful, and nothing atever occured to mar the success of the meet-

While the meeting was that of Railroad Telegph Superintendents, it indeed would have ased the hearts of the railroad presidents if ey could have been present and looked upon s body of intelligent and experienced men, on whom so much depends in the practical eration of railroads; and if they could have tened to the papers read. The papers prited were of the most important character and e proceedings of the meetings are becoming ore and more valuable to the members. The ter are beginning to appreciate the benefits rived from attendance at these meetings and ening to the papers read. There was a time the history of the association, we believe, when was difficult to get any one to consent to pre- re a paper on any subject for the benefit of embers in annual session. They used to think at they could not add much, if anything, to e sum of knowledge already acquired. They ve learned, however, that whenever a person dertakes to describe anything he can always d something to so nebody's knowledge on the bject discussed. The result is the number of pers read at the meetings are increasing in mber and practical value. Every one read at is meeting was of great practical value to all lroad men, and they simply show what the members can do when they make up their minds to act. Each member should prepare a paper on the subject with which he is most familiar, no matter if it does happen that some one else speaks on the same subject. Two persons can speak on a common subject and give new information. It is the account of the experiences and the methods adopted to effect a result that makes these papers valuable, and not the mere discussion itself. Rhetoric has nothing to do with the value of papers on practical subjects, and railroad superintendents are practical men. What they want to know is which is the best way to accomplish a result, and by the experience of others they profit.

The paper read by Mr. Robt. Stewart, of the Central Railroad of New Jersey, was a master piece. It was well written and teemed with information valuable to railroad people. The block system is yet in the stage of development, and the history of its growth from birth up to the present time, as set forth in Mr. Stewart's paper, is valuable knowledge to those interested. Particularly is this true in the case of those who are giving much thought and time to the improvement of railroad signaling. The paper points out the failures in the past, and describes in detail the various systems now in use. Such information cannot help being of great value to those who are bending their energies and thought in this particular line. We regret that limited space prevents our publishing this paper in full.

Mr. Selden's paper, which we print on another page, contains information that is particularly valuable to both electricans and railroad managers. The question of using electricity on railroads for increasing the traction of locomotives is an extremely interesting one. Mr. Selden adds some facts to our comparatively limited knowledge on the subject of this application of electricity. The experiments with which his paper was illustrated seem to prove conclusively that there is an actual welding between the rails and wheels when an electric current is passed between the two. He gives some valuable statistics as to cost of equipping a locomotive with an electric plant for the purpose of accomplishing this result, and this information is what concerns the practical railroad manager more than anything else. All inventions and improvements, while they may be interesting and even wonderful in themselves, must finally be tested on the basis of dollars and cents. If there is no improvement in this direction, the chances are against them. All new inventions, however, do not suffer the same fate even if they do not effect a saving. The railroads, while they are trying to increase their dividends, are not unmindful of the safety of the lives of their passengers. It is not infrequent that some invention is adopted which will really increase the apparent expenses of the road, but the increase in safety accomplished thereby more than compensates for the extra expense. Moreover, a road that is known to be what is called "safe" will be better patronized by the traveling public, and increased travel must necessarily increase the revenue. In this way an expensive, but reliable method of securing safe transit of passengers and freight might be able to increase the revenues of a road, but as we have already stated the chances against an improvement which increases expenses are great. Mr. Selden points out in his paper, how the adoption of this invention would save money to railroads. It would be done by dispensing in many instances with a second engine, and it would save much time and wear and tear, all of which represents money.

The paper of Mr. Taylor, of the Pennsylvania Railroad of the electric light cars used on that road for temporary outside work, was of special interest, and we regret that we have not the space to use it entire. Mr. Taylor dealt with his subject in a thoroughly practical manner, and it is safe to assume that such men as he are of great value to any railroad.

Another practical paper read was that of Mr. Leonard, of the Chesapeake and Ohio road. He entered into the details of railway lighting by electricity, and the discussion which followed brought out many important facts. An abstract of this paper is given on another page.

All of the other papers were of high order in their respective lines, and the official copy of the minutes of the proceedings of the Convention of 1890 will be of exceeding value to railroad managers.

Dealers in railway appliances have begun to appreciate the importance of holding an exhibition of their goods on the occasion of these conventions. The association is becoming a powerful factor in the railroad world, and the men who attend these meetings are the ones to whose attention improvements in railway appliances and methods should be brought.

The exhibit at this convention was an important one, and no doubt every concern represented there will be rewarded for their enterprise by increased orders. We hope so, as there were many worthy inventions shown, and if the traveling public could only appreciate how much time, money and thought are being expended for their safety, there would not be so much fault-finding with railroad management.

While safety is the primary object of all inventions pertaining to railroad operation, there is such a thing as having too many new fangled things on the line. Simplicity is a great desideratum in the operation of a railroad, and it is not surprising that engineers and train hands generally are not enthusiastic admirers of the patented arrangements. Of course they, in time, get used to semaphores, lights, and the like, but there is danger on some roads of getttng too many signals, which are liable to create confusion in the minds of trainmen. Therefore, simplicity is the great essential to keep in mind in the invention and adoption of railroad signals.

During a conversation with a representative of one of the largest and most successful roads out of New York, the representative of the ELECTRIC AGE learned some facts concerning that road which were quite astonishing. The general manager of this road does not believe in block signals, semaphores, etc., and will not have them on his road except where they are absolutely necessary, such as at crossings, etc. He argues that such things complicate the operations of the road. This road is run in the simplest way, and has a record of being one of the safest roads in the country. While it is safe it is abreast of the times as far as traffic accommodations are concerned, and it is, indeed, very seldom that accidents are heard of on its lines.

Much more could be said in regard to this important association and its future. Its management is in the hands of wise and experienced men, and railroad managers may well be proud of the interest taken by their telegraph superintendents in the welfare of their roads and the public.

Cincinnati was selected as the place for holding the next meeting. By going there it is hoped to get a large representation from the Southern roads to attend, and by moving around the country in this way give all the sections an opportunity to meet in annual session and exchange views and experiences.

STORAGE BATTERIES.—The Consolidated Electric Storage Company, of 120 Broadway, this city, in a circular just issued, announces its organization for the manufacture and sale throughout the United States of the Julien Storage Battery. This company is the exclusive licensee for the United States of the storage battery patents of Charles F. Brush, and control other patents which cover broad claims. The circular names several companies as makers of storage batteries which are clear infringements of the Brush patents.

THE CABANYES BATTERY.—*El Telegrafista Español* announces that the Cabanyes primary battery is to be used for lighting two rooms in the Royal Palace at Madrid.

ON PROF. ELIHU THOMSON'S ELECTRO MAGNETIC INDUCTION EXPERIMENTS.*

BY J. A. FLEMING, M. A., D. SC., M. I. E. E

(Continued from page 4 issue June 14th, 1890.)

Under these circumstances we can represent the changing strength of the magnetic field in which the ring is immersed by a simple periodic curve *m*, and the changes of current strength in the ring circuit by another simple periodic curve *c*, shifted backwards relatively to the first by a quarter of a wave length (see Fig. 5).

By Ampère's law the force acting on the ring at any instant is proportional to the product of instantaneous value of the surrounding field and this current strength. If we multiply together the ordinates of these two curves *m* and *c*, and form a third curve *p* whose ordinate at every point is

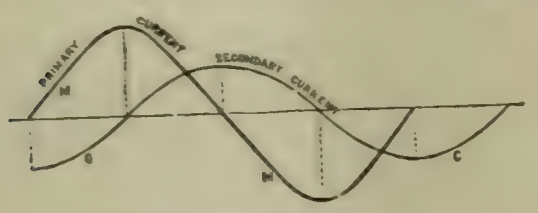


Fig. 5.

proportional to the product of the ordinates of the other curves (see Fig. 6) at those points, we obtain a curve which represents the fluctuation of force at every instant acting upon the ring. This curve *p* is also a wave-like curve, lying symmetrically above and below the horizontal line. The positive and negative areas of this curve included between the curve and the horizontal line represent the impulses or time integrals of the forces which act upon the ring. These impulses are alternating positive and negative. This is equivalent to saying that under the circumstances assumed the ring gets a series of small pushes and pulls, or repulsations and attractions, which succeed each other at the same rate as the changes of magnetic polarity of the magnet. The series of rapidly alternating and equal impulses would result in leaving the ring apparently unmoved. No real conducting ring can, however, behave in this fashion, because every real ring has a sensible "time-constant." Let us next see how the above statements will be modified if the ring has such a sensible self induction that the current induced in the ring lags behind the inducing electromotive force in phase. Repeating the above construction for a force curve, on the assumption that the instant of maximum of the current in the ring occurs later than the instant of reversal of magnetism in the magnet, it is easy to see that the force curve consists now of two very unequal parts. It is not symmetrically situated with respect to the horizontal lines (see Fig. 7). The area of the hummocks (shaded portions) which lie above the datum line and which represent the repulsive impulses on the ring are much larger than the area of the hummocks below the datum line and which represent the attractive impulses acting on the ring. This means to say, that the ring when possessing self-induction experiences on the whole a repulsive force, or a series of repulsive impulses, when immersed in

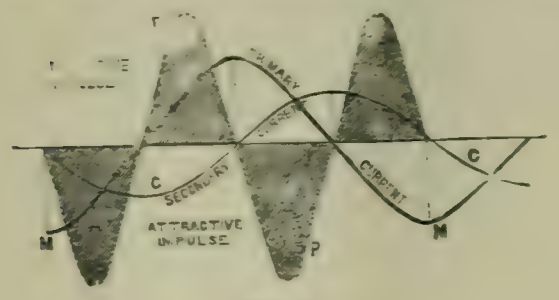


Fig. 6.

* A paper read before the London Society of Arts, May 14, 1890.

such an alternating magnetic field radiated from a magnetic pole; and this repulsive force will be, within certain limits, more pronounced, other things being equal, the greater the time-constant of the circuit. You see clearly, therefore, that a ring or disc of copper in which the induced currents lag behind the inducing electromotive force in phase must experience a repulsive force when this inducing electromotive force is caused by a rapid flux backwards and forwards of lines of magnetic forces perforating through the ring

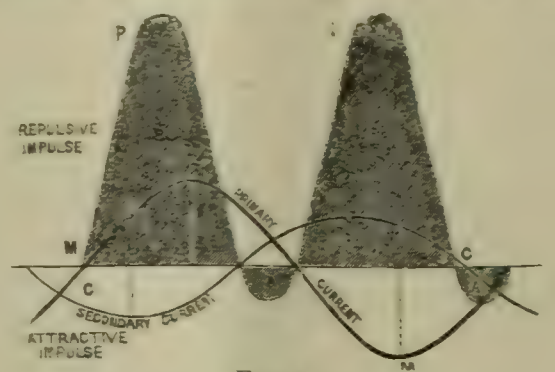


Fig. 7.

or disc. The realization of this inference in a striking manner is the first of a series of remarkable experiments on this subject due to Prof. Elihu Thomson. We have on the table an electro-magnet suitable for these experiments, which consists of a core of divided iron, surrounded by a coil in which I can cause to circulate a powerful alternating current of 40 to 50 ampères. Let us, however, begin with an experiment in which we employ a continuous current to energize the core. I give you, in Prof. Elihu Thomson's own words, an account of this preliminary experiment:

"In 1884, while preparing for the International Electrical Exhibition at Philadelphia, we had occasion to construct a large electro-magnet, the cores of which were about 6 inches in diameter and about 20 inches long. They were made of bundles of iron rod about $\frac{5}{8}$ inches in diameter. When complete the magnet was energized by a current from a continuous-current dynamo, and it exhibited the usual powerful magnetic effects. It was found also that a disc of sheet copper of about $\frac{1}{8}$ inches in thickness and 10 inches in diameter, if dropped flat against a pole of the magnet, would settle down softly upon it, being retarded by the development of currents in the disc, due to its movements in a strong magnetic field, and which currents were of opposite directions to those in the coils of the magnet. In fact, it was impossible to strike the magnet pole a sharp blow with the disc, even when the attempt was made by holding one edge of the disc in the hand and bringing it down forcibly towards the magnet. In attempting to

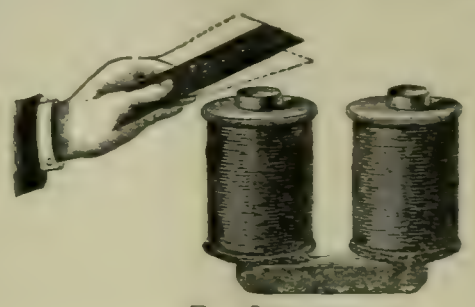


Fig. 8.

raise the disc quickly off the pole a similar but opposite action of re-istance to movement took place, showing the development of currents in the same direction as those in the coils of the magnet, and which currents, of course, would cause attraction as a result. The experiment could be tried in another way. Holding the sheet of copper by one edge, just over the magnet pole (see Fig. 8), the current in the magnet coils was cut off by shunting them. There was felt an attraction of the disc, or a dip towards the pole. The current was then put on by opening the shunting switch, and a repulsive action or lift of the disc was felt. The actions just described are what would be expected in such a case, for when attraction took place currents had been induced in the disc in the same direction as those in the magnet coils beneath it, and when repulsion took place the induced current in the disc was of opposite character or direction to that in the coils. Now let us imagine the current in the magnet coils to be not only cut off, but reversed back and forth. For the reasons just given we find that the disc is attracted and repelled alternately; for, whenever the currents induced in it are of the same direction with those in the inducing or magnet coil, attraction will ensue, and when they are opposite in direction, repulsion will be produced. Moreover, the repulsion will be produced when the current in the magnet coil is rising to a maximum in either direction, and attraction will be the result when the current of either direction is falling to zero

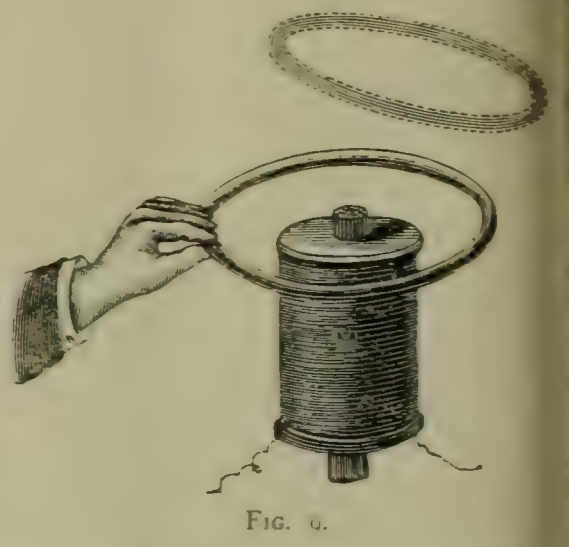


Fig. 9.

since in the former case opposite currents are induced in the disc, in accordance with well known laws: and in the latter case currents of the same direction will exist in the disc and the magnet coil. The disc might, of course, be replaced by a ring of copper or other good conductor, or by a closed coil of bare or insulated wire, or by a series of discs, rings or coils superposed, and the results would be the same."

We have already seen that in an alternating field the electro dynamic impulses so experienced by the disc or ring are alternately attractive and impulsive, and that when the circuit possesses a sensible self induction, the repulsive impulses overpower the attractive ones, and their repetition constitutes a repulsive force. Before adding a few more words of explanation, permit



Fig. 10.

me to show you some of these electro-dynamic repulsions produced by an alternating electro magnet. Here is a copper ring, and I lay it upon the top of this electro-magnet, having a divided iron core and excited by a powerful alternating current. On energizing the magnet the ring jumps up in the air (see Fig 9). If a copper plate is hung like a scale pan from a balanced beam, and placed over the magnetic pole it gives evidence of being strongly repelled the moment we pass the current through the coil of the magnet (see Fig. 10). Instead of employing copper rings or copper plates, we can use closed coils of thick wire, either insulated or not

; however, our plates or rings have a radial it made in them, or if our coils of wire are not losed-circuit coils, all the effects vanish.

So strong is this repulsion with proper appliances, that light copper rings tethered by strings nay be held suspended in the air against the orce of gravity, the upward electro-magnetic epulsion overcoming their weight, and holding hem, like Mahomet's fabled coffin, floating in he air (see Fig. 11). In cases where we are lealing only with impulsive effects, aluminium ings or discs give most marked results, because luminium has the highest conductivity per unit of mass; but in the cases like those just considered, where what is required is the greatest force effect, copper or silver gives a better result than luminium, because they have the highest conductivity per unit of volume. In Mr. Boys' experiments, if I remember rightly, he found aluminium the best to employ. In these cases of electro-dynamic repulsion the force effects depends essentially upon the lag of the induced urrent or its retardation in phase behind that of he inducing field, and, other things being qual, this is proportional to the conductivity of he circuit.

Electric Hand Lamp.—A fireman's electric and lamp is now being introduced by a firm of English engine makers. The battery and lamp are contained in a copper case, similar to a ireman's ordinary lamp, and fitted with a handle or convenience in carrying. The battery rough consists of six cells and the carbon and inc elements are carried on an ebonite plate capable of being moved vertically, so that when he light is not required the elements may be withdrawn from the exciting fluid, and kept in a position by pinching screws. The electrolyte used is a special solution of bichromate of potash with sulphuric acid. The battery may be quickly recharged by unscrewing a pair of screws and dropping the bottom trough out of the case. The spent liquid is then thrown away, and a fresh charge poured into the trough, this operation occupying no longer than is necessary for replenishing an oil lamp. Very powerful parabolic reflectors are provided, and the lamp, which has a duration of from two to three hours, forms an important adjunct to the outfit of a fire brigade. The lamp is also suitable for use in mines, gas works, gunpowder and chemical factories, etc. The advantages claimed for his lamp are its portability, facility in charging, capability of resting the battery when the light is not required, and its safety.

Prevention of Accidents.—An arrangement for the prevention of accidents by the electric current has been adopted at the works of the Morgan Engineering Company, of Alliance, Ohio. A board is fixed on the wall facing the dynamo in the engine room. On this board are six hooks for the checks of the six men who are employed in looking after the circuits. When a man is called on duty he removes his check from the hook and takes it with him. The engineer sees by a glance at the board that one check is absent, and that, therefore, one man is engaged about the lines around the shop, and the dynamo is not started until the check is replaced on the hook. The engineer then understands that the coast is clear, and turns on his current without fear of accident to any of the linemen.

Panic in a Theatre.—On June 4th, the performance at the Théâtre Française, Paris, was disturbed by an occurrence which resulted in a panic. The conductors carrying the current to supply the chandeliers seem to have come together, and the light was consequently extinguished, and sparks fell among the audience. The incident caused great excitement, although it appears that no damage occurred.

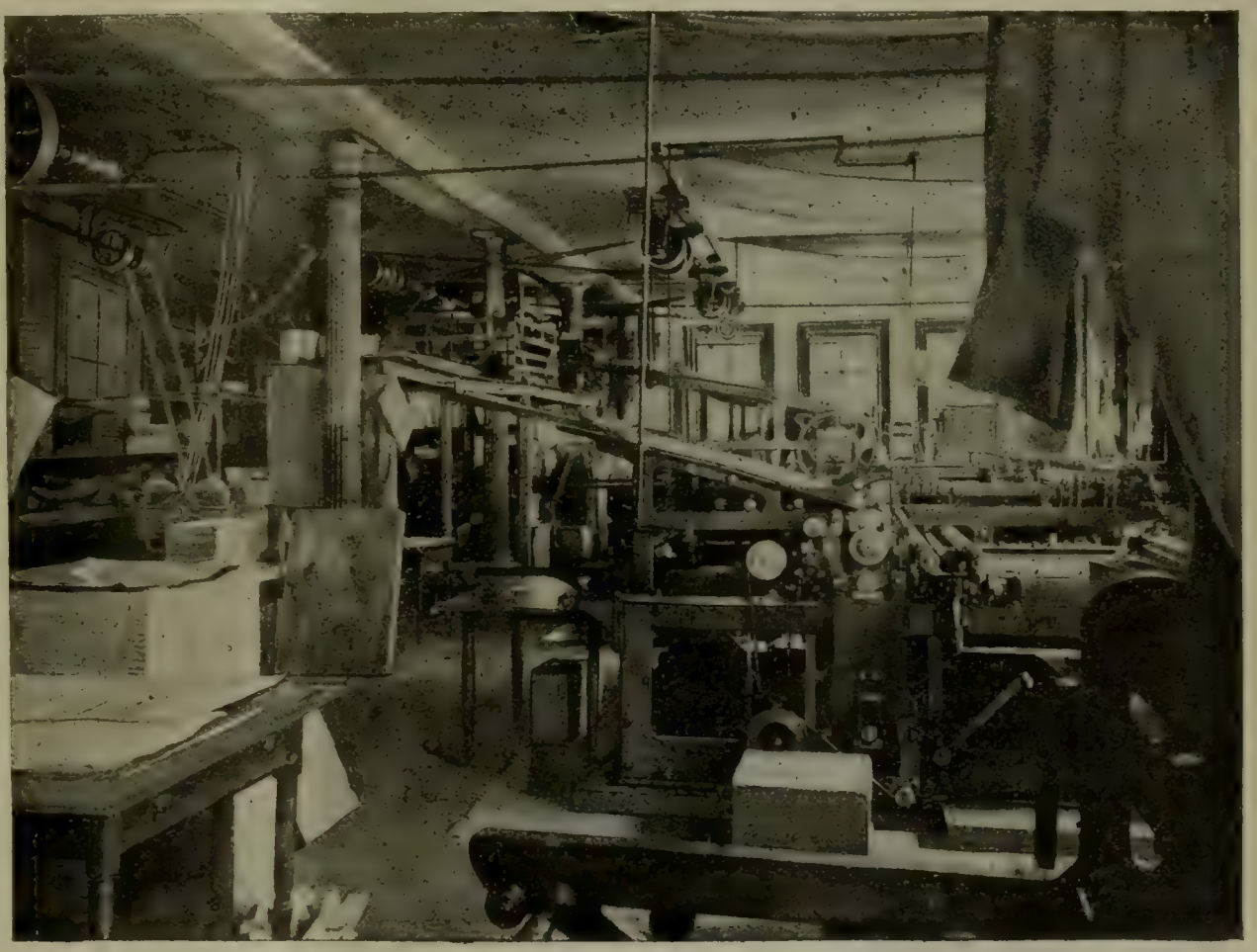
Tabasco (Mexico).—This town, which has a population of 100,000, is to be lighted by 100 arc lights of 1,000 candle-power, for the sum of 80,000 pesetas (£400) per annum.

ELECTRICITY FOR FINE PRINTING.

It is well known to printers that the highest class work in engraving and printing requires a power which is at once steady, reliable and under prompt control. The presses must run with perfect regularity, and at constant speed, and to supply these conditions electric motive power stands unrivalled.

Sprague electric motors from their ability to keep the speed constant under varying loads have long been used for these classes of work where such sort of service is a desideratum.

In this issue we illustrate the press rooms of the Boston Bank Note and Lithograph Company. in which all the power used is supplied by a 10 horse-power electric motor. This is belted directly to the line of shafting running the length of the room, from which are run the presses, folders, cutters and other machinery used. Only a part of the presses used is shown



PRESS ROOM OF THE BOSTON BANK NOTE AND LITHOGRAPH CO.

in the view, the shafting extending a considerable distance beyond the limits of the engraving.

It is interesting to note in this installation the relatively small size of the electric motor, compared with the amount of machinery kept in motion. A steam engine of this size would require from ten to fifteen times as much space without counting the room required for boiler, etc. The motor occupies a space of less than eighteen cubic feet.

There are now about twenty Sprague motors used in the city of Boston for operating presses alone, while the total number is in the neighborhood of two hundred.

Welding Machines in Demand.—The scarcity of ice this season is creating a demand for Thomson Electric Welding Machines. This may seem strange to many, but it is explained in this way. The machines are to be used in making the long coils of pipe for artificial ice machines and for general refrigerating purposes. These coils are frequently from 500 to 700 feet long, and as the original pipes are usually only from eighteen to twenty feet long it can easily be seen how much labor was required by the old process of welding to connect these sections. The joints were often imperfect and resulted in the loss of the anhydrous ammonia. By the new process a perfect weld is made, and the cost is less than one-seventh that of the hand process. The Thomson Company are reported to consider this industry next to their shell welding in importance.

Electric Communication Between Trains.—The train signal system which we described some time ago was practically tested recently, on the Baltimore and Ohio Railroad with very flattering results. A thick iron wire was placed on an insulated wooden projection about three inches above the track. Two engines were supplied with metallic brushes which were arranged so as to come in contact with this wire and were connected electrically with telephones in the cab. When the engines approached to within one mile of each other the telephone bells in both engines were set to ringing. The engineers knew that a collision was imminent, and stopped the train and asked each other through the telephone what the matter was. The new system seemed to work to a charm. Its liability to disarrangement by accidents to the projecting wire, however, would seem to militate against its entire reliability.

Electric Drilling.—The Thomson-Houston Electric Company are erecting a building in Lynn, Mass., which will be devoted to the manufacture of electric drills and mining machinery. Electrician C. J. Van Depoele, of the Thomson-Houston works, has been giving a good deal of attention to the subject of electrical mining machinery, and has produced an entirely new apparatus for mining, the work of developing being done by him with assistance at his home for two years past. The entire process is covered by patents already granted, or to be granted, and it is thought that the manufacture of these electric drills and other devices will soon be only second to that of electric railways.

Leprosy Cured by Electro-Homeopathy.—The Calcutta correspondent of the London *Daily News* telegraphs: Father Müller, of the Jesuits' College at Mangalore, claims to have cured several cases of leprosy by Count Mattei's system of electro-homeopathy. He gives a description of the statement, and states the cost to be only ten rupees for each cure. A gentleman at Calcutta claims to have effected cures by similar treatment.

THE GAYNOR FIRE ALARM SIGNAL SYSTEM.

(*Continued from page 2, issue of June 21st.*)

This system includes a very efficient repeater, by which signals are re transmitted to all tower bell strikers, tappers, gongs, etc.

For general alarms the largest bells are chosen, and steam whistles are sometimes employed. The Gaynor tower bell striker gives a quicker blow than any other, and can be arranged to strike any church or tower bell without in the least interfering with its regular use or requiring any change of fittings.

The system complete embraces everything that is necessary to make it perfectly reliable and efficient. One of the specialties of this company is the combination fire and police signal station, which is an octagonal booth

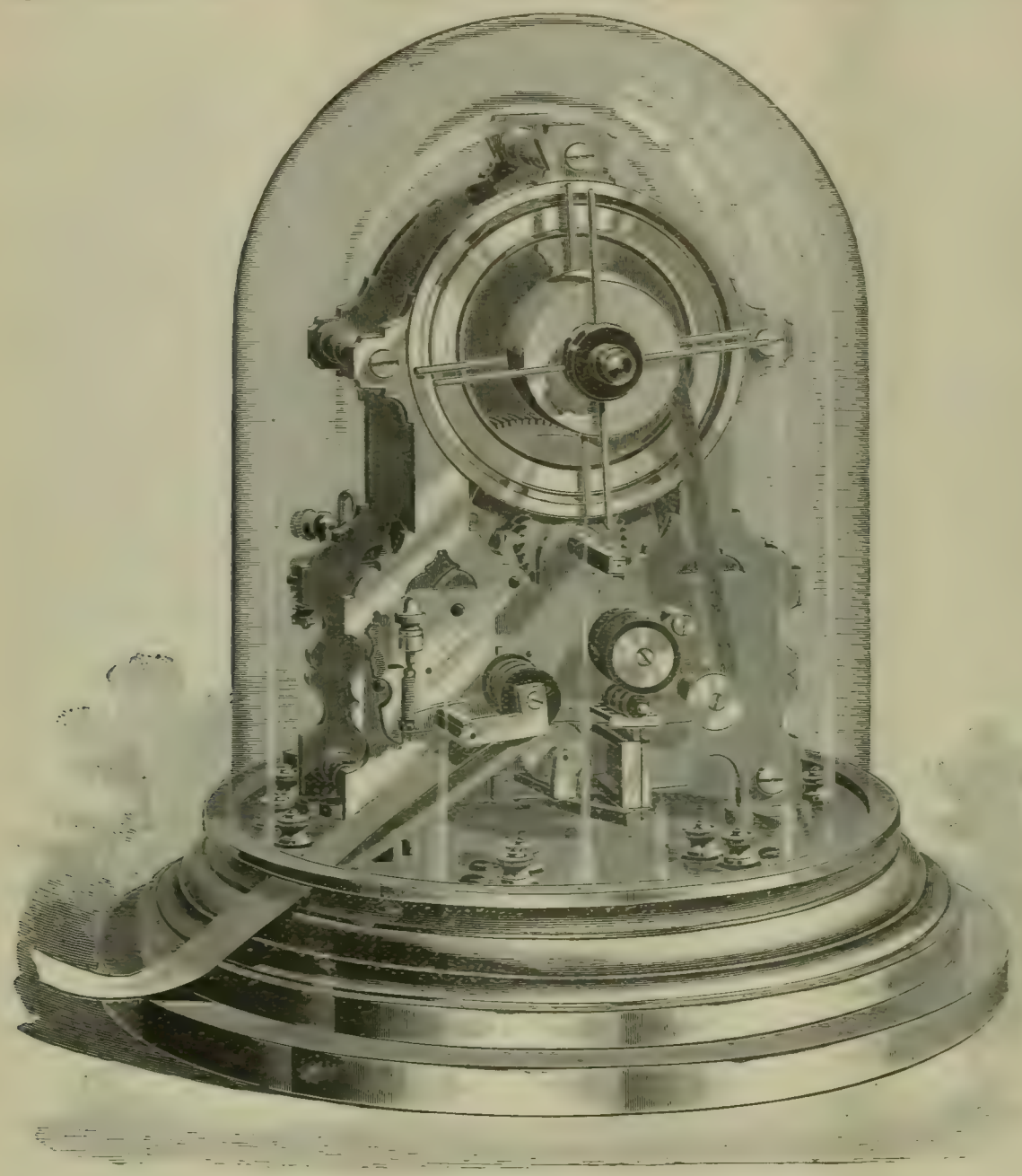


FIG. 2. REGISTER.

placed at convenient points in the streets. These stations contain the necessary instruments to ring an alarm of fire, and by their use much valuable time can be saved, as it is not always that the regular alarm boxes are near at hand. Some very ingenious inventions are covered in this signal station.

The principal points of advantage claimed for the Gaynor system are these:

In the Central Office System, all boxes come in whenever pulled and the signals are plainly read and registered. There is no holding back of any box at any time.

The boxes give the signals five or six times as fast as the Automatic System, two or three rounds always being in before the apparatus is ready to leave the engine house.

The alarm mechanism in the Central Office System being independent of the boxes, it is utterly impossible to ever give a mixed alarm, hence it is the only perfect non-interference system ever known.

Communication can be had between the boxes and the engine houses (which is one of the features of the System), without interfering with the alarm mechanism—bell, gongs, etc.

Test alarms can be turned in without calling out the department and without any previous notice being given.

The Chief, Mayor or Committee can be signaled without interference with the bells or other department mechanism.

When an alarm is given by telephone or messenger the box nearest the fire can have its number sounded from headquarters without manipulating said box in any way, thus locating the fire as if the box had been pulled.

Every part of the system is independent of the other parts, admitting of the most thorough and frequent inspection and testing without the possibility of alarms being sounded.

Independent signals can be given on the bells alone for school purposes, tolling, special police or other calls without alarming the fire department otherwise.

The system is being adopted by all enterprising cities wherever shown, with very satisfactory results.

COMPLIMENTARY REPORT.—Lieut. A. B. Wychoff, U. S. N., recently completed a tour of inspection of electric light and power plants. In his report he pays high compliment to the Edison and Thomson-Houston systems.

ELECTRIC RAILWAYS IN MISSOURI.—The Chicago office of the Thomson-Houston Electric Company has received a large order for electric motors from the Missouri Railway Company at St. Louis, for which fourteen miles of track are being equipped. There will be thirty-six cars built by the J. G. Brill Company, with Brill trucks, each provided with two fifteen horse power motors. The power house will contain five one hundred horse power generators, run by two five hundred horse power Corliss engines.

KINGSTON, JAMAICA.—Ernest Nielly, a Thomson-Houston electric expert, writing from Kingston, Jamaica, where he is stationed, says that the masons are fast completing the power station of the Jamaica Electric Lighting Company. Meanwnile, he, with a force of linemen, is kept very busy wiring churches, halls and residences.



FIG. 3. GONG.

12TH CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.—At a meeting of the Executive Committee held Monday, June 16th, it was decided to convene the Twelfth Convention of the National Electric Light Association, at Cape May, New Jersey, on Tuesday, August 19th. Full details of the arrangements made for the convention will be published at a later date. Mr. Allen R. Foote entered upon the duties of secretary and treasurer of the association on Tuesday, June 17th.

OUR THANKS. The ELECTRIC AGE hereby extends its thanks to Mr. L. P. Ivisy, Superintendent of Telegraph of the Delaware, Lackawanna and Western Railroad for courtesies extended to its representative to the Niagara Falls Convention.

ANNUAL BANQUET. The annual banquet of the Chicago Electric Club was held Friday evening, June 27th, at the rooms of the club, 103 Adams street.

CONVENTION OF RAILROAD TELEGRAPH SUPERINTENDENTS.

The annual meeting of the Association of Railway Telegraph Superintendents, was held at the Cataract House, Niagara Falls, June 18th and 19th.

The meeting was called to order at 10:45 A. M., June 18th, by President C. A. Darlton, in the chair.

The following persons were elected members: C. C. Ford, of the C. St. Paul and Kansas City R. R., St. Paul, Minn.; W. J. Stoneburner, D. & I. R. R., Two Harbors, Mich.; H. D. Milton, St. L. A. & Texas, Texarkana, Texas; J. V. Goode, K. C. & Southern, Kansas City; P. H. Hough, C. B. & N., Lacrosse, Wis.; G. N. Gish, Iowa Cent'l, Marshalltown, Iowa; H. B. Brigg, D. R. W. & S., Red Wing Minn.; T. W. Parks, I. & G. N., Tyler, Texas; J. N. Metler, Tex. & Pac., Dallas, Tex.; and W. D. Hendrickson, New York & Long Branch, Long Branch, N. J., also B. R. Pollock, Jr., of the N. Y. & N. E. Road, Hartford, Conn., whose name was proposed by Mr. G. L. Lang, of the New York and New England road.

The reading of the minutes of the last meeting, which was held in Washington last October, was dispensed with and the Treasurer's report read. After some discussion as to the collection of dues from delinquent members, the report was adopted.

The next business was the reports from committees. The committee on papers reported that the reading of several papers had been arranged for. The committee on arrangements reported that the Long Distance Telephone Company, and the Western Union Telegraph Company had extended the use of their lines to the members of the Association free of charge during the Convention, both of which companies were tendered a vote of thanks for the courtesies. It was decided to accept an invitation to make an excursion to Toronto, on Friday the 20th.

The election of officers for the ensuing year was then proceeded with. Mr. G. T. Williams, of the Nickel Plate Road, Cleveland, Ohio, was unanimously elected president. Mr. G. M. Dugan, of the Illinois Central, was elected vice-president, and Mr. P. W. Drew, of the Chicago and Eastern Illinois, Chicago, was re-elected secretary and treasurer. Mr. Drew tried hard to be excused from serving in that capacity any longer, but the association did not see fit to let him go.

The following named persons were then elected honorary members: P. W. Drew, C. N. Chevalier, of the N. Y. & N. E., Providence, R. I.; F. W. Dow, of the New London and Northern; Charles F. Wilcox, Henry F. Houlton, J. H. Hill, and J. B. Shaw, formerly of the N. Y. P. & O., after which the new president, Mr. G. T. Williams, assumed the chair.

After a vote of thanks to the retiring officers for the able and efficient manner in which they carried on the business of the association during the past year, the president was authorized to appoint a committee of three to consider the question of place and time for the next annual meeting, and report at the evening session. Messrs. Leonard, of the Chesapeake and Ohio, Selden, of the Baltimore and Ohio, and Kinsman, of the Wabash, were chosen members of the committee.

It was then voted that the association visit the exhibition of railway, telegraph and signal apparatus, etc., in a body, at 9 A. M., Thursday.

All business, except the reading of papers, having been transacted, the convention, at 12 o'clock, adjourned until 7 30 P. M.

After dinner the entire party went sight seeing, and drove in carriages to all the points of interest, taking in the falls from both sides of the river and the whirlpool rapids.

Evening session—Although 7.30 was the appointed hour for the reassembling of the convention, it was not until 8.45 that President Williams rapped for order. By resolution at the morning meeting, ladies accompanying members of the association were invited to be present at the evening session, and many accepted the invitation.

The first business of the evening was the reading of a letter from Prof. Morse to Henry J. Rogers, dated New York, May 24, 1845, in which he refers to an editorial article to be published by the *Journal of Commerce*, comparing the English and American telegraph systems. In it he also expresses the hope that "the receipts of each office will soon mount up to at least $5 a day."

"That sum will just pay expenses," the letter continues, "exclusive of my salary and Vail's."

At the conclusion of the reading of the letter and newspaper comments Mr. Robert Stewart, of the Central Railroad of New Jersey, read a long and interesting paper entitled the "History and Development of the Block System." Mr. Stewart, in introducing his subject, thanked the officers of the association for the honor conferred in assigning to him the discussion of the Block System of railroad signaling. He presumed the subject was assigned him more out of compliment from the fact that he was the first railroad telegraph superintendent to introduce this system of signaling than from any special ability on his part.

He then described in a very interesting manner the birth and the development of block signaling up to the present time, explaining in detail the operation of the various systems now in use. In concluding his paper Mr. Stewart said "The system of blocking trains has and can be improved. Rapid strides have been made in this direction and undoubtedly will continue until it has reached such a degree of perfection that rear end collisions will, in the railroading of the future, be an unknown occurrence. I believe that the time is not far distant when, upon the main trunk lines of this country, the business will have grown to such an extent that, in order to afford protection to all classes of trains, both passenger and freight, so that the latter, especially, can be moved at a higher rate of speed, it will be necessary to locate signal towers at a distance that will warrant the application of an "absolute" block to govern their movements. Speed and safety are so closely allied in the successful operation of railroads that, whatever tends to its accomplishment the progress of the times will not permit of being ignored."

The committee appointed at the morning session to suggest a place and time for the next annual meeting, reported that Cincinnati had been selected as the place, and the third Monday in June, 1891, as the time. The report of the committee was accepted. Mr. Chas. Selden then read an interesting paper on the subject of the application of electricity as a means of increasing the traction power of locomotives. The paper in full will be found on another page.

A discussion followed the reading of the paper as to the real cause of the increase of traction. The small model electric railway with which Mr. Selden intended to illustrate his paper was not in order for use at the evening session, but he promised to supplement his remarks in the morning session of Thursday by a practical demonstration of the operation of the subject of his paper

At the conclusion of the discussion on Mr. Selden's paper, Mr. L. Horton, jr., assistant telegraph sup't of the Northern Pacific Railroad, St. Paul, Minn., was elected member of the association, after which the meeting, at 10:45, adjourned till 9 A. M., Thursday, when they were to visit the exhibition rooms of railway appliances.

THURSDAY'S SESSION.

Thursday, June 19th. The members were a little tardy in meeting at the exhibition rooms owing to the late hour at which the night session of the 18th adjourned. Shortly after 9 o'clock however, they began to come in, and until 11 A. M. the various exhibits were shown and explained by those in charge. At 11 o'clock, the meeting was resumed in regular session in the hotel parlors.

Mr. Robt Stewart, of the C. R. R. of N. J., as an introductory explained the use of a train marker, which he exhibited and which was used on the Pennsylvania Railroad 25 years ago.

Mr. Charles Selden then, by means of a small motor car on a short piece of track, illustrated his paper, which was read at the night session of Wednesday. The demonstration proved clearly that the increased traction was due to actual welding between the car wheels and track, which point has been the subject of considerable difference of opinion. The fact that non-magnetic metal acted the same as a magnetic substance proved that the increase of traction was not due to magnetism as is claimed by some.

At the conclusion of Mr. Selden's experiments, Mr. W. W. Nicholls, of the C. B. and Q. road, followed with a paper entitled: "Some Details in the Manipulation of Block Signals."

An interesting discussion followed the reading of Mr. Nicholls' paper, as to the best and safest method of signaling trains under the block system.

Mr. Nicholls discussed the differences between the various block systems used throughout the country, and described what in his opinion constituted a model block system. His paper was a very able one and received close attention from the members present.

The next paper read was that of Mr. W. F. Taylor, of the Pennsylvania Railroad, on "Lighting at Wrecks." He described, at considerable detail, the system of portable electric lighting used on the Pennsylvania Railroad, the method of establishing the temporary plant, cost, etc. He also referred to the Lucigen and Wells oil lights, which are especially adapted for use in such emergencies as wrecks, or where a strong light is required for outdoor work.

Mr. Taylor, in connection with his paper, exhibited a blue print, showing the details of construction of the electric car used on his road. Speaking of the Wells light, he said it was very successfully used at Johnstown during the great flood of last year, and that the Pennsylvania Road had ordered 100 of the machines.

Mr. M. B Leonard, of the Chesapeake and Ohio, followed with a paper on "The Electric Light in Railway Yards."

A short discussion followed the paper, during which Mr. Selden made some interesting remarks on train lighting by electricity, which were supplemented by further remarks on the same subject by Mr. Leonard An abstract of Mr. Leonard's paper will be found elsewhere in this issue.

President Williams then stated that as it was customary to appoint a committee at each meeting to make arrangements for the next one, he would name Messrs. Leonard, Higgins and Dugan as such committee to make the necessary preparations for the meeting to be held at Cincinnati next year.

He also read an invitation to the members of the Association, from Henry B. Thomson, who represents the Shaver Corporation, at the exhibition rooms, to be present at 8 P. M., and listen to some music on the cornet over the Molecular telephone which forms part of the exhibit.

Recess was then taken until 2:30 P. M.

When the time of assembling arrived there were few members present, and as there was an evident disposition to spend the afternoon outdoors, the time of recess was extended until 8:15 P. M

EVENING SESSION, Thursday.—The members of the association and ladies met at Exhibition Room and listened to a cornet solo over the Molecular telephone, which was well reproduced and enjoyed by the audience.

At 8:30 the members reassembled in convention, and the first business brought before the meeting was a proposition to reconsider the vote on holding the next meeting at Cincinnati and hold it at Detroit instead. The motion, however, was lost.

Mr. G. C. Kinsman, of the Wabash road, then read an able paper on "Train Despatching—Its Uses and Abuses," and was followed by Mr. H. S. Pritchard, also of the Wabash, on the "Railway Time Service." He fully described the system of distributing and regulating time on that road.

This closed the reading of papers. Some discussion took place on the question of meeting the extraordinary cost of printing the minutes of the session on account of the large number and length of papers read. It was finally decided that the members take as many copies as they needed above the number allowed each by the by-laws and pay for them *pro rata* at cost price.

A long and interesting discussion then took place on Mr. Kinsman's paper on "Train Despatching," and was followed by one on Mr. Pritchard's paper on "Railway Time Service." The regulation of clocks received considerable attention, and many valuable points were developed. Self-winding clocks were generally conceded to be particularly adapted for railroad work, chiefly on account of the fact that they were wound every hour. This frequent winding limited the variation of tension of the spring, which had the effect of giving uniform motion to the clockworks.

Mr. L. B. Foley, of the D. L. & W., suggested the advisability of providing the members of the association with badges for use at future meetings. After some discussion on the subject, Mr. Ralph W. Pope offered to supply the same for next meeting.

At 11:25 p. m. the convention adjourned *sine die*.

On Friday morning the members of the association left the Cataract House in a body and proceeded to Lewiston, at which point they embarked on a steamer for Toronto. Some of the party returned by the same steamer in order to catch the early evening trains for home and others remained over one boat. The trip was a most delightful one and thoroughly enjoyed by all. This excursion was tendered to the association by Mr. Foy, General Manager of the Niagara Steamboat Company. The weather, during the entire three days of the convention and the Toronto excursion, was most beautiful, and everyone in the party enjoyed himself or herself in a most thorough manner.

The following is a list of the members that were present at the convention:

C. A. Darlton, R. & D. R. R.; P. W. Drew, secretary and treasurer; C. Selden, B. & O.; G. L. Lang, N. Y. & N. E.; C. S. Jones, Illinois, Central; E. A. Smith, Fitchburgh; A. R. Swift, C. R. I. & P.; A. R. Lingafelt, C. R. I. & P.; W. J. Holmes, N. Y. L. E. & W.; C. W. Hammond, Mo. Pac.; R. Stewart, C. R. R. of N. J.; G. M Dugan, Illinois Central; G. T. Williams, N. Y. C. & St. Louis; L. B. Foley, D. L. & W.; G. C. Kinsman, Wabash; W. F. Taylor, P. R. R.; M. Magiff, Central Vermont; H. C. Sprague, K. C. M. & B.; W. W. Nichols, C. B. & Q.; I. T. Dyer, H. & St. Joe.; J. W. Stacey, Texas Pacific; A. Ramseur, R. & D.; M. B. Leonard, C. & O.; O. C. Greene, Northern Pacific; W. E. Lewis, Long Island R. R.; S. K. Bullard, M. K. & T.; J. B. Stewart, West Shore; H. C. Reed, M. L. S. & W.; U. J. Frye, C. M. & St. Paul. The ELECTRIC AGE was represented by Mr. Thomas R. Taltavall.

THE ELECTRIC LIGHT.

The Syracuse Electric Supply Company has secured the contract to light the village of Medina, N. Y., with the Thomson-Houston system.

The trustees of Keesville, N. Y., have contracted with the Thomson-Houston Company to install an electric light plant in that village.

The Thomson-Houston Company has the contract to build and equip the West End Electric Street Railway at San Antonio, Tex.

INCREASING LOCOMOTIVE TRACTION BY THE USE OF ELECTRICITY.

PAPER READ BY C. SELDEN, SUPERINTENDENT OF TELEGRAPH, BALTO. & OHIO R. R., AT RAILWAY TELEGRAPH SUPERINTENDENT'S CONVENTION, NIAGARA FALLS, JUNE 18TH.

Within a comparatively short time after the discovery of the electro-magnet by Professor Henry, scientific m nds began to centre upon the application of electricity and the use of magnets as a means of motive power; and the American inventor, Page, was, so far as our records show, the first person to practically demonstrate, upon anything like a large scale, that propuls'on by means of electricity and magnetism was a possible thing.

He constructed a car and placed upon it a motor, by which it was propelled between Washington and Bladensburg, a distance of about seven miles, on the tracks of the Baltimore and Ohio Railroad Company. As the electricity was generated from a primary battery, however, it was soon determined that such a mode of locomotion was more expensive than that secured by steam, and the motor, therefore, was laid upon the shelf.

Later on, when the dynamo reached a high state of perfection, the infant electromotor suddenly sprung into the vigor of young manhood, and to-day we find Page's idea amplified and assisted by various improved devices, resulting in not only possible rapid locomotion comparatively, but affording a cheaper means than horse power.

When Page made his trial trip, the locomotive engine was not the machine which to-day thunders along drawing a train, at the rate of seventy-five miles per hour, but as the locomotive engine has been undergoing improvements from time to time, it has been apparent that a great proportion of the power generated by this machine, could not be utilized for the hauling of loads; and, by reason of only partial combustion of fuel, loss by exhaust, and non-adhesion to the rail, or lack of traction power, only a small percentage of its power was available for use.

In order to increase the adhesion of the locomotive to the rail, increased weight was placed upon the drivers; this increased weight necessitated an increase of furnace, boiler and steam capacities, and an increase of, say, one hundred per cent., only brought an appreciable increase of a small proportion.

From competent authorities on motive power, it has been determined that a locomotive, having a weight of 100,000 pounds, has a tractive power upon the rail, when in best condition, of but 25,000 pounds. And when the rail, by reason of the weather, is in a bad condition, the tractive power amounts to only about what an engine of 15,000 pounds weight should have. In other words, on good rail, by non-adhesion, the locomotive gives but twenty-five per cent., and on bad rail, but eighteen per cent. of the power which, theoretically, should be had from it.

Efforts were made some fifteen years ago, by an Englishman named Wederman, to overcome the non-adhesion, by winding the spokes of the driving wheels with wire, thus making a magnet of the wheel, with the view of, by magnetism, attracting the wheel to the rail, thus increasing the friction, and, thereby, the adhesion to the rail on the part of the locomotive. Having but a primary battery, it is plain to be seen that the results were so slight as not to be appreciable. Another objection, even had the dynamo been used, was that, in order to secure sufficient magnetism to be of benefit upon such an immense machine as a locomotive, the magnets would have to be very large, and the winding upon the spokes of the drivers would have necessitated a change in the construction of the engine, so that as the bobbin was being revolved by the wheels there would be room to clear the fire box on the inside and the side rods of the locomotive on the outside. This, of course, would render necessary a longer crank-pin for the bars, and, being longer, it must necessarily be stouter in order to stand the increased leverage, so that a device of this character for the locomotive engine would not be economical, and would necessitate the reconstruction of all locomotives using it. This inventor filed patents in this country and several others followed in his footsteps, but nothing practical has yet been evolved from that method.

Elias E. Ries, an American inventor, secured letters patent upon his method of increasing the adhesion of the locomotive to the rail, by the use of electricity, and he took a wide departure from the path pursued by former inventors.

Mr. Ries proceeded upon the hypothesis, that an electric current of large volume, if properly employed, could be used to weld metals. Acting upon this theory, he proposes to arrange upon a locomotive, a dynamo of sufficient power to be run by a small auxiliary engine and to pass the current from the dynamo to the driving wheel of the engine, along the rail to the next driving wheel, through its axle and the other wheel to the other rail and back to the first driver, thence to the dynamo, thus making a local circuit, so to speak, which would travel with the locomotive, passing a current through the drivers and along the rail as indicated, and for this purpose, by a very simple method, he insulates one pair of the driving wheels.

By this means the inventor proposes to cause an "incipient weld" between the driving wheels and the rails. I say "incipient," because the wheels, being in motion, the weld, if any, is being made and broken by the revolution of the wheels, therefore a perfect weld is not obtained nor, of course, would it be desirable except for brake purposes, as in descending a grade for instance.

If the theory advanced by Mr. Ries can be made a success, practically, it means a great many things to the railroad world. If by means of this invention the tractive power of a locomotive is increased, say, even twenty-five per cent. it means ten additional cars on a forty-car train. It means a large gain in the hauling capacity on high grade railroads. It means increased speed for passenger trains. It means a saving, indirectly, of fuel; it means the employment of lighter locomotives to do the same amount of work as the heavier ones, thus being easier on the road-bed and bridges; it means the mounting of grades that would not be considered as possible at the present time. All this, provided that in practice, on a locomotive, the theories advanced shall hold good.

Through the kindness of the inventor I have borrowed, for this occasion, a model motor and a piece of track, which practically demonstrates, of course in a minor way, the correctness of his theory, and the more than probability that it may be applied upon a large scale.

As it would not be possible to secure a small engine propelled by steam with which to demonstrate the idea he employs this carriage which, as you all see, is simply a small electric motor.

The motor is charged by means of one or two cells of battery, and the track (when greater adhesion is desired) is charged from another cell or two of battery. The track is charged in this instance, instead of the motor carrying the power and charge for itself on account of its smallness and the weight which it would have to carry, as you can easily see, but the application is in effect the same as the other method.

You will note that one of the poles of the battery is connected to one rail and the other pole to the other rail; therefore, when the motor wheels are on this track, if a current be flowing along the rails, it will pass from the rail on one side, through the motor wheels, along the axle through the wheels on the other side to the rail, thence to the other pole of the battery completing the circuit, just as it is proposed to do by means of a dynamo on an engine.

To show that this circuit, passing in that direction, does not enter into the motor, I now make the connection. You notice that the motor remains quiet, thus proving that if any increase is hereafter shown in the power of this motor, that increase does not come by reason of increasing the *power* of the motor, by increasing the electro-motive force, but must come from the fact that there is an incipient welding or increase of adhesion, between the wheels of the motor and the rails, and that, therefore, its "torque" or "bight" has been so much increased as to enable the motor to have, as it were, an immovable fulcrum for its leverage, instead of one which is always slipping, as can be shown in the other case.

By making a twenty per cent. grade, which you will, of course, remember is twenty feet in the hundred, being over one thousand feet to the mile—and not usual—the motor is powerless to ascend and it remains at the bottom of the grade with its wheels revolving and slipping, unable to move.

If you now apply the circuit, so as to cause incipient welding between the wheels and the rails, the motor mounts the grade.

Another experiment—reduce the track to a level, fasten the motor to a Fairbank spring balance, start the motor and observe what strength it displays. In other words what is the amount of its pull in weight? The result, as shown on the scale is say, between five and six hundred pounds. Watch the motor when the traction circuit is made and the result is twenty-four hundred pounds—an increase of almost five hundred per cent.

These results are shown upon a rail which is dry and in the best possible condition for mechanical traction—And just here it occurs to me that I can picture in my mind, the woe-begone look on the face of the woman who is said to have gotten even with the railroad company, should she attempted to do so in like manner, with an engine equipped with this device and in successful operation. As the story goes, a woman living alongside the railroad, lost her cow, it having been struck by an engine; and as is customary in such cases this $30 cow became worth $50. When the papers in the claim reached the railroad company, naturally there was correspondence to and fro and delay in settlement of the claim. The woman's property happened to be adjacent a very bad curve, and as many of the trains had to use sand, she concluded that as the railroad company did not intend to accede to her demand, and was giving her a great deal of trouble, that it was no more than fair that she should do the same for them. It was at that time of the year when people in the country make soft soap, and with a goodly kettle-full of soap she proceeded to lather the track with it for a quarter of a mile. Prior to that, limited trains had passed by without stopping at the station near hear, let alone doing her the honor of stopping at her house, but they all stopped there that day and the following day, and again next day until the cause was discovered and the woman taken into custody.

If we take a piece of soap and soap the track—and in order to make it as soft as possible, I will put water on it besides—it becomes as slick as a toboggan slide, and the motor will not proceed. But if the traction circuit is applied, away she goes—soap or no soap.

For fear, per chance, that this soap has dried and has really become as sand upon the track, you may oil it. You will note that the oil makes no difference to the motor. This simply goes to prove, to my mind, that irrespective of the condition of the weather, be it rain or snow, the device, if practical in dry weather, is equally so on a bad rail; and being equally so, is a much greater help, proportionately, when the rail is in perfect condition.

Another feature of this invention is that it is not necessary to keep the current flowing all the time, unless you need it, but when you stop the train and want to start it, your locomotive, at that time, not being in motion, a more perfect weld is obtained thus enabling you to start at once, without slipping, and after you have gotten your train under headway, your current, if desired may be switched off. So much for the pulling power and so much for the motor.

To show the effect of this track circuit lift one end of the track and place across it a small iron bar, which is free to move from the top to the bottom of the grade, and the bar may be pushed or allowed to slide by its own weight with the same result. You will see it does not reach the bottom of the grade. On the other hand you can stop it at will, for the instant the circuit is applied the bar stops And you will note that you can take hold of the bar and shake the track with it: in fact, lift it, thus proving conclusively that with the circuit as used through this track, the motor operates exactly as it does with the bar, and that the ability of this motor to climb grades, and the increase of its pulling capacity is due entirely to the tractive results of incipient welding between the wheels and the rails.

There is no doubt of what the model performs. There is no doubt that the theory is correct, but practical tests alone will determine whether or not sufficient power can be had from a proper dynamo and auxiliary engine, to show even twenty-five per cent. of such increase upon a locomotive as has been shown here. If it can, then great results are sure to follow.

It is but fair to state that one trial of this device has been made upon an engine. The reports upon the subject, while tending to show possibly a slight effect, did not show an effect so appreciably large as to warrant the statement that it had been successful. The engineer said that it was a great sand box. To my mind, however, (being acquainted with the circumstances and with the amount of electric power used on that occasion) I do not consider the test as having been in anyway fair to the device. I do not mean unfair on the part of the people who were making it, but I mean unfair in this sense: that I would as soon have expected to extinguish a house on fire, loaded with rags and petroleum, with a pint of water, as to have expected the volume of current employed, to have performed what was attempted. A dynamo built for a thirty-five ton engine, was placed on a sixty-five ton eight wheeler; and, to my mind, it almost was the same as trying, with a few cells of battery, to perform the work that a dynamo is called upon to perform in arc lighting.

I understand that the inventor has recently made arrangements to make a trial on a large scale, which will prove, conclusively, either the usefulness of the device, or its impracticability upon a large scale; and as railroad men, and especially electrical men, we are, of course, more or less interested in anything of an electrical nature, which becomes, or is liable to become a part and parcel of railroad equipment. Possibly at our next meeting this matter will have been tried; if so, whether it be successful or not, I hope to be able to present you with all data in connection therewith.

I will now perform for you the experiments about which I have been talking, so that you may see the corroboration of the statements made.

ELECTRIC RAILWAY OPENED.—The first electric railway in Indianapolis, Ind., was opened a few days ago. The operation of the Thomson-Houston cars gives entire satisfaction, and on the trial trip of the first car six miles were covered in twenty minutes.

THE PHONOGRAPH IN LYNN.—Prof. Elihu Thomson, of Lynn, Mass., has paid a fitting tribute to his great contemporary, Edison, by placing a phonograph in his new house, and another in his private office the convenience of which will be readily understood by those acquainted with the workings of the instrument.

THE EXHIBITS AT THE RAILROAD SUPERINTENDENTS' CONVENTION.

Mr. P. B. Delany was present and exhibited his Line Adjuster, Electric Counter and the Screw Posts which we recently described. All of his devices attracted marked attention.

The Edison Phonoplex System was in practical operation to Syracuse, a distance of 185 miles. A Western Union wire was used, and the instruments worked with entire satisfaction. A favorable impression was evidently made, and there was considerable interest taken in the operation of the system. Mr. W. S. Logue had charge of this exhibit and was kept busy answering questions and explaining the system in detail.

An attractive display was made of the various types of the Edison-Lalande Battery. Mr. James F. Kelly, the general sales agent for this battery at 19 Dey street, New York, was present in person, and made a very favorable impression for the battery. The cells on exhibition ranged from the 15 ampère-hour cell to that of 600 ampère-hours. Mr. Kelly had also on exhibition a cautery cell made with double copper frames holding four oxide plates and three zinc plates. This battery gives a current of 20 ampères.

The Shaver Corporation gave a practical exhibition of the Molecular Telephone over a circuit of 1,000 feet in length. A diagram hung over the telephone showed the route of the wire, which had ten angles in it. Conversation was carried on satisfactorily notwithstanding the racket in the room caused by the operating railway signals, gongs, bells, etc. The strains of a cornet at the other end of the circuit were distinctly heard all over the room. This exhibit was in charge of Mr. Henry B. Thompson, who very ably explained the operation of the telephone.

Mr. C. A Scott represented the Union Switch and Signal Company, of Swissdale, Pa, and presented each person with a reference book giving complete details of the company's system.

The Pennsylvania Steel Co., of Steelton, Pa., had a fine display of their system, including semaphores The display included the new interlocking feature of the system, which adds much to its general efficiency. This system was fully described and illustrated in the ELECTRIC AGE some months ago. The company's interests were in charge of Mr. H. M. Anderson, the special agent of the frog, switch and signal department, and Mr. M. W. Long.

The Electric Secret Service Company's Exhibit attracted much attention. Mr. Thomas Sturgis, the president of the company, was personally in charge and explained the objects and the valuable features of the system.

Mr. Wm. F. Z. Desmt, vice-president and superintendent of the Desant Electric Company, of Columbus, Ohio, gave a practical illustration of the operation of the locomotive cab signaling system of that company. The system is a most complete and reliable one, and is, withal, the cheapest of all automatic signal systems. Mr. Desant had a small outfit, comprising circular track (six feet in diameter), steam locomotive, cars, etc. This system gives both visual and audible signals to the engineer in the cab, and can also be used to operate semaphores and other methods of signaling.

The Hall Signal Company, of 50 Broadway, New York, had a large and complete exhibit of their system. Mr. Hall himself and Mr. Marsh A. Young, the manager of the company were present, and explained the operation of the system.

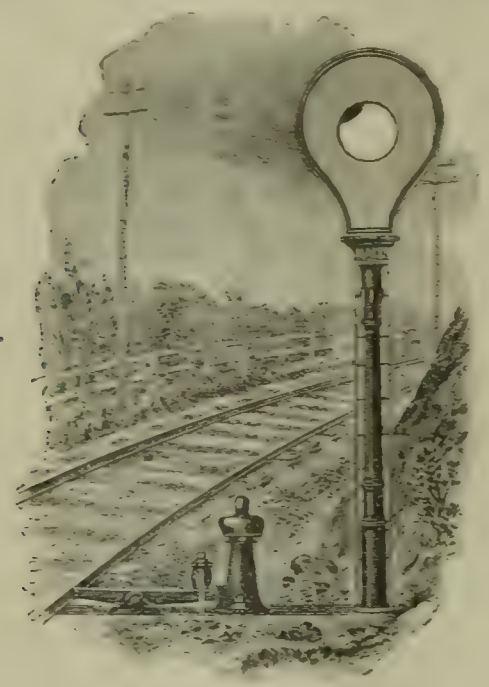
TRIENT.—The streets of the old episcopal city of Trient are now lighted by electricity. Trient is the first city in Austria proper to adopt the electric light municipally.

FIRED BY LIGHTNING.—Lightning struck a large warehouse on Union Wharf, Salem, Mass., on June 6th, setting fire to the building. The building and several hundred bales of cotton were destroyed.

THE HALL RAILWAY SIGNAL SYSTEM.

In the paper read by Mr. Robert Stewart, of the New Jersey Central Railroad, at the Convention of Railway Telegraph Superintendents held at Niagara Falls, June 18th and 19th, the system of the Hall Signal Company of New York was fully described. The system was first used on the Eastern Railroad now the Boston & Maine in 1871.

In this system the signal is now operated on a closed circuit running from the battery through the "block" track instrument, through the magnet of the signal instrument, through the points of the relay, through the relay magnets back to the battery, thus completing a circuit which holds the signal to "safety," simply by the force of the circuit. By the momentary breaking of the circuit, by the passage of a train over the closed spring track instrument the magnets of the relay are demagnetized, the points are separated, and the signal falls to "danger" by gravity, from a lack of force to sustain it in the "safety" position. It will also be seen that from any cause, such as the breaking or crossing of the line wire, the failure of the battery, or any of the mechanical parts, the signal will immediately go to "danger" by the interruption of the circuit. After a signal has been set at "danger" it cannot be restored until the train shall have



HALL RAILWAY SIGNAL.

operated the "clear" (open spring track instrument at the end of the section).

The "clearing" circuit runs from the battery through the open spring instrument, then through the relay magnets back to the battery. On completing the circuit through the "clear" track instrument, the relay magnets are magnetized, the points of the relay are again brought in contact, the former circuit is therefore completed, and the signal again goes to "clear." If a switch on the main line is misplaced, a circuit is broken in a switch machine attached to the switch which also causes the signal to fall to "danger." The signal instrument is certainly most simple in construction, consisting of a pair of electro-magnets, between the prolonged coils of which revolves an armature, to one wing of which is attached the disc, and to the other its counterweight rod, which being lighter than the signal, allows of a gravity movement of the signal whenever the forces holding the signal is withdrawn. In the "Hall track instrument" the piston on being thrown up by depressing the lever breaks, or makes a circuit on the top plate. This piston is operated in an air chamber, which cushions the upward blow, and also retards its fall, thus saving all wear to the apparatus.

ELECTRIC LIGHT IN THE RAILWAY SERVICE.

ABSTRACT OF PAPER READ BY MR. M. B LEONARD, SUPT. OF TELEGRAPH OF THE CHESAPEAKE & OHIO R. R, AT THE CONVENTION OF RAILWAY TELEGRAPH SUPERINTENDENTS, NIAGARA FALLS, JUNE 19TH, 1890.

The extraordinary development during the past decade of years of the art of lighting by electricity, and the success attending its daily use on our streets and in our houses have been so apparent that its utility and benefits were quickly recognized in the railway service, not only in this country but abroad, with this difference, however, that in the United States only the illumination of depot yards and train sheds by means of the arc lamp was at first attempted, while in Europe the lighting of trains and station houses primarily engaged the attention of the profession. Yet the advantages of the new illuminant have been so manifest, and its adoption so extensive, that in this country nearly all of our important passenger trains are lighted by electricity, and across the water the arc light has met with such favor that in one station of the Great Western Railway of England (Paddington) not less than 100 arc lamps are in use, while the French, German and Italian railways are gradually lighting up the larger yards and stations in this way.

The introduction of the arc light in the railroad yards here was found to work wonderful improvement in the making up of trains and switching of cars at night. It enables the yard and engine men to see one another almost as clearly as in sunlight, and in addition to prevent accidents, permits the work to be done with almost as much dispatch as during daylight, while without the light double the amount of time would be required to perform the same service, and even then with less safety to machinery, cars and men. An extended inquiry among the men using these lights develops the general belief that they pay for themselves several times over in the single item of repairs saved to rolling stock by enabling engine men to do the switching more carefully and with less damage to the cars.

Reference was made by Mr. Leonard to the experiments recently instituted in Germany to ascertain the candle power of arc lamps, in which it was found that in a Siemens differential lamp with a current of 14 to 15 ampères and E.M.F. of from 48 to 52 volts, the horizontal intensity was about 196 candles, increasing rapidly to about 20 degrees below the horizontal, where it was 1,150 candles, then more slowly until it reached a maximum of about 42 degrees below the horizontal, where the light was 2,014 candles; it then began to sink rapidly until below 60 degrees there was no light, but only shadow, the average intensity was 1,228 candles, without the globes.

The new Saunderson arc lamp was also alluded to, where by means of a hollow lower cylinder connected by a wick with a reservoir of oil, hydro-carbon vapor was given off in the arc, nearly doubling the efficiency of the same in watts per candle, according to the tests made by Dr. Hopkinson, of London, a single drop of the oil lasting nearly a minute.

The efficiency of the arc lamps for locomotive head-lights was shown, and the new improvements described briefly.

Electric light in switch-stands was next taken up, and the plant of the Southern Pacific Ry. Company at Oakland, Cal, fully described. At that point 134 lamps are now lighted by the automatic and interlocking signals, switch-stands, switch-lights and signal towers, 31 of these lamps having underground wire connection.

The signal lamps are 38 volt, and are wired from 10 to 15 in multiple, according to the number of lamps within convenient distance to form a group, so reducing the E.M.F. that the lamps use only from 20 to 28 volts pressure, thus lengthening their life and yet giving a sufficient amount of light to illuminate the bull's eye lens of the lantern.

In wiring up the lamps, for the purpose of preventing trouble, in case they should break or are burned out, a simple switch is used with paper between the contact points so that in case a wire to a number of lamps is broken, an arc will form at the switch, burn the paper and thus close the circuit.

The lamps first installed over three years ago are still in use, and have required no other care or attention than renewing the underground wire to two of them. The cost for repairs and maintenance for all of these lamps does not exceed $90 per month.

NEW YORK NOTES.

Mr. H. C. Whitney, of the Crosby Electric Company, has just returned from an extended trip through the West and reports large sales of their battery. The company are receiving orders and making large shipments to the English market where it has made a marked success. The company is way behind their orders.

The Metropolitan Telephone and Telegraph Company are to build a seven-story brick and brown-stone front office structure on the northeast corner of Broad and Pearl streets, at a cost of $250,000.

S. D. Greene, manager of the Chicago office of the United Edison Manufacturing Company, is in town this week.

The Dessant Electric Company of this city are now equipping the suburban elevated road north of the Harlem River with twenty of their signals, and are going to have the official test sometime this week. A full report of the test will be given in our next issue.

The Elektron Mfg Company, of Brooklyn, has just issued a neat little pamphlet relating to battery motors and batteries and their applications The pamphlet is issued to meet the large demand among the general public for information as to the details of such plants, and the information given is written in such a way that any one without any knowledge whatever of electrical matters may understand it The company reports a constantly increasing demand for Perret motors, especially for the multipolar low speed type which is used in all sizes above 2 horse power. The Elektron Company has recently been obliged to enlarge their works materially, and are about to take an additional floor in the building which they now occupy, and which is one of the best factory buildings in the city. This will give them nearly the whole building. Mr. Perret has just returned from a trip to Iowa, bringing an order for several 15 horse-power motors to be used in coal mining. A part of them will be combined with under-cutting machines, taking the place of compressed air apparatus used heretofore.

R. J. G.

PERSONAL MENTION.—A jolly party, under the charge of Mr. L. B. Foley, Superintendent of Telegraph of the Delaware, Lackawanna and Western road, consisting of Superintendent Robert Stewart, of the New Jersey Central road, his son and daughter, Miss Tilly Lu, Mr. C. H. Church and Dr. J. C. Morton, of New York; Superintendent W. E. Lewis, of the Long Island Road, and Mr. Thomas P. Taltavall, Editor of the ELECTRIC AGE, went to the Falls to attend the convention, leaving New York Tuesday evening, on the D. L. and W. Road. Mr. Foley's many thoughtful and kind attentions during the trip, both will long be remembered by those who made up the party. The trip was a delightful one and was thoroughly enjoyed by all. Mr. A. O. Tate, of the Edison Laboratory, Orange, N. J., was present during the convention, looking after the Edison interests. Mr. Tate reports that considerable interest was manifested in the Edison-Lalande battery and the Phonoplex. The phonoplex circuit worked perfectly, and a decidedly favorable impression was produced by it.

MORE ELECTRIC CARS FOR RICHMOND.—The city of Richmond, Va., will always be rembered by street railroad men as being the place where the superiority of electric over other methods as a means for propelling street cars was first demonstrated. Although the apparatus installed in Richmond for street railway work was almost the first which had been designed for operating a street railway of any considerable size, the results, as our readers well know, were such as to call forth the admiration of street railway and electrical engineers, and was the direct precursor of the great impetus in electrical equipment which has since followed. Experience has taught a great many things, and there has been a large number of changes made in the design of electrical apparatus, but it is interesting to note that Richmond is still enthusiastic over electric traction, and that the two other important roads in the City of Richmond, Richmond City Railway and the Richmond and Manchester Railway have decided to supplant animal power by electric power. These contracts, one with the City Railway Company calling for ten cars, and the Richmond and Manchester Road calling for five cars, were closed by the Sprague Electric Railway and Motor Co. during the last month.

BOOK NOTICES.

DERIVATION OF PRACTICAL ELECTRICAL UNITS.—By Lieut. F. B. Badt and Prof. H. S. Carhart, Electrician Publishing Company, Chicago, Ill; pp. 56, twelve illustrations. Price, 75 cents.

The reading matter of this little volume consists mainly in biographical sketches of the eminent physicists whose names have been selected to designate the practical electrical units. These are Weber, Gauss, Ampère, Coulomb, Volta, Ohm, Faraday, Watt, Joule, Dr. Werner von Siemens, Sir William Siemens, Daniell and von Jacobi. Accompanying each biography a portrait of the subject is given, except in the case of Coulomb, whose features are not portrayed. The last chapter of this book describes the modifications of the practical electrical units. This little work will no doubt find a hearty welcome among electrical people in general, as it gives information regarding these eminent scientists that cannot easily be obtained elsewhere. It brings to a focus the personalities of these investigators who are much talked about by electricians, but whose personal histories are little known among those who ought to know them best.

ELECTRICAL ENGINEERING.—By W. Slingo, Principal of the Telegraphists' School of Science; Director of the Electrical Engineering Section, People's Palace, London, and A. Brooker, Instructor in Electrical Engineering at the Telegraphists' School of Science, and at the People's Palace, London. Longmans, Green & Co., London and New York.; pp. 631, with 307 illustrations. Price, $3 50.

This book is born of the very general demand existing among electric light artisans and students for a single work covering the whole field of electric lighting. The scope of the book will be best appreciated by giving the contents by chapters and the number of pages devoted to each subject: I., Current, Potential, Conductors, Insulators (11 pages); II., Practical Units, Ohm's Law, Fundamental Units (31 pages); III., Primary Batteries (39 pages); IV., Measurement of Current Strength (49 pages); V., Measurement of Resistance (32 pages); VI., Measurement of Electro-Motive Force (39 pages); VII., Electro-magnets, Electro-magnetic Induction (28 pages); VIII., Dynamo Electric Machines (alternate current), (40 pages); IX., Dynamo Electric Machines (direct current), (47 pages); X., Direct Current Dynamos (continued), (63 pages); XI., Direct Current Dynamos (open coil), (22 pages); XII., Motors and their Applications (42 pages); XIII., Transformers (22 pages); XIV., Secondary Batteries (26 pages); XV., Arc Lamps (34 pages); XVI., Incandescent Lamps, Photometry (50 pages); XVII., Installation Equipment, Fittings, etc. (47 pages).

To cover the entire electric light field with one volume is a large undertaking, but an examination of the contents of this book shows that it was not too large for accomplishment by the authors. They have succeeded very well in their task. The work, too, shows that it is of master hands, and it is as complete as anything we have ever seen. It deals with the theoretical as well as the practical side of the subjects discussed, but in such plain language that we do not apprehend that any one will find any difficulty in mastering the subjects. One great feature of this volume is the clearness with which the subjects are illustrated. Not only are the instruments and machines shown complete, but also in detail. It is extremely difficult, in fact quite impossible to describe the details of some machines in language clear enough to be understood; whereas one simple diagram might make every obscure point clear at a glance. This fact has been taken advantage of in the production of this work, and the result is, one look at many of the illustrations tells a story that ordinarily might require several pages of type to explain. Even then there might be some doubt in the mind of the student as to whether he thoroughly understood the subject. Detail illustrations are very essential in a work of this character, and greatly facilitate the study and understanding of the subjects discussed. This book should meet with a hearty reception among electricians and students of electricity, for it is one of the most comprehensive works ever published. Everything that is necessary to a clear understanding of electric lighting and kindred subjects is found in this volume, and we think that every individual of the classes mentioned would greatly further his own interests by possessing and studying this work.

LIST OF ROADS IN OPERATION OR IN COURSE OF CONSTRUCTION UNDER SPRAGUE SYSTEM--JUNE 19, 1890.

	CARS.
Akron, Ohio—Akron Electric R'way	25
Asheville, N. C.—Asheville Electric R'way	9
Atlantic City, N J.—Atlantic City Electric R'way	17
Augusta, Ga.—Augusta Street R'way	16
Baltimore, Md—North Ave. Electric R'way	1
Berlin, Germany—Elekt. Eisenb. der Allgem. Elek. Ges	3
Bay Ridge, Md.—Bay Ridge Electric R'way	2
Binghamton, N. Y.—Binghampton Street R'way	28
Brockton, Mass—East Side Street R'way	4
Brooklyn, N. Y.—Jamaica & Brooklyn Street R'way	4
Brooklyn, N. Y.—Coney Island & Brooklyn R'way	2
Buffalo, N. Y.—Buffalo Street R'way	4
Butte City, Montana—Butte City Electric R'way	5
Canton, Ohio—Canton Street R'way	14
Chattanooga, Tenn.—Chattanooga Electric R'way	16
Chicago, Ill.—Cicero & Proviso R'way	12
Cincinnati, Ohio—Cincinnati Incline R'way	30
Cleveland, Ohio—B'way & Newburgh Street R'way	24
Cleveland, Ohio—East Cleveland Street R'way	95
Colorado Springs—Colo. El Paso Rapid Transit Co.	18
Columbus, Ohio—Glenwood & Greenlawn St. R'way	5
Council Bluffs, Ia.—Omaha & Council Bluffs R'way	2
Dallas, Texas—Dallas Rapid Transit R'way	3
Davenport, Iowa—Davenport Central R'way	6
Davenport, Iowa—Davenport Electric R'way	4
Dayton, Ohio—Dayton & Soldiers Home R'way	2
Denver, Colorado—Denver Cable R'way	2
Denver, Colorado—University Park R'way	3
Denver, Colorado—Colfax Ave. Electric R'way	5
Denver, Colorado—Capitol Hill Line	1
Denver, Colorado—West End Electric R'way	13
Des Moines, Iowa—Des Moines Electric R'way	2
Detroit, Mich.—Detroit, Rouge River & Dearborn R'way	5
Dubuque, Iowa—Dubuque Electric R'way Light & Power Co.	12
Dubuque, Iowa—Key City Electric R'way	4
Eau Claire, Wis.—Eau Claire Street R'way	6
Elgin, Ill.—Elgin City R'way	9
Erie, Pa.—Erie Electric Motor Co.	21
Florence, Italy—Firenzi & Fiesole R'way	12
Fort Worth, Texas—Fort Worth & Arlington Hts. R'way	3
Harrisburg, Pa.—East Harrisburg Pass. R'way	11
Hartford, Conn.—Hartford & Wethersfield R'way	4
Kearney, Neb.—Kearney Electric R'way.	2
Keokuk, Iowa—Keokuk Electric Street R'way	6
Lafayette, Ind.—Lafayette Electric R'way	9
Laredo, Texas—Laredo Improvement Co.	7
Lexington, Ky.—Lexington Pass & Belt R'way	10
Long Island City.—N. Y., Long Island City & Newtown R'way	2
Los Angeles, Cal.—Electric Rapid Transit R'way	10
Marlboro, Mass.—Marlboro St. R'way	6
Milwaukee, Wis.—West Side St. R'way	30
Minneapolis, Minn.—Minneapolis St. R'way	100
Moline, Ill.—Moline Electric R'way	3
Nashville, Tenn.—So. Nashville St. R'way	10
Nashville, Tenn.—Nashville & Edgefield St. R'way	10
Nashville, Tenn.—Citizens Rapid Transit Co.	5
Newark, Ohio.—Newark & Granville St. R'way	4
Newark, N. J.—Rapid Transit St. R'way Co.	16
Omaha, Neb—Omaha St. R'way	37
Paducah, Ky.—Paducah St. R'way	9
Piqua, Ohio.—Piqua Electric R'way	6
Pittsburgh, Pa—Federal St. & Pleasant Valley R'way	45
Plattsmouth, Neb.—Plattsmouth Electric R'way	2
Portland, Oregon.—Metropolitan St. R'way	10
Portland, Oregon.—Miltonah St. R'way	10
Port Townsend, Wash—Belt Line Electric R'way	4
Portland, Oregon.—Willamette Bridge R'way	6
Quincy, Mass.—Manet St. R'way	2
Reading, Pa—East Reading Pass R'way	6
Reading, Pa.—Neversink Mt. R'way	4
Richmond, Va.—Richmond City R'way	10
Richmond, Va—Richmond Union Pass. R'way	42
Richmond, Va.—Richmond & Manchester St. R'way	5
Salem, Mass.—Naumkeag St. R'way	6
Salem, Oregon.—Capital City R'way	2
Salt Lake City, Utah.—Salt Lake City R'way	35
Salt Lake City, Utah.—Salt Lake Rapid Transit Co.	9
San Antonio, Texas.—San Antonio St. R'way	10
Scranton, Pa.—Peoples Street R'way	20
Sedalia, Mo.—Sedalia St. R'way	4
Sherman, Texas.—College Park Electric Belt Line	5
Sioux City, Ia.—Sioux City St. R'way	25
Sioux Falls, So Dak.—So. Dakota Rapid Transit Co.	3
Sterling, Ill.—Union Electric R'way	7
Steubenville, Ohio—Steubenville Electric St. R'way	8
Stillwater, Minn.—Stillwater St. R'way	5
St. Joseph, Mo.—Peoples St. R'way	18
St. Joseph, Mo.—Union Pass. R'way	20
St. Joseph, Mo.—Wyatt Park R'way	18
St. Louis, Mo.—Lindell St. R'way	80
St. Paul, Minn.—St. Paul St. R'way	80
Tacoma, Washington.—Tacoma St. R'way	34
Tokio, Japan—Tokio Electric R'way	2
Troy, N. Y.—Troy & Lansingburgh R'way	24
Utica, N. Y.—Utica & Mohawk R'way	5
West Bay City, Mich—West Bay City St. R'way	12
Wilkesbarre, Pa.—Wilkesbarre & Suburban R'way	8
Wilkesbarre, Pa.—Wilkesbarre & West Side	3
Wilmington, Del.—Wilmington City Electric R'way	10
Winston & Salem, N. C.—Winston & Salem St. R'way	10
Youngstown, Ohio.—Youngstown Electric St. R'way	6

THE DESSANT ELECTRIC AUDIBLE SIGNAL.

A model of the Dessant Electric Audible Danger Signal was exhibited at the convention of Railway Telegraph Superintendents, at Niagara Falls, and excited a good deal of favorable comment. This signal is of the type known as the block signal, that is, a train entering a block at one point sets the signal to danger until it enters the second block, when it sets the second to danger, and the first back to safety.

The danger signal in this instance is a semaphore arm set to danger and a whistle blown in the cab of the locomotive.

Thus, in case of fog, heavy snow storm, or color blindness, this signal is indispensible, giving both a visual signal on the road, and an audible signal on the locomotive, so the engineer can hear his signal if he does not see it. In the paper read by Mr. Robert Stewart, at the Convention of Railway Telegraph Superintendents, held at Niagara Falls, June 18th and 19th, this system was fully described, as follows:

The entrance to a "block" is insulated in two places within one hundred feet of each other. The first insulation is for the purpose of signaling to a train, and the other for setting the relay on the track. The wires from these points are led to a relay connected to the contact springs; the contact springs are worked by two pairs of magnets, one for setting the signal to "danger" or closing the circuit, the other for opening the circuit, or setting to "safety." The wires from the first relay are run two to the first insulation, or signal point, two to the second insulation for setting the instrument to contact, or "danger." The wires from the second relay run the same as above, with the exception of a line wire running back to the first, to set back to "safety." Five cells of battery are necessary to work this signal at each "block." This signal can be connected to switches, drawbridges, tunnels, etc. The locomotive is fitted with an instrument consisting of a pair of magnets, an armature, and a small weight connected with the whistle valve; the wires are run one from the truck of the tender through a coupling, and the other from the frame of the locomotive to the instrument. The locomotive thus has two terminals always on the rails, namely, the wheels of the locomotive and tender. The action of the signal is, when a train enters a "block," the first insulation is passed, being the signal point; if at "safety," the track is not charged, consequently there will be no signal, but on passing the second insulation, the current is switched into the relay, turning it to "danger" and charging the track for the following train. On entering the second "block" the train switches the first relay back to "safety" and the second to "danger." The principal claim of this company is, that they are able to connect their system with any of the semaphore signals at present on the market, thereby giving both a visual and audible signal on the same "block." In doing this, it is claimed that it is only necessary to equip the engine with their instruments, no relay on the road being necessary. This is done by connecting the movement of the semaphore electrically with the rail, so that when the semaphore is down the circuit is closed to the rail, and when up the current is cut off. The batteries are all distributed along the road, each "block" being independent of another. It is now in operation on the Suburban Road, north of the Harlem River. The system is owned by the Dessant Electric Co., of 45 Broadway, New York.

PRACTICAL APPLICATION OF STORAGE BATTERIES TO CAR TRACTION WORK.

BY J. K. TUMELTY.

(Continued from June 7.)

The knowledge that electricity is a power that can be harnessed like a horse and controlled for work is an old story to-day. The later knowledge that electricity can be confined like gas in a case or box and made to do work at any time and anywhere the box or reservoir is taken is of more recent date. The storage battery is practically a reservoir of electrical power. Although this power is made and retained by the aid of electro-chemistry, and gives out more or less work as the reservoir or battery is well or badly made, fully or partially charged.

At our present writing the knowledge of the storage battery, its peculiar chemical action, and its uncertainties are well enough understood by those who make and handle them, and upon the two mentioned conditions, to-wit: mechanism, which means durability, and proper charging and discharging, which means working efficiency, depends the commercial value of a storage battery.

The mere chemical action is the same in all; the manner in which they are made is the same in nearly all of them; the faults are the same, except in a few. There is one storage battery which differs in many ways in its mechanism, and has proved to those who have tried it to show unusual durability. This battery is mentioned here merely to show that estimates hereinafter made, which depend so completely upon durability can be depended upon, since without durability it is useless to make estimates at all. We must not be compelled to say that the electro-chemical force exhibited by a battery is so and so, if the battery would only last. Such uncertain data shown to a practical railroad engineer would gain merely a shrug of the shoulder and the remark probably that he had no time to fool away. Suppose then that a battery has proved itself durable under severe work for a year, and looks in every way uninjured, we may then be allowed to make estimates and compare figures.

At the present moment weight of material composing a battery seems to be a criterion of its efficiency, that is, the greatest number of atoms in the least extent of surface that can be acted upon by electrolysis will promote the most constant efficiency.

Allowing that this is a fact, then the effort which is being made to produce a lighter battery by the use of materials less heavy than lead. will not be entirely successful; for although we might use more batteries, or individual cells, and thus make up efficiency in this way, and even be able to use cheaper material than lead and its oxides, such as iron and manganese, for instance, we find the space occupied is a matter of moment in our traction work, so the line must be drawn somewhere. It is well known, and is now a fact upon which estimates for traction work are made, that each cell gives a fairly constant pressure of two volts, and that the quantity of current in ampère hours depends on the size of each cell, that is, upon the accumulated number of atoms and molecules exposed to the action of electrolysis. Pressure in volts multiplied by quantity of ampères delivered or running out of the battery per hour gives us a result in watt hours. Watts divided by 746 give us the number of horse-power hours we have in a certain delivered current. Hence if our work demands so many horse-power per hour we can estimate approximately how many cells to use and how large. It is pretty well established now that a car weighing 7,000 lbs., including batteries, and carrying 30 people, uses, after it is started, about 4½ horse-power on a level, running say at eight miles an hour; hence we would need, say, 100 batteries, representing a pressure of 200 volts and 18 ampères, if this was the average load and speed, and the car could be started from an outside force. Then 150 cells of 150 ampère hour capacity, and weighing about 35 lbs. each would run 150 divided by 18, or eight hours and forty minutes. But we must overcome the inertia of a standing loaded car by resources within the battery. This often demands a force of 25 horse-power, which for a moment calls for a large flow of ampères, say 80, and as our electro-motive force in volts is, as before, 200, we can only estimate what we have taken out of our stored power approximately; but we know, of course that the oftenener we have to start a load under these circumstances the more we draw from the battery this intermittent current.

Then the practical working of a street railroad with storage batteries depends on the condition of the road, its frequency of stops and starts, and its grades. Experiments on a Paris tramway, referred to in the first portion of this article, will show what increased horse-power is needed on certain grades, and what increase of ampères is needed to make up this horse-power. The pressure in volts being always the same for a car on which 100 batteries of 200 volts is carried. It will be seen that in this experiment 200 volts was the constant electro-motive force used. With a current of 16 ampères a car of the weight mentioned above and carrying thirty persons ran over a level grade at the rate of eight miles an hour calling for 4½ horse-power.

When passing over a one per cent grade at the same speed eight horse-power was needed, and 29 ampères of current at 200 volts pressure. Climbing this grade at a lower speed of 4½ miles an hour about 18 ampères was required.

Two per cent. grade, 8 horse-power, taking 29 ampères, 8 miles an hour.

Three per cent. 11 horse-power, 42 ampères at same speed; at a speed reduced to 4½ miles an hour on a grade of 3 per cent. 12½ horse-power, 46 ampères.

Four per cent. grade, 15 horse-power, 57 ampères, 3½ miles an hour.

Four per cent. rise, 10 horse-power, 38 ampères.

Five and a half per cent. rise, 11 horse-power, 40 ampères.

As for the economy of storage batteries over the Trolley System with overhead wires, we can estimate the steam power needed to charge a number of sets of batteries for say seven cars, and that necessary to keep dynamos running to drive seven cars by the overhead system. We learn that on the Minneapolis line, where seven cars are run constantly it necessitates 260 horse power engine always at work. To charge 700 cells of battery with a current of 40 ampères would need four dynamos of 20 horse power each, or eighty horse power, running four hours. If the batteries cost, say, $8,000 it would be less than the cost of the copper in the overhead wires and keeping them in repair. A properly made battery, such as referred to above, ought not to cost over $100 for keeping it in order for the first year, and about ten per cent of first cost for all repairs and renewals for five years. The Patton motor combination needs for each locomotive car hauling a trailer only 7½ horse power dynamo and gas engine, and 60 cells of storage battery. Seven locomotive cars would need 50 horse power and would pull seven trail cars loaded. This system seems the most practical and economical of all, using fuel in the most condensed and available form, the distance run depending only on the amount of fuel which could be taken on at stations in the same manner that coal is by steam locomotive. In this case the batteries are always at hand to start the gas engine and to store up the current that may not be needed in running down grade. If the oil carried gives out near the supply station the battery will run the train for some miles.

Referring to the average horse power needed on a level track, mentioned in the experiments alluded to, we find that 4½ horse power does most of the work, over a good share of most street tracks. As the dynamo on the Patton motor car delivers a current of 200 volts and ampères sufficient to make 7½ horse power, the 60 batteries are always receiving a current equal to 3 horse power, when the greater part of the car driving work is being done. So when the grades or curves or starting is encountered, the batteries deliver the necessary current and electric motive force in watts to produce 15 or 20 horse power, for which current the motor is wound. Now as the dynamo works most economically when carrying its full load, there is no actual loss in charging the battery; and if the road is long, level grade, and few stops, the battery alone does much of the work and the engine for a time is shut off. More will be written of this combination in the near future.

In closing, the writer is strongly of the opinion that, in order to avoid carrying too much weight of batteries, and still have a high voltage, the trips on the road should be shorter and the renewal of batteries more frequent. A battery made in a horizontal position, with absorbant inert fiber of pure cellulose between the plates, and when the poles, both positive and negative, are placed in the centre of the plates opposite each other through which a heavy copper rod runs and is buried in the lead, like the one referred to above, invented by the writer, will be strong enough and flexible enough to receive a charge of 50 ampères per hour and would not weigh over 25 lbs. each, and would have and ampère hour capacity of 90 ampère hours. This would run on an average a car for three hours, thus making, say, a thirty mile trip, which would allow time enough to charge the battery taken out on the previous trip, and being light and easily handled in groups of four, they could be changed in three or four minutes. Then if connected in groups of twenty-five, on the cars, in parallel, with a four point switch in the hands of the driver on the platform, in starting he could use his switch as an engineer does the throttle to his engine. By moving the switch one point, the motor would receive a current of say thirty ampères and fifty volts, feeling the influence slightly, just enough to move the armature. His next turn of the switch is to throw in fifty cells in parallel, which would probably move the car with an E. M. F. of 100 volts and 25 ampères, or perhaps more. When still in motion, the next turn throws the 100 cells in series, with an E. M. F. of 200 volts and probably 16 ampères, which as we have seen is the average flow of ampères at eight miles an hour. This motion, of course, need take up but two or three seconds of time. In stopping or slowing up, the reverse turn of the switch would have the proper effect until the motor could be reversed in an instant to stop the car dead without using the wasteful brakes. A short resistance wire between the sections of the switch would prevent the heavy sparking and flashing, which would otherwise be an objection.

ARC LIGHT FORMULA.—Mr. Tischendorffer, of Vienna, gives a formula for the relation between current and lighting power for arc lamp. He says that L being the lighting power, and C the current, $L = 100 \left(C + \left(\frac{C}{4} \right)^2 \right) - 200$. This gives the following values:—

C	L	C	L
2	25	16	3,000
4	300	18	3,625
6	625	20	4,300
8	1,000	30	4,825
10	1,425	40	13,800
12	1,900	50	20,425
14	2,425		

PERSONAL.—Mr. S. C. Peck, of the international department of the Thomson-Houston Electric Company, Lynn, Mass., has resumed his duties after his illness and subsequent trip to the Bermudas for recreation.

ELECTRICAL PATENTS ISSUED JUNE 17TH.

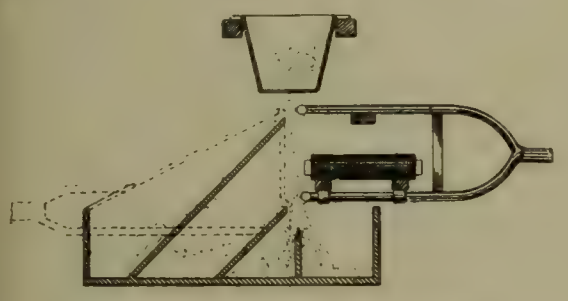
430,128. Telephone. John H. Irwin, Morton, Pa. Filed April 24, 1880.

430,156. Manufacture of Incandescent Lamps. Wm. L. Voelker, Morton, Pa., assignor to John H. Irwin, trustee, same place. Filed March 9, 1882.

430,147. Electric Car. Louis Ffingst, Boston, Mass. Filed March 24, 1890.

430,175. Combined Fire Alarm Telegraph and Gas Lighting Device. Charles H. Crockett and Chancellor C. Allen, Boston, Mass. Filed Sept 3, 1887.

430,208. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor by mesne assignments to the Thomson-Houston Electric Company, Boston, Mass. Original application filed June 29, 1887. Divided and this application filed Dec. 3, 1887.



NO. 430,275. MAGNETIC SEPARATOR.

430,252. Electric Switch. John A. Norton, Bridgeport, Conn., assignor to John M. Oxford, same place. Filed March 17, 1890.

430,260. Arc Lamp. Alfred U. Alcock and Henri Galopin, Melbourn, Victoria. Filed April 25, 1889. Patented in New Zealand Oct. 4, 1888, No. 3,283, and in Victoria, Oct, 9, 1888. No. 6,249.

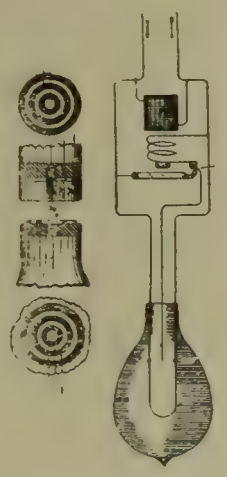
430,263. Signal for Electric Railways. Edward M. Bentley, Washington, D. C. Filed Aug. 30, 1884.

430,274. Phonograph Blank. Thomas A. Edison, Llewellyn Park, N. J. Filed July 30, 1888.

430,275. Magnetic Separator. Thomas A. Edison, Llewellyn Park, N. J. Filed Sept. 20, 1888.

430,276. Phonograph. Thomas A. Edison, Llewellyn Park, N. J. Filed Jan. 15, 1889.

430,277. Automatic Determining Device for Phonographs. Thos. A. Edison, Llewellyn Park, N. J. Filed Feb. 11, 1889,



NO. 430,326. ELECTRO-MAGNETIC CUT-OUT FOR ELECTRIC LAMPS.

430,278. Phonograph. Thomas A. Edison, Llewellyn Park, N. J. Filed April 10, 1889.

430,279. Voltaic Battery. Thomas A. Edison, Llewellyn Park, N. J. Filed July, 2, 1889.

430,280. Magnetic Separator. Thomas A. Edison, Llewellyn Park, N. J. Filed July 29, 1889.

430,296. Insulator. Samuel Oakman, Melrose, Mass Filed Nov. 1, 1889.

430,297. Underground Electric Cable. Wm. R. Patterson, Chicago, Ill., assignor to the Western Electric Company, same place. Filed May 14, 1889.

430,298. Spark Arrester. Charles Potticary, St. Thomas, Ontario, Canada. Filed Nov. 4, 1889. Patented in Canada, Sept. 17, 1889.

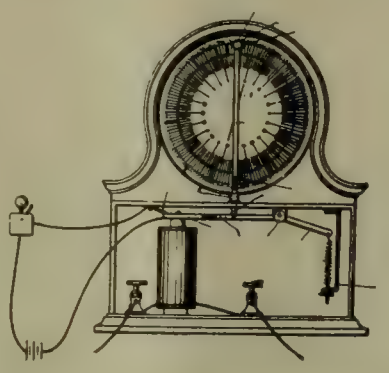
430,320. Method of Synchronizing Alternate Current Machines. Edwin W. Rice, Jr., Lynn, Mass. Filed Feb. 4, 1888.

430,326. Electro-Magnetic Cut Out for Electric Lamps. Elihu Thomson and Edwin W. Rice, Jr., Lynn, Mass. Filed Sept. 6, 1886.

430 327. Regulator for Dynamo Electric Machines. Elihu Thomson, Lynn, Mass. Filed March 8, 1888.

430,328. Alternating Current Motor. Elihu Thomson, Lynn, Mass. Filed Jan. 19, 1889.

430,329. Electric Railway. Merle J. Wightman, Hartford, Conn. Filed April 1, 1885.



NO. 430,551. ELECTRIC METER.

430,357. Electric Arc Lamp. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed March 20, 1886.

430,418. Car Truck. John A. Brill and George M. Brill, Philadelphia, Pa. Filed Oct. 2, 1888.

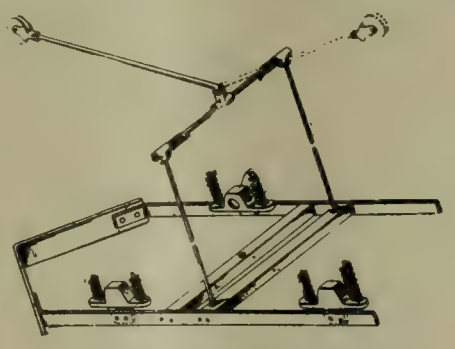
430,432. Electric Meter. Joseph Oulton and Joseph Edmonson, Bradford, County of York, England. Filed Dec. 12, 1889. Patented in England Oct. 16, 1888, No. 14,843; in Belgium July 15, 1889, No. 86,999, and in France July 15, 1889, No. 199,587.

430,437. Incandescent Lamp. Frederick C. Rockwell, Hartford, Conn. Filed March 4, 1890.

430,453. Process of Melting or Reducing Metals by Electricity. Thomas L. Willson, Brooklyn, N. Y. Filed Aug. 3, 1889.

430,462. Electric Incrustation Preventer. William B. Bull, Quincy, Ill. Filed March 12, 1890.

430,485. Incandescent Lamp. Frederick C. Rockwell, Hartford, Conn. Filed February 28, 1890.



NO. 430,580. ELECTRIC RAILWAY.

430,487. Electric Crane. Alton J. Shaw, Milwaukee, Wis. Filed June 25, 1888.

430 515. Electric Railway. Daniel B. Devore, U. S. Army. Filed March 27, 1890.

430,554. Electric Meter. George H. Wade, Atlanta, Ga., assignor of one half to William B. Palmer, same place. Filed April 2, 1890.

430,569. Coin-Controlled Telephone Guard. Samuel M. Dowst and Frank H. Hosmer. Chicago, assignors by direct and mesne assignments, to said Samuel M. Dowst and Charles O. Dowst, Evanston, Ill. Filed July 27, 1889.

430,570. Phonograph Blank. Thomas A. Edison, Llewellyn Park, N. J., assignor to the Edison Phonograph Company, of New Jersey. Filed Nov. 26, 1887.

430,580. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed April 4, 1890.

ELECTRIC COAL CUTTING MACHINE.

The Thomson-Houston company has put in operation an electric coal cutting machine which has attracted attention from mining men throughout the country. The machine is in practical operation near Osceola, Penn. The plant consists of a seven horse power steam engine, belted direct to a seven horse power generator. The electric current is conveyed through the mine to the coal cutter by a wire suspended along the roofs of the chambers. The cutter in this case is nearly a mile from the generating plant. A five horse power motor operates it and is compactly placed on the same bed plate with the machine. The cutter itself consists of an iron frame twenty-four inches high, eight feet six inches long, thirty inches wide. Nine auger shaped drills similar to those now used in mining are placed in the lower part of the frame. Between each drill is a steel cutter bar which cuts all coal left between the holes drilled by the auger bits. On the under side of each cutter bar are attached several scrapers, which hang loosely and pull all the coal back as soon as it is cut or drilled, keeping it out of the way and making the opening clear. All coal taken out of this cut is coarse, and none is wasted.

The height of the cut is four inches. The machine makes two cuts in five minutes, as it is easily handled, and needs only to be pushed along the breast by lever bars. The switches and controlling devices are so placed that one man easily operates the cutter. The machine is provided with twin wire cable, which is long enough to extend along an ordinary chamber and does away with the need of permanent wiring except in the headings. A suitable track is provided for the cutter, upon which it may be carried around the mine with ease. An ingenious device will be provided on future machines, by means of which the motor will haul itself and the cutter off and on the track as required. The weight of the complete machine is a little over half a ton. One strong point in favor of this machine is the readiness with which it accommodates itself to varying hardness of strata. The motors are wound for but 220 volts pressure, so that all danger from high potential current is done away with. The capacity of the machine is 160 tons of coal per day of ten hours in a four foot vein. Several improvements on the first machine will be embodied in the regular apparatus, which is now being manufactured at the Thomson-Houston company's factories, Lynn, Mass.

RECKENZAUN'S CAR IN AUSTRALIA.—The Melbourne *Age* of the 18th ult. contains an account of the unofficial trial of one of the new cars of the Sandhurst and Eaglehawk Tramway Company, which was entirely successful. The cars used are on the Reckenzaun system. The machinery consists of two 8 horse-power Reckenzaun motors, each driving an axle through the medium of worm gearing. The motors are collectively capable of yielding 24 horse-power. The field magnet coils of each motor are divided into four equal sections, which, by means of a commutator, may be coupled in a variety of ways, so as to produce four different speeds and powers. The motors are placed under the floor of the car, being only 26 inches long, 22 inches wide, and 12 inches high. The storage cells are 72 in number each made up of 17 plates, giving a capacity of 160 ampère hours. They weigh, with tray, etc., two tons. The car, when loaded with 30 passengers, requires five electrical horse-power, to run at seven to eight miles per hour, and nearly four times that power on a grade of 1 to 15 rise. The car is beautifully finished, and lighted by incandescent lamps.

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EASTERN NOTES.

FROM HOME OFFICE OF THE ELECTRIC AGE,
ROOM 12, COOK BUILDING,
BOSTON, June 19, 1890.

Mr. Grant has been elected president, and Mark Lewis treasurer, of the New England Safety Protector Company.

Belfast, Maine, has an electric grist mill on one of its wharves, the power being delivered by a 39 horse power Thomson-Houston motor.

Work is well under way on the new dam to be built for the Farmington Power Company, on the Farmington River, below Tariffville, Conn.

H. E. Swift & Co. have moved their factory from Sudbury to Oliver street. This is the second time this enterprising firm has outgrown their quarters.

Mr. B. F. Pearson and Mr. C. F. Fraser of Halifax, N. S., and who are largely interested in the electrical affairs of that city, were in town for a few days this week.

The report of the Conference Committee of the Massachusetts Legislature, on the bill as to the consolidation of gas and electric light companies, has been adopted.

C. W. Holtzer of the Holtzer-Cabot Electric Company who was injured by being thrown from his carriage some three weeks ago, is slowly recovering. He is now able to sit up for a short time each day.

The Thomson-Houston Motor Company, of Boston, has put an electric coal cutting machine in operation in a coal mine near Osceola, Penn. The capacity is 160 tons a day in a four foot vein.

The Salem Aldermen, on Monday, granted the Essex Electric Railway Company the right to put up a double trolley wire for its new road. Protests were entered by residents. This was referred to the committee on streets.

The committee on ordinance in the Bainbridge Board of Aldermen, last Wednesday night, was directed to report an ordinance for the regulation and suppression of electric wires, in accordance with the recent act of the legislature.

The syndicate that recently purchased the Merrimac Valley Street Railway met in Lawrence, last Thursday afternoon, when the formal transfer took place. No new company will be formed. The old company will simply be extended, with an increase in its capital stock.

The firemen in Newburyport have discovered a new use for the electric cars. In answering an alarm of fire the hose carriage was hitched to an electric car one day last week, and dragged a distance in seven minutes that would have taken twenty the ordinary way by hand.

A syndicate consisting of C. W. Morse, B. B. Jones and other gentlemen in Haverhill, with parties in New York, has been formed for the purpose of building an electric street railway from Haverhill to Lawrence. Work will be commenced as soon as the city grants permits to lay tracks in the streets.

Herman Lemp, electrican for the Thomson Electric Welding Company, has patented a sliding clamp for welding machines, which obviates the danger of the clamps sticking and thus breaking the current. Mr. Lemp has also patented a new transformer for heavy currents by means of which great volume is secured by low electromotive force.

A committee has been looking over the electric light plants throughout New Hampshire preparatory to ordering the apparatus for a new electric light plant that is soon to be erected in Woodville, that State. During the season of steady water the dynamos will be driven by a large turbine, the engine to be used as a relay.

The Thomson Electric Welding Company have received a highly complimentary letter from the Parry Manufacturing Company, of Indianapolis, Ind., the largest cart manufacturers in the United States, who say that "the difference between their present plant and the old fire method of making welds is so great that they can give no comparison."

Prof. Elihu Thomson has just put an Edison phonograph into his office, which will be run by the smallest operating dynamo in the world. The dynamo is about five inches long, and its capacity is six watts or enough to run two incandescent lamps of one candle power each, that being the service it performed at the Paris Exposition where it was on exhibition.

The Society of Electrical Engineers, which is under the direction of Lieut. Cahoon superintendent of the expert and car construction department of the Thomson-Houston factories, will be provided with a hall with a capacity of 300, on the upper floor of the new office building. There are over 70 experts and firemen enough to make a membership of 100 in the society, which discusses purely technical subjects.

A delegation from the New Bedford city government, inspected the working of the apparatus of the Boston Municipal Signal Company last Wednesday. The working of the signal at the office of the company was explained by Mr. D. J. Desmond, after which, under the escort of Mr. C. H. Chapman and J. J. C. Wilson, they were shown its working at the various police stations, and were then taken to lunch at the Boston Tavern.

A meeting in the interest of electric lighting and street railroading was held in Stetson Hall, Randolph, last Wednesday evening. W. A. Stiles and W. B. Ferguson, of the Thomson-Houston Company were present, and explained the mode of operation. A paper for the subscription to stock will be opened at once in Randolph, Avon, and Brockton, and, as soon as the franchise can be obtained, work will be commenced on the construction of a plant for electric lighting and railway.

The Eastern Electric Light and Storage Battery Co. of Lowell, chartered in November, 1889, was organized for the purchase of patent rights of the Sooey storage battery for the territory of New England, and since that purchase they have bought the one-fourth interest which the Anglo American Co. of New York held in the Eastern Electric Light and Storage Battery Co. Increasing business made it imperative that the company should be in a position thoroughly to equip electric light plants, and with that end in view propositions were made to the firm of L. H. Derby & Co., electricians at Lowell. The negotiations resulted in the purchase of the entire patent and the firm consisting of L. A. Derby, F. A. Derby, and C. F. Morse, have entered the employ of the Eastern Electric Light Co., each to assume the duties of their respective departments as heretofore. A few of the places that have been equipped by them are the Lowell Bleachery, the Lawrence Co., White Brothers & Co., tanners, the Travelers and Mechanics Insurance Co., J. Montgomery Sears' country residence Southboro, Dam on Safe Works and several of the largest buildings in Boston.

By invitation of the Tripp Manufacturing Company a large party had the pleasure of riding on one of the large new cars of West End Railway Company last Thursday night. The car is mounted on two trucks, one at each end, and each truck has four 30-inch steel wheels, and one 15-horse power Thomson-Houston motor. The car is provided not only with the common car brake, but also a vacuum brake, and it is possible to stop very quickly, even when going at high speed. The Tripp anti-friction bearings are used throughout, and the trucks are of an entirely new design (on which patents are pending), the equalizing bar being connected to the journal boxes underneath, instead of passing around the top as usual. The car is also provided with the Jewett frictionless car centres, which carry the weight of the car on frictionless rollers that move with the slightest strain, permiting the car to adjust itself to the movement of the trucks. Among those present were Supt. Samuel A. Randall of the Tripp Co.; Mr. Henry Clarke, superintendent of time tables; Mr. Pierson, electrical engineer, and Mr. W. H. Powell, superintendent of the first division, West End road; Hon. Moses Humphrey, president, and Hall R. Holden, director, Concord (N. H.) horse railroad; Messrs. W. W. Rand and Theodore Stebbins of the Thomson-Houston Company and several other gentlemen. The object was to test the ability of the car to move round some of the sharpest curves to be found in the West End system, and generally the test was satisfactory. The car turned the 40-foot radius around the Emancipation Group in Park Square with ease, but some little difficulty was experienced in getting around the 31 foot radius from Charles into Cambridge street, but this was not so much the fault of the car as it was from the trolley-pole jumping from the wire. An attempt was made to get around the 28 foot radius from Merrimac street into Sudbury, but after two attempts it had to be given up. On account of the extreme length of the car some difficulty was experienced in keeping the trolley on the wire: it was more for this reason than any other that the Merrimac street curve could not be taken.

The Supreme Court is divided in an opinion in the case of John C. Wilson v. Martin Wilson, Automatic Fire Alarm Company. This was a bill by a creditor, to reach and apply in payment of a debt certain patents of the defendant. The defendant is a Maine corporation, and it has already been decided by the Court that, the service of process made in this cause is sufficient to enable the Court to render a personal judgment against the company which would be held valid in other jurisdictions as well as this.

Immediately after the bill was filed, all the officers of the defendant corporation, except the clerk, being citizens of Massachusetts, resigned, and caused their places to be filled by citizens of the State of Maine who had no pecuniary interest in the company.

The case came before the Court on the defendants appeal from a decree which provided that the patent in question should be sold by a Master, and that the defendant corporation should make an assignment to the purchaser, and that in case the defendant should refuse to make such an assignment, then the Master should make it in the name and behalf of the defendant.

The majority of the Court, in an opinion written by Mr. Justice Knowlton, hold that the defendant was subject to the jurisdiction of the

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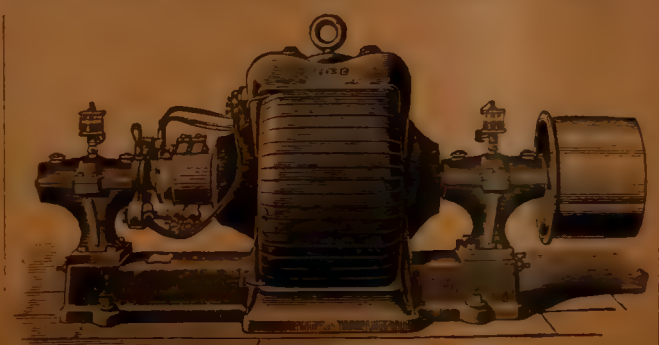
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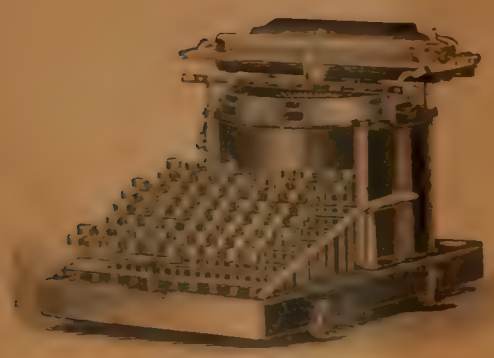
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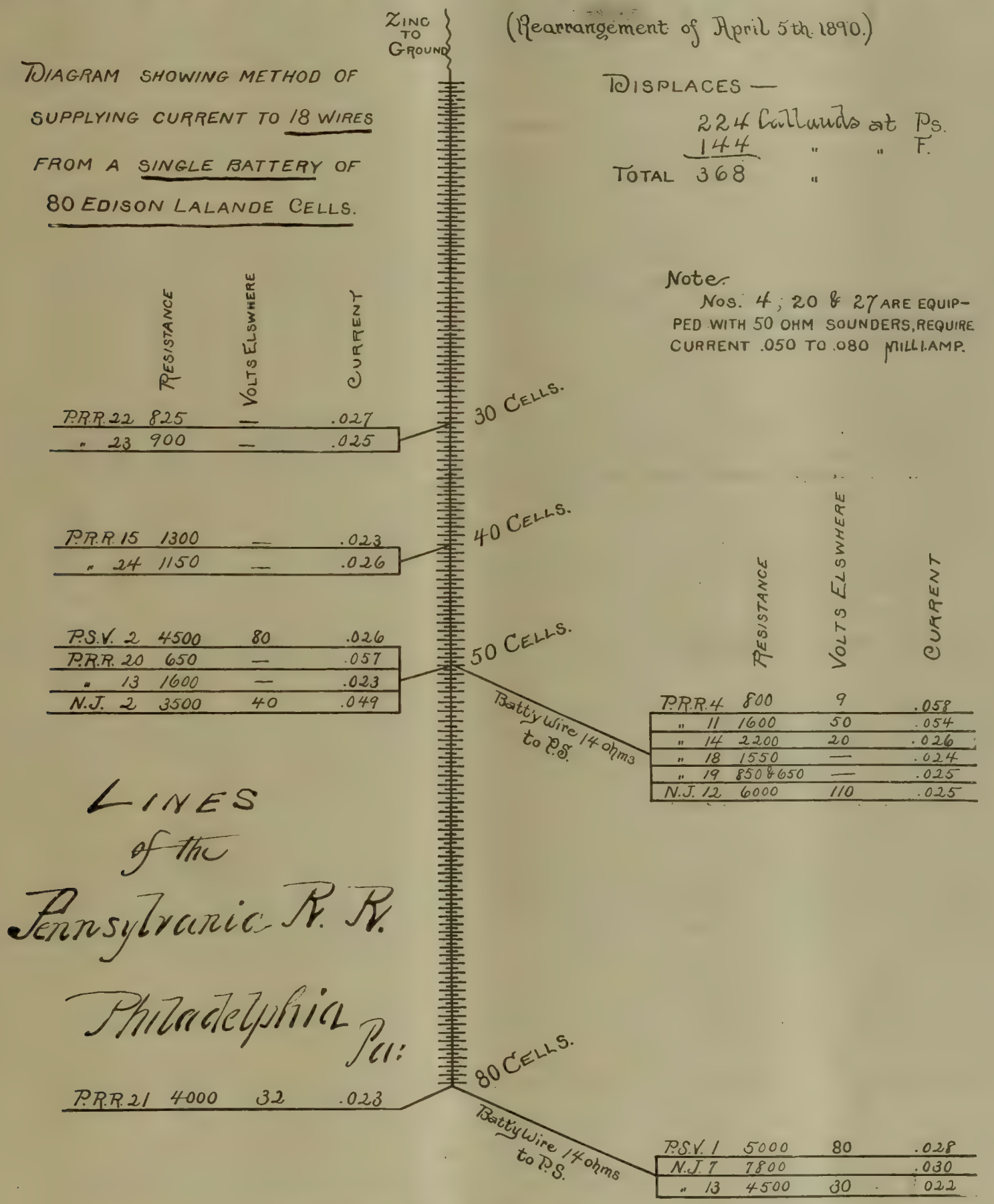
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An Absolutely Reliable Automatic Electric Railway Signal.

NEW YORK, NEW HAVEN & HARTFORD R. R. CO.

March 1, 1882 .....2 Signals in operation.
January 1, 1890.....74 " " "

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May 30, 1888 .....1 Signal in Operation
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This Company is prepared to supply at their own expense, and **LEASE**, their **AUTOMATIC ELECTRIC SIGNALS** to Railroad Companies at fixed annual rental for a **GUARANTEED SERVICE** to be rendered, payment of rental to be dependent upon fulfilment of such guarantees.

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CAPITAL, $500,000, PAID UP.

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WALDO P. ADAMS, General Manager.

Court as much as if it had been a Massachusetts corporation. The right of the Court to determine the equitable ownership of the patent, as between the defendant and the plaintiff, is unquestioned. The majority are of opinion that other States have no such jurisdiction over the defendant's patent as to affect the validity of a decree which confessedly is good, so far as it directs a sale to be made by the Master and which would be questioned if it related to property wholly within the Commonwealth.

Judges William Allen and Field, who dissent, say that there is no question of the authority of the Court to compel the owner of a patent to assign it to a receiver or a master appointed to receive it, or to a purchaser under the order of the Court. The objection is that the Court cannot itself by decree transfer the title, for the reason that the patent is not within its jurisdiction. All the Court can do is to restrain the defendant from assigning, but if it should assign in contempt of the restraint, it is a *bona fide* purchase. No assignment is valid except by an instrument in writing, signed by the owner, as required by the statute.

W. J. P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BANK BUILDING,
CHICAGO, June 21, 1890.

THE JOLIET ELECTRIC CLOCK COMPANY has been formed at Joliet, Ill., with a capital stock of $5,000; incorporators, John Anderson, C. E. Benson, Charles Anderson.

W. P. ADAMS & Co., western representatives of the McIntosh & Seymour Engine, have just closed a contract for three compound condensing engines, aggregating 600 horse power, to be placed in the new south side station of the Chicago Edison Company.

MR. H. P. LUCAS, of the Northwestern Thomson Houston Company, has just returned from an extensive business trip in the east, and, while en route to headquarters at St. Paul, Minn., could not resist the temptation of stopping in Chicago long enough to dine with the boys at the Electric Club.

BLECKERT & NELSON is the name of the new firm succeeding to Noyes Bros., in the manufacture of gas, electric and combination fixtures. The new firm are increasing their facilities by the addition of new machinery and increasing their working force. The business will be conducted at the same place, 85 and 87 Fifth avenue, Chicago, and the favor with which their line of goods have been received by the trade, lead the new firm to look for still greater returns.

ARC LAMP LITIGATION. The latest move on the part of the Brush Electric Company is the filing of a bill at St. Louis, on the 18th inst., for an injunction against the Municipal Electric Lighting and Power Company, to prevent their using double carbon lamps. The Wood system is the one employed by the Municipal Company. The point on which an infringement is claimed is the same as that on which injunctions have been granted against the Fort Wayne Electric Co., the Sperry Electric Co., and others, which are referred to in the bill, namely: "An arc electric lamp, in which two or more pairs of carbons are independently adjusted and regulated, and are burned successively to secure the continuous burning of one pair of carbons prior to the establishment of the arc between the other pair."

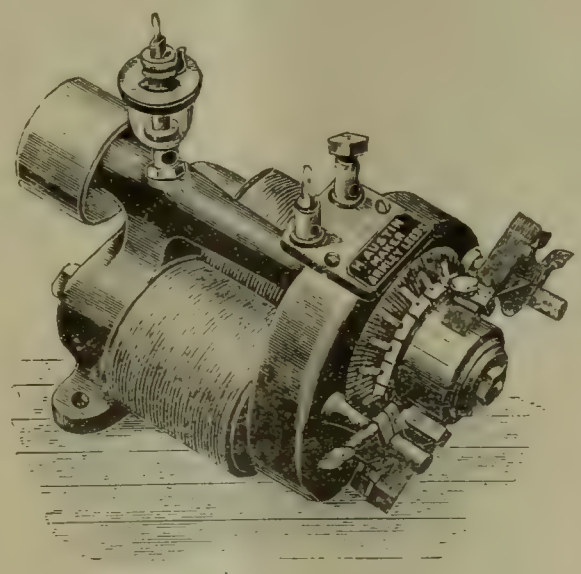
THE WESTERN POWER CONSTRUCTION COMPANY has been organized with headquarters at Chicago. The capital stock of the company is $500,000, fully paid up, and is held by prominent western capitalists. Mr. W. P. Adams, formerly with the International Thomson-Houston Company, will be general manager of the new company, and Mr. J. E. Wilson, formerly representing J. A. Grant & Co., of Boston, and recently associated with Mr. Adams in managing the western interests of the McIntosh & Seymour engines, will occupy a responsible position. The company will do a general construction business of power plants for electric light and railway companies, and will extend their operations over the entire western territory, from Pennsylvania to California. They are independent of any company or system, and will do whatever work is demanded impartially. The new company will make a specialty of the McIntosh & Seymour engine. They will occupy the offices at 144 Adams street.

ELECTRICITY IN A MINE. In the No. 3 shaft of the Chicago, Wilmington and Vermilion Coal Company, at Streator, Ill., a very successful use of electricity on a small scale is made in the employment of an electric motor to pump water from a very wet portion of the mine. Heretofore the water in this section of the mine has been bailed by men into boxes mounted upon the ordinary car trucks used in mines, and drawn by mules to a point where it was dumped into a ditch running into the main pump at the bottom of the shaft. This work required the time of six men and three mules and cost about $14 per day. Now by the use of a three horse power motor geared direct to a Smith & Vail pump, the water is handled at a saving of about $10 per day, the only labor required being a boy to tend the small arc dynamo on the surface and a man below at the pump. This plant has been installed under the direction of the Sperry Electric Mining Machine Company, of Chicago, and is giving perfect satisfaction to the owners of the mine.

F. M. I.

AUSTIN'S INFANT DYNAMO.

Under the name of the Infant Dynamo, Mr. H. Austin, of Armley, Leeds, is introducing a machine which he hopes may meet the demand for small dynamos, having equal merits with the larger ones made by the leading makers, as far as regards good output for power absorbed. He commences where other makers leave off, namely, at one unit, the range of sizes being 1,000,



AUSTIN'S INFANT DYNAMO.

700, 400, 200, 100, and 50 watts. These are all made alike in every detail, differing only in size.

The armature core is made up of thin best Swedish charcoal iron rings (No. 18 B.W.G.), accurately turned both inside and outside by special machinery. The sharp corners left on in turning are all carefully ground off each separate ring, which is then coated on both sides by a varnish made up of very thin shellac varnish, in which is mixed some fine Paris plaster. The core is then built up to the required depth, the separate pairs of rings, while under pressure, being carefully tested for insulation, and mounted on a strong spider of hard brass. The core is then well insulated, and wound in the gramme fashion. The commutator is made up of segments of brass of a special quality (all carefully insulated with asbestos or mica), and has a good wearing depth. The field magnet cores are made of best Swedish iron, carefully annealed, and are screwed into the pole-pieces—the pitch of thread being almost microscopical—a method which gives a very good contact between the two surfaces. The yokes are very massive, having a sectional area three times that of the cores. The bearings are of very hard phosphor bronze, and are of good length. Each dynamo is fitted with a sight-feed lubricator The used oil finds its way by suitable passages into the oil dish under the yoke of the magnets. There is only one lubricator to each dynamo, the oil entering between the two brushes and working outwards, thus keeping the bearings perfectly clean.

The armature can be taken out for examination in a few moments, it only being necessary to lift the brushes off and loosen the nut off at pulley end of spindle. The dynamos are fitted with rockers to brushes in special cases, but in most cases this is unnecessary, the required lead being given by a suitable arrangement on brush-holders, which, when fixed, are not so easily tampered with as rockers. There are no loose wires dangling about from brush-holders to terminals, and every effort is made to make the machine as simple and effective as possible, the workmanship also being of the best class.—London *Electrical Review.*

ELECTRIC LIGHTS IN MINES.—It is reasonable to suppose that if electricity had been used to light the mine at Dunbar, Pa., many lives would have been saved. On June 16th an explosion of gas occurred in the Hill Farm mine, which resulted in the suffocation and entombment of thirty-one miners. The explosion was caused by a miner's lamp, and the terrible result teaches a lesson that mine operators cannot afford to ignore. One of the greatest results of the introduction of the electric light as an illuminant for mines is the prevention of disasters of this character. The safety of the miners' lives is a consideration of the highest importance, and the electric light is the only available one that will fill all the requirements for mine operations. Mine operators should not defer the introduction of electric lights in their mines any longer. Public sentiment strongly demands it, and the mine owners themselves would be greatly benefitted by its use. Operations would not be interrupted by accidents of this sort, which are very expensive to mine owners; and most important of all, there would not be so much sorrow and bereavement in the families of the poor, hard working miners. The cost of an electric light plant would soon pay for itself in the prevention of accidents and consequent suspension of operations.

PRESERVING LEATHER BELTING.

Various expedients are resorted to to prevent power belts from slipping. Slipping belts mean loss of power, and loss of power means additional cost for which there is no return. Anything, therefore, that will prevent slipping of belts will save power and money. Castor oil, rosin, etc., are usually applied to prevent slip, and while the use of these substances effect the desired result they shorten the life of the belt.

It is the custom of many owners and superintendents to use nothing on their belts, but when the belts slip, to tighten them up. This, however, heats and wears the journals, consumes the lubricating oil, and does not remedy the trouble of slipping. Weight we know increases journal friction, and the tightening of a belt acts just the same as would the adding of dead weight to the journals. The tighter the belt is made, the surer it is not to slip, but it is impossible to tell how much additional work it and the power plant have to do when made too tight.

There is a certain amount of elasticity in all good leather belting, but time and continued hard work weaken it, and the application of soap, rosin, tar, tallow, and castor oil is simply an injurious and temporary stimulant which tends to destroy the vital energies and shorten the natural life of the belting

The Dixon Belt Dressing and Leather Preservative is the only article in the market that is free from the objections to the use of all other substances. It is not a new and untried article, but has been in the markets of Europe and this country for over twenty years and has given perfect satisfaction during all that time. It saves the life and elasticity of the belt to a most wonderful degree, and, as it completely prevents slipping of the belt, no power is wasted and the greatest economy secured. The Jos. Dixon Crucible Company, N. J., are the manufacturers of these goods.

FACTS WORTH KNOWING.

The system of electric lighting used on the Statue of Liberty in New York harbor is that of New American Electrical Arc Light Company.

The first boat propelled by electricity was in 1839, by Jacobi. He derived the power for his motor from a galvanic battery.

The legal Ohm is the resistance of a column of mercury one square millimetre in cross section, and 106 centimetres in length.

A NEW USE FOR THE TELEPHONE.—There is no limit to the applications of the telephone. Sir Humphrey de Trafford, near Manchester, has perhaps the finest kennels in England, the kennelsman's house adjoining them. From each kennel a telephone arrangement leads to the kennelsman's room, so that when any dog is noisy at night the keeper can speak to him so as to be heard without leaving his room.

ELECTRIC MOTOR BLOWERS.—The electric motor blower is suggested for ameliorating the condition of the firemen on the great ocean steamers who are subjected to the frightful heat entailed by forced draft.

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Gives 150 copies, exact fac-similes, from any writing, drawing, design, plan, typewriting, music, etc., without washing, stencil, roller, in different colors, simultaneously.

Each apparatus contains 3 plates in cabinet and ink. Note size, $4.50; Letter, $6.50; Cap, $7.50; Brief, $10.50; and any larger sizes to order.

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½ TO 36 CANDLE POWER.
2½ TO 40 VOLTS.
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WE WILL SEND FREE, CATALOGUE E.
which gives prices and descriptions of lamps, and directions
HOW TO MAKE A CHEAP BATTERY
to run them. Any intelligent boy can make these batterie under these directions.
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The DOUBLE CYLINDER LAW BATTERY
The Standard for all Open Circuit Work.
ITS NINTH YEAR.
The Negative Element has 147 square inches of surface, which is more than double the surface found in any other. The Cell contains 2½ pints of solution, which is nearly double that in any other cell.



4½ ins. square, 7 ins. high.

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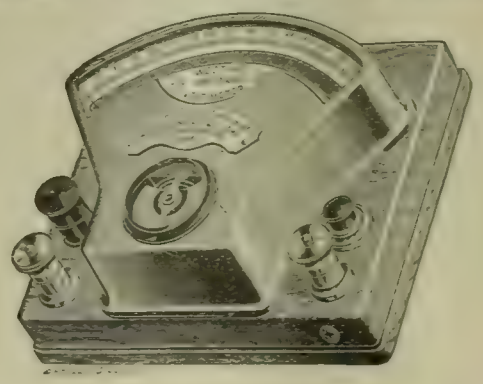
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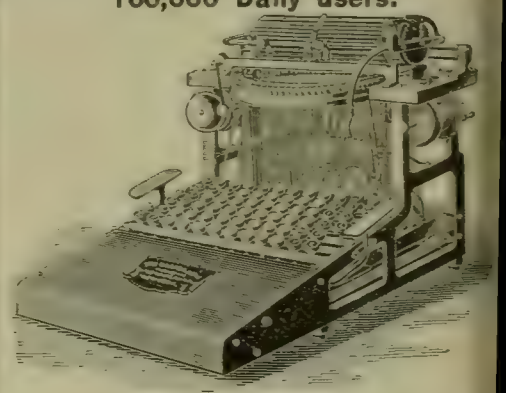
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FOR THE NEW ENGLAND STATES.
The Office of the Parent Company is at 171 Broadway, New York, where the system may be seen in operation on a line to Boston.
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LOOK AT THESE PRICES:
$2.00 Dry Batteries, large size, 83c. $2.00 Iron Box Bells, 3-inch, 49c. 75c Bronze Push Buttons, 25c.; 25c. Wood Push Buttons, assorted, 6c.; 50c Switches, one point, 10c.; 40c Bell Hang-er Staples, per lb., 9c.; $1.00 Leclanche Batteries, best made, 44c.; $3.75 Spark Coils, 3 inches, $1.50; $10.00 Medical Batteries, $3.50. Send for Catalogue No. 4.
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COUNSELOR AT LAW.
Electrical Patents.
181 BROADWAY,
New York.
Specialty Electrical Patents.

NATIONAL ELECTRIC LIGHT ASS'N. KANSAS CITY. C=E/R FEBRUARY. 1890.

SPECIAL NOTICE.
VOL. VII and VIII,
PROCEEDINGS OF THE
National Electric Light Ass'n Conventions,
Held at Niagara Falls and Kansas City,
Will be published in July (in book form, cloth bound). It has been decided to accept a few pages of appropriate advertising. This matter has been placed in charge of the
MAN'F'R'S ADVERTISING BUREAU,
BENJ. R. WESTERN, Proprietor. 111 LIBERTY ST., NEW YORK. Write for Particulars.

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THE BEST AND CHEAPEST DEVICE

BY WHICH TO

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AGAINST DANGEROUS ELECTRIC CURRENTS.

TESTIMONIALS

BOSTON, MASS, April 24th, 1890.

To Whom It May Concern: This is to certify that my endorsement of the Crandall & Cartwright protectors was given by me prior to my knowledge of the Brown Electric Protector, which, when presented, was given the most severe tests such a device could be given, and fully demonstrated its absolute powers of control over dangerous currents of electricity. I have, since that test, which was given at the power station of the West End Railroad, Boston, Mass., on their Trolley system, given the Brown Protector many tests, both privately and publicly, and I unhesitatingly say that it is the most complete and effective electrical protector before the public to-day. Its simplicity of construction and its line connections recommend it to all, especially electrical people.

There are no fancy or difficult wire connections or weak electrical contacts, the obviation of which renders a device of this nature more positive and sure in its action, and not liable to get out of order, as is the case with other devices which were submitted to me for test.

This Protector, with the new Smith Automatic Auxiliary Cut-Out attachment, makes it the most perfect and absolute protector; and I recommend its use upon all grounded and metallic circuits, telephone, fire alarm, police signal, and such other kindred wires. The Brown Protector is also a complete Lightning Arrester. This statement is made without fear or favor, and in justification of facts made apparent at the recent electrical tests given in this city under the auspices of the Boston Fire and Underwriters' Union, which I personally conducted, and at which numerous other devices were tested without satisfactory results.

D. KILLECUTT.
Late Electrical Inspector of the Boston Fire Underwriters' Union.

BOSTON, April 21, 1890.

The Brown Safety Device has been submitted to a thorough test, and its efficiency demonstrated. WM. BROPHY, *Inspector New England Insurance Exchange.*

DEPARTMENT OF PUBLIC SAFETY, BUREAU OF ELECTRICITY.
MORRIS W. MEAD, *Supt. of Bureau.* RICHARD MCCLATCHEY, *Asst. Supt.*

PITTSBURG, PA., May 24, 1890.

WM. H. SMITH, ESQ., *Gen'l Manager Brown Electric Protector Co., of New England.*

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Upon trial it proves to be of great value. The essential idea being in cases of metallic circuits, especially those in fire alarm and police telegraph service, to throw the current to ground both sides of the point wherever line may have been burned by coming in contact with wires carrying dangerous currents, thus automatically closing the circuit through the earth until permanent repairs can be made, and still leaving boxes operative both sides of the break.

This is a valuable feature for city service on all metallic circuits, and can be highly recommended.

This instrument is thus a protector for both grounded and metallic circuits.

Very respectfully,
MORRIS W. MEAD, *Supt.*

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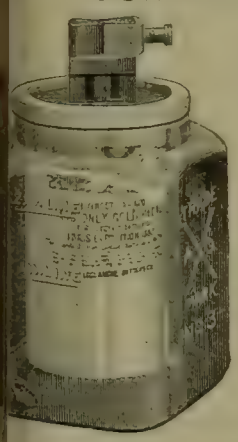
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Advantages of the Crosby Dry Battery for Open Circuit Work.

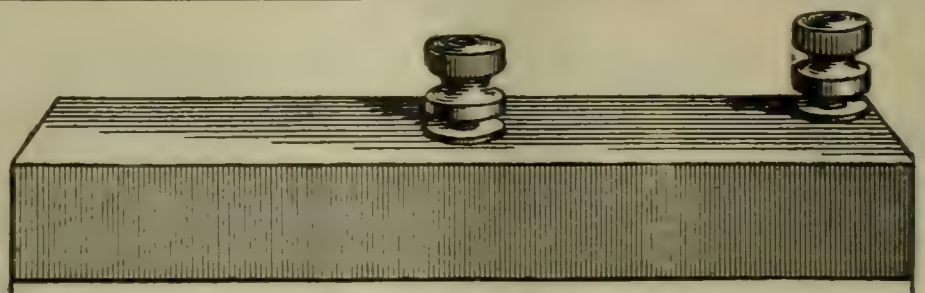
The **CROSBY DRY BATTERY** is the **best Open Circuit Battery in the market.** It possesses all the advantages claimed for any Open Circuit Battery, and is capable of performing **more work** than any other. In addition to this, it is the **most reliable, most compact, most durable,** and **simplest** cell yet discovered. It is so constructed that **it is not destroyed** or seriously injured by **short circuiting,** and we are prepared to prove at any time that its **power of recuperation** is proportionately **greater** than that of any other. For Electric Bells, Gas Lighting, Burglar Alarms, Annunciators, Telephones, Microphones, Medical Electrical Purposes, Electrical Clocks and all the uses to which Open Circuit Batteries may be put, **it has no equal,** whether it be compared with **Liquid** or **other Dry Batteries.** We guarantee **depolarization, absence of offensive crystallization** and **perfect cleanliness.**

The **CROSBY BATTERY** is the only Dry Battery sold **semi-charged. It does not work until wanted.**

The preference as between **Liquid and Dry Batteries** should always be given to the **latter,** provided the amount of working power required and a constant current can be obtained. **No form of Dry Battery** has as yet been placed before the public, **except the Crosby Dry Battery,** which will do the work of Wet Batteries and **give a constant supply of Electricity sufficient for reliable Open Circuit work at all times.** The advantages of a Dry Battery are obvious, because Wet Batteries, of whatever form, are constantly giving out offensive odors and spoiling everything with which their fumes come in contact. They are disagreeable and uncleanly machines, unsightly in appearance and easily broken and injured. **The Crosby Dry Battery is perfectly clean, emits no destructive gases or acids,** and after once being properly connected, **requires no attention whatever,** while the Liquid Batteries are frequently in need of being cleaned, and the solution used must constantly be renewed.

The Crosby Battery is not affected by temperature; whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for **Open Circuit Work.** If, however, through an accident, it becomes **Short Circuited, it recoups itself.** This cannot be said with equal truth of any other Dry Battery known.



Crosby Electric Company.

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NEW YORK, U. S. A.

This Battery is Sold Semi-Charged.

To Fully Charge Battery:—Remove the cover and pour in **SLOWLY** through the holes in the top **ONE GILL** of pure water, divided equally between the two holes. In a few minutes the battery will be ready for use. If found necessary, after a long period of service, the battery may be recharged in the same manner To prevent corrosion, care should be taken not to wet the brass connections.

The Crosby Dry Batteries are manufactured in **different sizes and forms,** to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistances is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in the **Crosby Dry Batteries varies from one to ten amperes,** according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.

Dr. Schuyler S. Wheeler, in writing **of the Crosby Dry Battery,** says: "I have examined the Batteries sent to me from your office, and take pleasure in assuring you that you are manufacturing a first-class Battery for Open Circuit Work which, for convenience and portability, has no equal. Its qualities of simplicity of construction, cleanliness, finish and general adaptability to the work which such batteries have to perform are at the same time equal to those of any battery yet brought to my notice."

OFFICE OF FLEMMING'S ELECTRO-MEDICAL INSTRUMENT MANUFACTORY, No. 1009 ARCH STREET, PHILADELPHIA, MARCH 8, 1890.

CROSBY ELECTRIC COMPANY, NEW YORK:

GENTLEMEN: The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No. 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it January 28, 1890, at 4 P. M., kept running all night and following day, January 29, when at 4 P. M. it became accidently short-circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till January 30; 7.30 A. M., started again, and left running until February 13, stopping during night time. Thus, in defiance of a two-hour short circuit, the cell functionated = 371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterwards, still retains its working capacity, apparently as good as previous to its testing. Very respectfully,

COPY.] Signed) OTTO FLEMMING.

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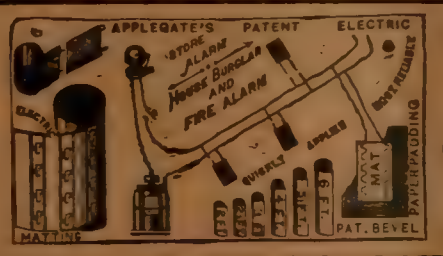
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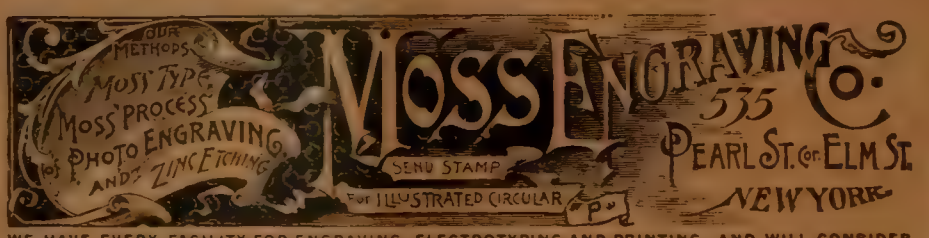


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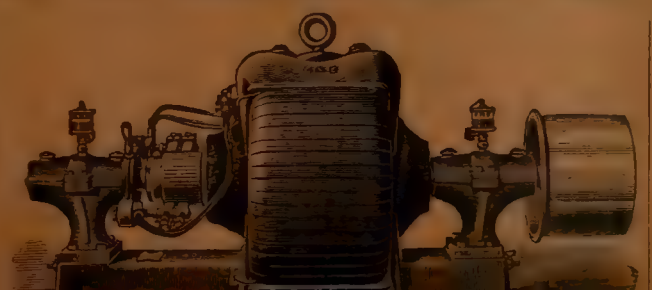
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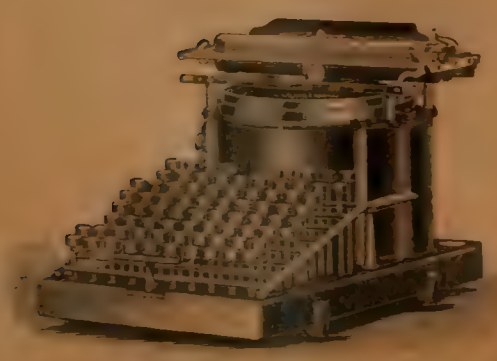
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NEW YORK, JULY 5, 1890.

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ERIOUS CHARGES.—It is quite difficult to understand a general press dispatch originating in ston on the 26th of June. The dispatch in estion was to the effect that the sum of 2,000 was claimed as damages against the st End Street Railway Company for personal uries sustained since January 1st. It was ased that the plaintiffs in nearly every case were ured by coming into contact with the electric s. Such enormous claims and charges against or any other company would, from one ndpoint, indicate gross mismanagment on the t of the operating company. Sometimes h dispatches are baseless in fact, but are sent for the purpose of unfavorably affecting the erests involved, and whether this particudispatch is founded on truth or not, it creates ery unfavorable impression in regard to the mpany operating the road. The Thomson-uston system is used on the West End line, while they may be in no way responsible for accidents charged against the railroad comy, it is unfortunate that their electric system uld be thus incidently brought into the affair.

ONE OF THE USES OF ELECTRIC LIGHT—Prof. tner, State Entomologist at Albany, has been king some calculations as to the number of ects destroyed in a night by a single elec-light. He puts the figure at 100,000 per p. He states that the electric light will unbtedly prove an active agent in the destruc-n of insect life. If he had only stopped there would have received the thanks of thousands citizens of the State of New Jersey for his at discovery, but he did not. The hope that d the breasts of Jersey men that the mosquito included in the great slaughter was blasted en Prof. Lintner particularly stated that there e no mosquitos among the thousands of dead ects. Mosquitos are like thieves—they keep y from the light.

TREATING ORES BY ELECTRICITY.—The treatment of ores is a subject of interest to miners, and a good deal has been said of late about the electrolytic method. While the electric method has been much talked of there has been, in many instances, a good deal of mystery attached to it. The object of this, no doubt, was to keep as many as possible ignorant of the new and better method in order that its advantages might be enjoyed by a favored few. But such a state of affairs cannot last long these days in this wide-awake land. It is needless to say that the air of mystery and secrecy placed around the new system of ore treatment was absurd, and prompted only by selfishness. There is nothing mysterious about the process, and any mine operator may enjoy the great benefits derived by the use of the electrolytic treatment if he will but invest in the proper plant. The Edison United Manufacturing Company, of this city, are now turning out dynamos capable of developing any amount of current necessary for treatment of ores, and are ready to contract for everything necessary for the complete equipment of such a plant. They, moreover, give all the information required for the successful operation of such plants. Their knowledge and experience in this line is sufficient guarantee that an equipment of this sort established by them will be a financial success. We print on another page an article that will be read with considerable interest in this connection.

AN INTERESTING ELECTRIC POWER PLANT.—In another column a description is given of an electric power plant to be established near Portland, Me., for the purpose of running the machinery of the Presumpscot Paper Mills. One mile and a quarter above the mills is a large water power, at which point the electric generators are to be located, and their total capacity will be 400-horse power. The application of the power at the mills is a novel and advantageous one. Several motors are to be installed, each driving isolated machines, or independent lines of shafting. By this method great advantage is gained in being able to apply the power to any particular line of shafting, or any one machine, and it is practically the same thing as having an independent steam engine in each case. Usually one steam engine is employed to drive all of the machinery, and all the shafting is in motion whether the power is all required or not. By the proposed method of applying the electric power, however, this will be changed and the power will be applied just where and when it is needed. The Mather Electric Company are to be congratulated on the successful solution of the problem and their proposed method of distribution of power will no doubt find a large field for application.

ELECTRIC LIGHTING.—The electric light companies of New York City and the Gas Commission do not seem to be very well mated as regards effecting a contract for lighting the streets by electricity. For the second time the Commission have rejected the electric light bids as being too high, and they have invited the electric light companies to try it again. In the meantime lighting is to go on under the old contract. One thing is quite evident, and that is, the electric light is preferred and wanted, or there would not be so much dickering. A compromise will probably be effected some of these days; in the meanwhile the city is getting its electric light at the old rate.

TELEPHONE BETWEEN LONDON AND PARIS.—A press despatch from Paris, on June 26th, announces the successful experiment of establishing telephonic communication between Paris and Calais. It is proposed to connect the Paris lines with the submarine cable across the English Channel, which lands at Dover, England, and at Dover the London wires will be connected. In this way London and Paris will be placed in communication by telephone. The result of the latter experiment will be watched with considerable interest.

ELECTRIC PROTECTORS.—In the wonderfully rapid development of electric systems requiring currents of large volume, and the dangers incident to the accidental contact of telegraph and telephone wires with those carrying heavy currents, the necessity has arisen for some means of protecting property against these dangers. Large currents are safe enough as long as they are confined to their natural channels, but if they are diverted by the accidental contact of a telegraph or a telephone wire, the building or buildings into which the latter run are liable to be fired if no protective device is used for the purpose of rendering such abnormal currents powerless to do harm. Many devices of this class have been invented, and most of them have some good points. It is necessary however, to have an instrument which shall possess every requirement necessary to insure protection under all circumstances. The Brown Electric Protector which we describe elsewhere, is an instrument that fulfills every requirement, and the fire inspectors of Boston and Philadelphia endorse it with the highest praise. It is simple, and yet most efficient, and any building equipped with this automatic safety device is said to be absolutely proof against the dangers above mentioned. Such an instrument as this is valuable, and when insurance inspectors endorse such a device with the praise that they have bestowed upon the Brown protector, it is safe to assume that the instrument possesses merit.

INTERIOR CONDUIT AND INSULATION COMPANY.—Any meritorious article of trade does not have to wait long to be recognized as such. The American people know and appreciate a good thing when they see it. This is especially true in a business sense, and it is not surprising to hear of the good fortune of the Interior Conduit and Insulation Company. The demand for their goods is exceedingly gratifying, and is constantly growing larger. The company has not long been in its new and greatly enlarged factory, and already, we learn that their present productive capacity is put to its extreme test. The so-called dangers from electric light wires are far beyond the range of possibility where these interior conduits are used. There are two good reasons why the Interior Conduit and Insulation Company should achieve success and renown. The first is that their goods have the stamp of real merit, and the second is that the business is conducted on a fair and square basis. The policy is a wise one, and the advantages to be derived in the use of these conduits are placed within the reach of all.

BRITISH INSTITUTE OF ELECTRICAL ENGINEERS.—Following the example of the American Institute of Electrical Engineers in holding a meeting away from headquarters, the English society of that name propose to do likewise, and will meet in Edinburgh on July 15th, 16th and 17th. The London *Electrician* in commenting on the wisdom of this move says: "For the purpose of creating local interest in the objects of such societies, as well as for strengthening the community of interests which attach them to the scattered members of the profession they represent, no more useful or sensible plan could be devised than this of extending the meetings beyond the narrow boundaries of the central meeting-house."

KEMMLER.—It is now believed that this unfortunate man will be launched into eternity by the lightning process some time in August. It is hinted, however, that an injunction may be brought against the State by the company manufacturing the dynamo to be used, prohibiting the use of the dynamo for such purpose. There does not seem any probability, however, that such steps will be taken. If the stay process is kept up much longer Kemmler will die of old age.

ELECTRIC RAILWAY.—It is reported that a company has been organized for the purpose of connecting Buffalo and Niagara Falls with an electric railway. The distance is 22 miles.

AN IMPROVED THERMO-ELECTRIC BATTERY.

On April 15th last, Mr. John Edelkamp, of New York, obtained letters patent on a thermo-electric battery, which is one of the most practical and efficient yet produced. The invention consists of an electrode formed of metallic alloys and combining the same with a protective outer casing of baked clay sufficiently hard to resist the action of heat and ordinary handling, and which is enlarged at the end to be exposed to the heat of the furnace.

In the accompanying drawing two of the improved elements are shown as mounted in the wall of a furnace, the one being shown in longitudinal central section and the other in elevation.

One of the most serious obstacles encountered in the art of generating electricity by means of heat is found in the frailty and instability of the elements found needful in the construction of a thermal battery, and in the destruction thereof incident to their exposure to the high temperature of the furnace. After long-continued experiments Mr. Edelkamp has succeeded in measurably overcoming the difficulties in the manner described.

Referring to the illustration:

A represents the wall of a furnace of any approved form of construction adapted to receive the elements of a thermo-electric battery.

B B are the improved elements supported in and by the wall, so that one end of each shall be fully exposed to the heat of the furnace and the opposite end be left projecting outward to such a distance as will permit it to be cooled and kept comparatively cool by extraneous influences.

The elements B B are each constructed of an outer casing C, of fire-clay or other equivalent refractory material, of substantially a uniform thickness throughout, and having an enlarged base or bulb *d* preferably rectangular in form, and an extended cylindrical neck projecting centrally from one side thereof, as shown in the drawing. Through the walls of this casing, near to the opposite extreme ends thereof, a series of electrode-wires *f f f* and *g g* are inserted, preferably from opposite sides, to project nearly to the center of the casing, and the several wires thus projecting through the wall into the casing are united at each end and connected to the single conducting-wires H H, by which the circuit is completed.

The interior of the casing C is completely filled to its extreme outer end with an alloy K, of antimony and zinc, to which, by preference, cadmium has been added.

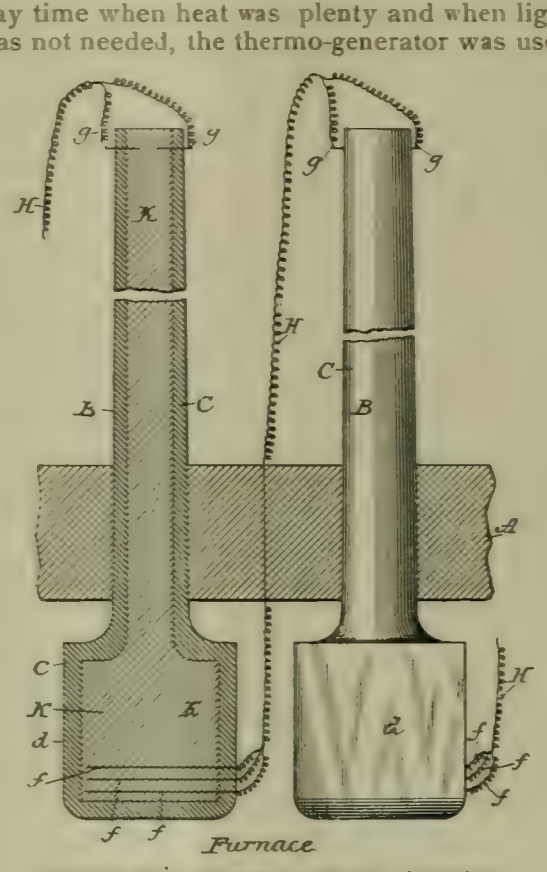
The composition, however, does not constitute a part of Mr. Edelkamp's invention, and he contemplates the use of a filling for the extended inclosing-casing C, of clay, or its equivalent, of any suitable material or compound found to be efficient as an electrode.

It will be noticed that Mr. Edelkamp does not employ two distinctive alloys in each casing, as is usual in the construction of thermo-electric cells, each to represent a separate electrode. During his experiments he found that the two extremities of the element, constructed as described, resolve themselves, when exposed to the action of heat at one end and of a cooler temperature at the other, into a negative and a positive pole, respectively, and that the wires *g g* at the outer cooler end become positive, and those *f f f* at the inner heated end negative electrodes, and that the efficiency of an element thus constructed for generating an electrical current is greater than where the element is composed of two alloys. In constructing a pile with these elements the positive electrodes at the outer end of one element are connected by the wire H with the negative electrodes of the next element in the series, substantially as illustrated in the drawing.

In the operation of the device the enlarged end of each element is exposed to an intense heat, while its opposite end is kept comparatively cool, the result being the generation of a current of electricity through the element, which will be conducted by the connecting wire to the next element in order to enforce the current similarly generated therein. Since the alloy within the casing C is fully protected and inclosed, its fusion or partial fusion within the heated end of the casing, when the battery is in operation, will not impair the efficiency of the circuit or diminish the generation of the current. By the enlargement of the inner end of the element the largest mass of metal is exposed to the action of the heat in the most compact form with improved and beneficial results.

Mr. Edelkamp conducted his experiments and perfected his invention at the factory of E. Gothberg, 115 Cator avenue, Greenville, (Jersey City.)

He had in operation there a battery which gave a beautifully clear and brilliant light from a 15-volt lamp. Each cell has an electromotive force of .33 volts. and gives 1⅜ ampères of current. This plant was an unique one. In the day time when heat was plenty and when light was not needed, the thermo-generator was used



EDELKAMP'S THERMO-ELECTRIC BATTERY.

to charge accumulators, and at night, when light was needed, if there was no heat available, the accumulators could be depended on for current.

For domestic purposes this battery seems to be particularly adapted. It can be placed on an ordinary stove or range, if no other special heating apparatus is provided, and the current therefrom utilized in any desirable manner; to supply power for light work, for lighting or for charging accumulators. Its greatest field seems to be in the line of domestic work, but, of course, it is not by any means limited to such use. It is valuable anywhere where an electric current is needed.

The battery just referred to contained approximately 300 cells, and the whole thing did not occupy a space of more than three feet in diameter and as many feet high.

Indeed its comparatively small size and its portability are its striking features, and considering its efficiency, there seems to be no reason why this battery should not meet with a great demand, particularly for domestic use.

ELECTRIC RAILWAY.—An interesting case involving the introduction of an electric railway has just been decided by Judge Roney, of Augusta, Ga. It seems that many years ago the Augusta & Summerville Railroad Company was empowered by the city of Augusta, and incorporated by the State Legislature to operate cars in the streets of Augusta. The company was in short, given the exclusive right to run cars by "horse, animal or steam power" through specified streets of the town. Recently the Augusta Railway Company was organized for the purpose of building and running a road operated by electricity. The older road thereupon applied for an injunction restraining the new company from building the road, holding that it alone had the right to run cars through the streets, basing its argument on the paragaph in the original which said that the company should have "the exclusive right of way through and over all streets of Augusta (except such as specified) and authorizes them to construct their lines and to operate thereon railway cars and carriages to be drawn by horse, animal or steam power." The very minute specification of their rights was the weak point, and the judge properly held that "the grant of the exclusive right of way for the purpose of building a street railway to operate cars thereon to be drawn by horse, animal or steam power, does not prevent a subsequent grant to use electricity." In conclusion, he admitted the exclusive right of the company as far as specified, but would not admit an implied contract. As a court once said in a well-considered opinion, "Let it once be understood that exclusive grants carry with them implied contracts, and we shall be thrown back to the improvements of the last century, and be obliged to stand still until the claims of the corporation are satisfied, and that shall prevent the States to avail themselves of the lights of modern science, and to partake of those benefits, which are now adding to the wealth and prosperity and the convenience and comfort of every other part of the civilized world."

THE COMING STEAMER.—The *Pall Mall Gazette* was looking far into the future when it saw the "Coming Steamer," which it describes as follows:

She will be over a quarter of a mile in length and will do the passage from Sandy Hook to Liverpool in thirty six hours, being one night only. She will be driven by electricity, and in such a fashion as to keep railway time, despite storm or fog.

Passengers can be secured by flash photo. Edison's patent—and the ticket will include an opera stall, or a concert ticket, or a seat in a church pew—the opera house, concert hall and church being all on board. A covered ring for horse exercise will be provided and a race track for fast trotters. A base ball ground and tennis courts will also form a portion of the attraction. For business men a stock exchange will be operated, the quotations being posted from the tickers every two minutes on the vibration system. The leading papers of all countries will be reprinted each morning by the electric reflection system.

A spacious conservatory containing the choicest flowers of all climates, will afford an agreeable lounging place, and bouquets will be provided gratis. As at Monaco and Monte Carlo, a suite of apartments will be laid out for play, to be kept open all night—a sumptuous supper, with costliest wines, free. English tailors and shirt makers will be in attendance, and clothes will be made and finished during the passage.

The millinery department will contain the French fashions of the previous day, and costumes will be confectioned while the ship is in route, and delivered complete on arrival at dock. Accommodation will be furnished for 1000 passengers.

THE LIGHTING OF BRUSSELS.—The commission appointed by the Communal Council to report upon the various proposals made for the lighting of the city by electricity, has reported against them on all financial grounds. Fresh offers are invited, and should none be found satisfactory the authorities will, it is expected, undertake the lighting.

AN ELECTRIC LIGHT COMPANY FOR THE ISLE OF MAN.—A company has been registered in the Isle of Man, with a capital of £25,000, to carry on the business of an electric light company.

AN IMPROVED TELPHER SYSTEM.

Mr. Charles J. Van Depoele, of Boston, Mass, as just been granted letters-patent on new and seful improvements in telpherage systems.

In the accompanying drawings, Fig. 1, repre-nts a view in elevation, showing a system of able-conveying apparatus. Fig. 2, represents top plan view of the supporting and driving heels and connections. A represents the otor-car upon which is mounted an electro-namic motor a. This car is supported by rong metallic arms B B, extending upward erefrom, and secured at their upper extremi-es to the axles b of a pair of grooved support-g and driving wheels C C, which travel upon st ong metallic cable D. The conductor D is onnected directly to the source of electricity rough a manual-switch E and conductor E, nd the main current is led to the motor from ne of the traction wheels, and is turned to a cond (negative) conductor F, through a small ldit onal roller f, which is insulated from the st of the frame but in connection with the otor-circuit.

G and H are two separate vehicles in the rm of buckets, within which the freight to be ansported by the system is deposited. The sired to empty the buckets by inverting them, said arm L will strike against a stop placed to receive it, and by so doing will, through the remaining inertia of the moving buckets, completely invert them.

At the same time that the buckets are inverted the arm K will operate to throw the arm K′ and shift the commutator brushes and place the motor in condition to start back automatically with its load of inverted buckets.

In each of the main carrying-wheels, included in the train, a lining of rubber or some other such material is inserted, which, being somewhat elastic in its nature, will very greatly increase the tractive power of the wheels on the cable and counteract the great tendency to slip on up-grades, or when the cable is wet or icy, and will a'so greatly decrease the wear thereupon, and in that manner very much prolong its life.

Fig. 2 shows three sets of carrying wheels I, all connected by links M. Upon the axles *h*, sprocket wheels O are placed, and upon these sprocket wheels are placed endless link chains Q.

All the supporting wheels throughout the train are positively connected, as shown in the illustration, thus the total tractive force is used for the propulsion of the train.

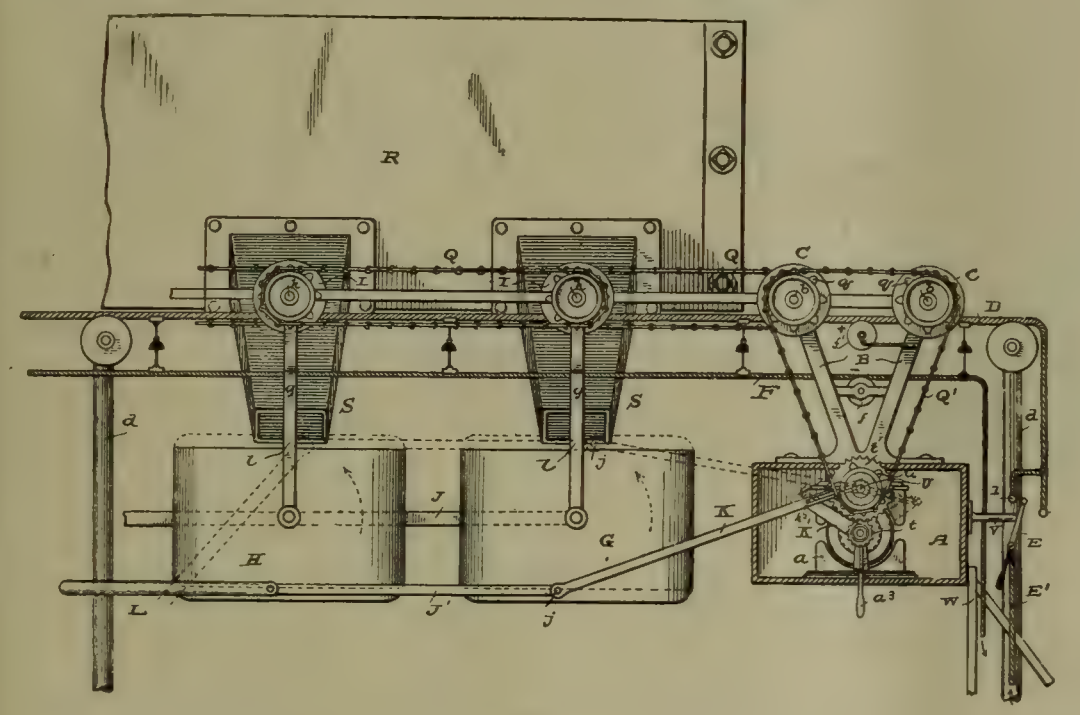


FIG. 1.

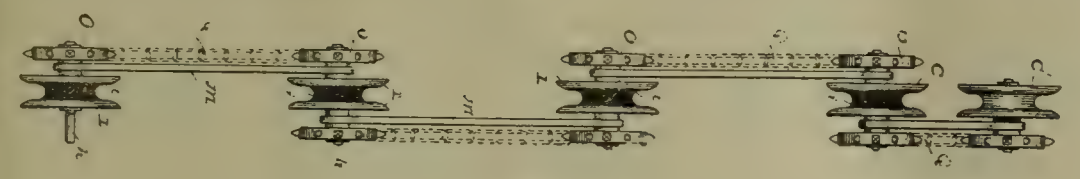


FIG. 2.

VAN DEPOELE'S IMPROVED TELPHER SYSTEM.

ckets are prevented from jostling against each her in any way changing their relative posi-ons by means of connecting rods J, which are aced upon and extend between the pivotal pports of each of the buckets. Each bucket further provided with a protecting boss j near s lower edge, upon which bosses are secured her connecting rods J, from the foremost one which extends a rod K, which is formed with slot k in its free end which engages a pin k 2, tending from a pivoted lever arm K, mounted on the bearing of the armature-shaft of the otor, said lever-arm being in position to en-ge a projection k, extending from the com-utator-brush carrier, by means of which, when e buckets are dumped to discharge their con-nts, the condition of the said commutator-ushes will be reversed by the thrust of the rod against pin k, the direction of rotation of the mature of the motor reversed and the train rried back to its starting-point. From the last nk J, extends an arm L, and when the train as reached the end of its route, where it is de-

Upon the said armature shaft, or upon the plain bearing T is journaled the inner end of the link K′, attached to the reversing rod K, and to the extremity of the armature shaft is attached a gear-wheel *l*, which meshes with a gear-wheel *l′*, mounted upon an independent shaft U, secured to the motor frame and provided with a sprocket wheel *u*, which is connected by a link belt Q′ with the sprocket wheel *q* upon the axes of the supporting wheels C C′ of the motor.

The carrying wheel C′ of the motor is shown as all metal, in order that it may act as a traveling contact to take the current from the main conductor D to the motor.

The motor carriage is provided at its front end with a projection V. As the train returns to its original position the projection V will strike the switch E, throwing it off the contact point I, and thus breaking the current and stopping the motion of the motor and buckets. By turning the switch the current is restored and the train starts on another trip.

ON THE TREATMENT OF ORES BY THE ELECTROLYTIC METHOD.

A well-known writer states in his work on metalurgy, and in reference to the electrolytic treatment of ores, that :

"During the past forty years many attempts have been made to extract metals from their ores by electrolysis, and many ingenious processes have been devised, but few of these, so far as we are aware, have proved successful. Some of the earlier investigations of Bunsen, Sainte-Claire, Deville, and Bacquerel are of special importance as indicating the general principles upon which such electrolytic operations may be conducted; there is little doubt, however, that much has yet to be done before the separation of the metals from their ores will attain the position of a really practical branch of electro chemistry. We have noticed in the cases of copper refining by the wet way, that many attempts were made in this direction long before a commercially successful application of the electrolytic method was arrived at, and we still hope and believe that electricity will yet be practically employed in extracting metals from their ores; indeed, some trials which we have recently made in this connection are at least of a very hopeful character."

This paragraph could now well be eliminated from his work. Electrical engineering firms for the past three years have given this branch of the science great attention, and with the result that their efforts in constructing dynamos especially adapted for this work have been successful. The United Edison Company, with their unusual facilities for the manufacturing of generators, promptly exploited this field, and are now turning out dynamos to develop any amount of current requisite for the capacity of the works treating the ores.

Many mine owners and operators of existing plants treating ores in the old method have, from time to time, been considerably exercised in their minds on reading and hearing reports of the marvellous statements that have appeared, about the output of the establishments already provided with plants for treating copper ore electrolytically.

1. The pureness of copper deposited.
2. The recovery of the gold and silver obtained by no other method.
3. The cheapness of production.
4. The ready sale of the product.

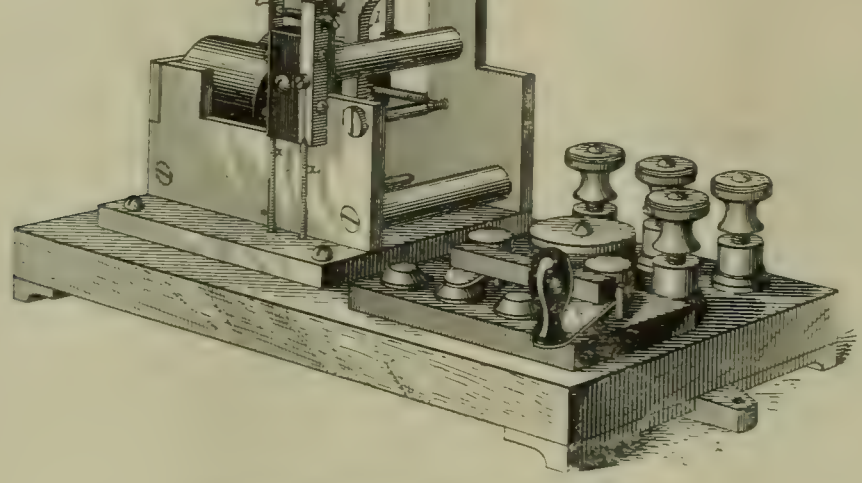
These statements are so far true, but the owners on investigating the matter have had great obstacles thrown in the way, getting no information as to the construction of the plants, and being told that the method is altogether done in a secret manner. This consequently has dampened their ardor, and they have returned to their old system of conducting their operations. But it may be at once stated that there is no real secret process. Owners of electrolytic plants have, however, only adopted the ordinary wise and business caution of, when they have a good thing, keeping it as far as possible to business. The United Edison Company, with a thorough knowledge of the whole system, can now contract with parties to furnish them with a complete plant, including motive power and generators, baths, pumps, and with all necessary information for conducting, with financial success, the operations of treating any ores by the electrolytic method.

OBJECT TO ELECTRIC LIGHT POLES. — A small riot occurred at Schuylerville, New York, on June 21st, over the right to set poles for electric lighting in front of a church. The parishioners objected to their being placed there, but the electric light men went to work and dug the holes. As fast as they were dug, however, the church people filled them up. A row ensued, during which the air was filled with missiles. After a good deal of lively scuffling order was restored. No serious injuries were reported.

THE DELANY IMPROVED LINE ADJUSTER.

The accompanying cut represents the latest improved Line Adjuster and Break Repeater, invented by Mr. P. B. Delany, of South Orange, N. J. The principle of operation is the same as in the original instrument, but important improvements have been made in the mechanical construction. A toothed wheel, and spring contact, takes the place of the segments and the trailing finger. This instrument, when once adjusted cannot change, and is in every respect a perfect machine.

Its operation is as follows: On the end of the armature lever, *l*, is formed a pallet, *p*, which operates an escape wheel, *e*, on shaft S. On the end of this shaft is a toothed wheel, *w*, which revolves in the direction of the arrow when the armature lever is moved forward or back by the make of the local circuit. When the lever comes back a tooth engages the end of contact spring C, pressing it away from contact screw, *d*, thus breaking the main circuit until the tooth passes off the end of the spring, allowing it to snap back, and close the circuit again at contact screw, *d*. When the armature lever is attracted the wheel, *w*, turns as before, but its teeth being so arranged that none engage



DELANY'S IMPROVED LINE ADJUSTER.

the contact spring *c*, on the *forward* movement of the armature lever, the circuit remains closed. The line is only opened when the relay breaks the local circuit of the Adjuster, and the lever, *l*, comes to its back limit. It will be obvious, therefore, that when a key is opened at any station of the line, the main circuit is also broken for an instant by the adjuster, or break repeater, wherever it may be placed in the circuit. The effect of this short break when an adjuster is placed at each end of the line is to open the line at both ends, and thus allow all the relay armatures along the line to be pulled back by their adjusting springs, so that the operators must know that the line is in use. The relays can also work on a lower adjustment, enabling the operator to receive with greater ease, and more correctly.

Recent experiments have demonstrated that an adjuster placed in the middle of a wire having a heavy "escape" improves the working to a very marked degree. It acts as a repeater of all the breaks, and renders through working possible, when, otherwise, the line would have to be abandoned.

These instruments are in use on the wires of the Erie, Del., Lack. and Western, Chesapeake and Ohio, Fitchburg, and Lehigh Valley Railroads, and are giving very satisfactory results

ELECTRIC LIGHTING OF NEW SCOTLAND YARD.—The new central offices of the Metropolitan Police on the Embankment, London, are being fitted throughout with the electric light. Altogether some 1,260 incandescent lamps will be employed to light the 300 rooms and multitudinous corridors and passages. In order to obviate any risk of a total extinction of the light from any cause, the wiring, which will require altogether about 15 miles of conductor, is arranged with alternate lamps on different circuits supplied by separate engines and dynamos, and a special feature will be the arrangement of the lights in the various offices in each of which all the connections will be made with twin flexible conductors which will start from a distributing box over the door and run separately to the pendant lamps across the ceilings on the surface of the plaster, the twin cables being held in place by small insulating eyes. This arrangement has been specially designed to suit the construction of the building, in which all the floors are of the parquet description laid on solid concrete, and the exigencies of the police requirements which necessitate from time to time alterations in the positions of the lights.

It was at one time proposed to obtain current from one of the public supply companies, but having regard to the large size of the installation and the importance of the lighting, being entirely independent of labor disputes or such other troubles as might affect an outside source of supply, it has now been determined to put down a special generating plant with which, on the considerable scale required, it will be possible to manufacture the electric energy at a price considerably below the 7¼d. per unit demanded by the supply companies.

The generating plant will consist of three Lancashire boilers and four sets of engines and dynamos, having a combined power of some 160 electrical horse power, and will be placed in a special underground engine house excavated outside the main building, so as to avoid the possibility of the noise or heat causing any nuisance in the latter.

There will also be a battery of accumulators capable of maintaining 200 lights for nine hours when the engines are at rest.

The installation, which will be one of the largest and most complete of the kind in London, is being carried out to the specification of Mr. A. A. Campbell Swinton, who has been appointed by the Home Office to superintend the whole undertaking.

PHONOGRAPHIC COMPANIES CONSOLIDATED.—The trustees of the New York Phonographic Company and the trustees of the Metropolitan Phonograph Company met in Poughkeepsie, N. Y., June 25th, and ratified an agreement entered into by the trustees of each company for the consolidation of the two companies. The name of the consolidated company is the New York Phonograph Company, and the trustees elected for the first year are John P. Haines, John D. Cheever, Richard Tounley Harris, Noah Davis, W. Seward Webb, William Fahnestock and John L. Martin. The office of the new company will be located here.

NEW MANNER OF APPLYING ELECTR POWER.

The Mather Electric Co. of Manchester, Con have just closed through their New Engla agents, Claflin & Kimball, of Boston, an impo tant electric power contract, by means of whi electric power is to be applied in a new manr to commercial use. The plant will be used run a large part of the Cumberland and P sumpscot Paper Mills belonging to the firm of D. Warren & Co., of Boston. These mil which are the largest paper mills in the wor are situated on the Presumpscot River, abo four miles from Portland, Me.; about one and quarter miles above the mill there is a large wa power belonging to the mills, which the fi have for a long time wished to utilize in sor way at their mills, but up to the present time ha been unable to do so, as there seemed to be feasible way of transmitting the power, but the contract just closed with the Mather Electr Co. the problem has been solved. At the fa in the river will be placed the generating stati where there will be five generators capable delivering 80-horse power each, thus having combined capacity to deliver 400 horse-powe this power will be then carried to the mill, miles below, and there distributed througho the mill, driving motors of 40-horse power c pacity each. The motors will drive isolate machines or lines of shafting as the case may b and as each motor can be stopped and started will it can be easily seen that the power can used in the most convenient and economic way. In general these motors will have to r from 6 o'clock on Monday morning to 6 o'clo on Saturday night, night and day without a sto this is the most severe service that machine can be put to and shows the confidence th manufacturers are beginning to have in electr machinery in general and in the apparatus the Mather Electric Co.'s manufacture in pa ticular. The contract was awarded to the Math Electric Co. after a long and sharp contest; t electric apparatus of all the large companies w successfully investigated by electrical enginee in the interest of Messrs. S. D. Warren & Co., a the award was made upon the very high rep tation which the electrical goods manufactur by the Mather Electric Co. has obtained amo those who are capable of judging.

This plant will be the first of its kind in Ne England and it is the beginning of what w doubtless be a very large field for the appl tion of electric power. By means of electr power thus applied, manufacturers can loca their mills at points on railroads or other plac where most convenient, and can still have the benefits of cheap water power, they can di tribute their power as is most convenient in d ferent parts of their mill building and will e tirely rid themselves of steam plants and the accompanying annoyances. By thus distri uting their power around the mill they will avo long and heavy lines of shafting and save t power required to run them, they will also ha their power under complete control at the poi where the power is used, and will thus be ab to economize their power to the greatest exte starting or stopping a motor as the power is quired for actual use.

The Waltham Watch Co. have just placed the order for another increase of their already mar moth electric light plant. They have order through Claflin & Kimball, agents of the Math Electric Co., an increase of 1,000 lights, th making a total dynamo capacity of 3,000 lam and a total number of lamps hung of near 4,000, all of the Mather system. This plant whe completed, will be by far the largest electric pla in a single manufacturing building in the count

ELECTRIC RAILWAYS.—All the street railroa in Louisville, Ky., are now controlled by a Ne York syndicate and will be run by electricit There are thirty miles of road in the city.

SMALL ELECTRIC MOTORS.

The question is frequently asked, "if electricity can be utilized as power for running heavy machinery, why can not small motors be made for domestic work, such as running sewing machines, etc.?" There is only one answer to this question, and that is small motors are made for just such purposes. There are hundreds and thousands of housewives in the land who would be glad to have their sewing machines run in this manner; but they do not know that small motors can be had for such work.

The demand for motors for light work has grown to such proportions that, the manufacture of small machines has become an important industry. The Elektron Manufacturing Co.,

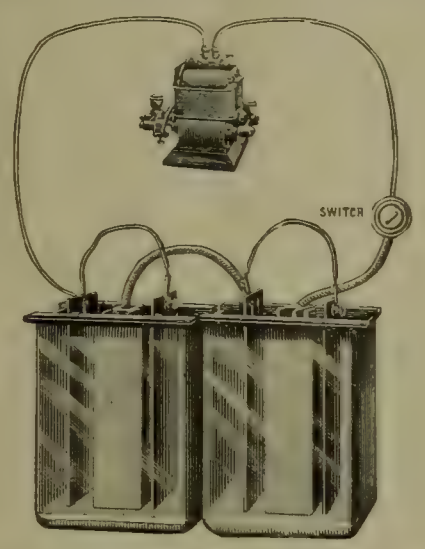


FIG. 1.—BATTERY AND CONNECTIONS.

of Brooklyn, have acquired a very worthy reputation for the goods of this class they turnout. They have just issued a little pamphlet, intended for those who are not familiar with electrical matters. Information concerning their batteries and Perret motors, which is the name of those manufactured by this company, is given in the plainest language with a view to popularizing their goods. In the accompanying illustration Figure 1 shows the type of battery used for driving small Perret motors. The figure also shows the connections between the battery, switch and motor.



FIG. 3.—FAN OUTFIT.

Figure 2 shows a Perret motor, attached to a sewing machine. The Perret motors are well-known to be the most efficient and best made machine in the market, and it is also the simplest. It received the highest award at the Universal Exposition of 1889, at Paris.

One of the latest adaptations of small electric motors is for driving small fans. A fan outfit is a great luxury in warm weather, and one of these fans, run by a Perret motor, can be placed in any convenient place in a room, and will, when in operation, give a delightfully cool breeze when wanted. The demand for these fan outfits is growing at an astonishing rate. There is nothing like them for the sick room, house or office, and the comfort that can be derived from their operation must be experienced to be appreciated.

Figure 3 shows one of these fan outfits, which are ornamental as well as useful.

The Perret motors are made in all sizes up to



FIG. 2.—MOTOR ATTACHED TO SEWING MACHINE.

20 h. p. The battery motors are adapted to running dental engines, jewelers' lathes, surgical drills, jig saws, working models, graphophones and phonographs, as well as sewing machines and fans.

THE UTICA BELT LINE RAILWAY.—The Utica Belt Line Railway, at Utica, N. Y., recently put in operation under the Thomson-Houston electric railway system, is a fine piece of construction which embraces more than a few conditions not found in ordinary electric railway construction work. The total length of track is 20 37 miles. Six 80 horse power Thomson-Houston railway generators are now in daily use. The station switch-board, which contains the auxiliary appliances, is very handsome, and finely constructed throughout. The car equipment consists of twenty-five cars, each equipped with two 15 horse power Thomson-Houston railway motors.

THE JABLOCHKOFF CANDLE.—One of the earliest electric lights used in practice, was the Jablochkoff candle. It was invented by a Russian military officer of that name, in 1872. As late as 1880, twenty-five hundred of these candles were used in Paris for street lighting; and though finally superseded by better methods, it will always possess a historical interest on account of its success and popularity in the early history of electric lighting.

IN FAVOR OF ELECTRICITY.—The Brooklyn City and Newtown Railroad Company has mortgaged all its property for $2,000,000. It is stated that this has been done in order to introduce electricity as motive power.

THE WIRE CRUSADE.—During the crusade against overhead wires in this city, last year, some American Rapid Telegraph wires shared the fate of the others. Suit for damages was brought against the Mayor, Commissioner of Public Works Gilroy, and the Board of Electrical Control. The case was on June 25th decided in favor of the defendants.

ESSICK PRINTING TELEGRAPH.

The company controlling the new page printing system are slowly but surely branching out and making itself known before the public. Three of the principal railroads in Boston, and others in other cities, have put their experts to examine the system, and they have each time reported in favor of adopting it for railroad service. It is especially adapted for this kind of work, since it does away with the necessity of maintaining an expert operator at every station. The system can be operated by any person, since the action is essentially that of a typewriter, and the message is printed in page form simultaneously in the presence of the operator and at any number of stations on the line. The action of receiving is entirely automatic, and the presence of the operator is not necessary for the reception of a message.

A very valuable feature of the system is its ability to drop off messages in any number of stations desired, which strongly recommends it to railroad companies and news associations.

The system has been operated, with perfect results, between Boston and Washington, dropping off a copy at New York.

As a solution of the problem of cheap telegraphy for the U. S. Postal Telegraph System, Postmaster-General Wanamaker advocates the system. He personally operated the instruments in Washington and sent a message to New York.

The system may be seen in practical operation at 171 Broadway, N. Y., and 113 Devonshire street, Boston.

SOME NEW AND VALUABLE BOOKS.

ELECTRIC TRANSMISSION OF ENERGY, AND ITS TRANSFORMATION, SUBDIVISION AND DISTRIBUTION.—A practical hand-book, by Gilbert Kapp, C. E. Second Edition, 348 pages; illustrated; 12 mo., price $3.00.

This book is the most complete work of its kind extant. It is profusely illustrated, and the subjects are covered in a most thorough and practical manner.

ELECTRIC LIGHT INSTALLATION AND THE MANAGEMENT OF ACCUMULATORS.—A practical hand-book, by Sir David Salomons, Bart., M. A., Assoc. Inst. C. E. Fifth edition, revised and enlarged 99 illustrations; 348 pages, price $1.50.

This is a very valuable book on these important subjects, and the information is fresh and timely.

ELECTRIC BELLS AND ALL ABOUT THEM, by S. R. Bottone, second edition, Revised.

A practical hand-book for practical men, with over 100 illustrations. Price 50 cents.

THE ELEMENTS OF ELECTRIC LIGHTING.—By Philip Atkinson, A. M., Ph D. 260 pages, 104 illustrations. Price $1.50.

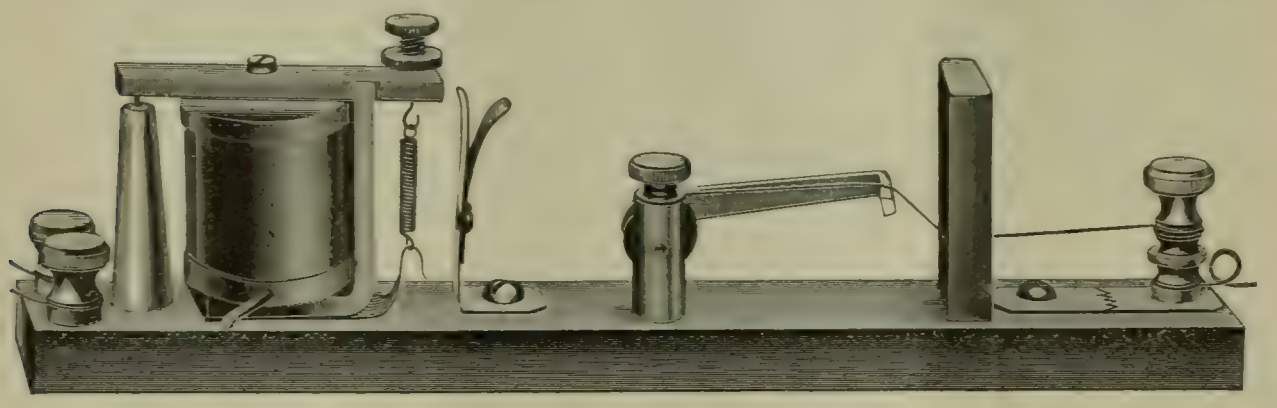
All the principal systems of electric generation, measurement, storage and distribution are fully described, and altogether it is one of the most practical and interesting books on the subject ever brought out. These books and all others on electrical subjects are for sale by the the ELECTRIC AGE PUBLISHING COMPANY, 5 Dey street, New York. Send for our book catalogue.

MULES.—"What shall we do with our mules?" is a question that perplexes Louisville, Ky., street railroad authorities just now. Twenty-three hundred of these docile quadrupeds will be out of employment ere long, when electricity becomes the propelling power on the street railroads in that town. We should not be surprised to hear of a good deal of "kicking" as a result of this wholesale lockout.

THE MIKADO'S PHONOGRAPH.—Recent advices from Tokio, Japan, state that a phonograph, made by Mr. Edison expressly for the Mikado and presented to him last week by Edison's representative, has been set up in the Mikado's palace, and the monarch is delighted with it.

THE BROWN ELECTRIC PROTECTOR.

The adage that an ounce of prevention is worth a pound of cure is applicable to the use of large electric currents as well as any thing else. It is easier to prevent a thing from happening when we know that it will happen if we do not take proper precautions to prevent it, than it is to apply a remedy after it has happened. We take precautions to prevent boiler explosions as far as possible, knowing that death and destruction may result if we neglect to do so. The same is true in the handling of electric currents of large volume. Every one now knows that if large electric currents are not confined to their proper channels damage will result. Up to a comparatively recent date these currents in getting astray accidentally have caused death, and destruction to property simply because no protective devices had been employed. Lately, however, the necessity for such devices having become manifest, instruments of this class have been broughtout by the score. Each inventor naturally claims that his is the best, but when the practical test is applied many fail to perform their functions reliably, or not at all. When a really reliable and efficient instrument of this character has been put to the test and proved its merit the fact is worth knowing. That is why we call the attention of our readers to the Brown Electric Protector. It is a thoroughly proved protector, and has been adopted by the Pensylvania Railroad Company and endorsed by the Inspector of Insurance Patrol and Electric Lighting for the Philadelphia Board of Fire Underwriters. The Gamewell Fire Alarm Telegraph Company have no less than 50,000 of these instruments in use. This extensive application of the device is indisputable evidence that it has merit. No one would order 50,000 instruments of any kind without first knowing that they were efficient to fulfill every requirement.



THE BROWN ELECTRIC PROTECTOR.

The accompaying illustration shows the Brown Electric Protector with the Smith attachment to be used on fire alarm circuits.

The Brown Electric Protector assures absolute protection to property, telephones and telegraph instruments from fire and destruction by abnormal electric currents from electric light wires and lightning. The manufacturers claim the superiority and preference of this instrument over all others for the reason that it does its work better than any other similar device in existence and affords absolute protection against a wider range of dangerous currents, also presents no weak electric contacts whereby the service of any line upon which it may be used can possibly be impaired.

After an exhaustive investigation of electric protectors the Pennsylvania R. R. Co., has adopted the Brown instrument and equipped the Broad street and all the other station buildings and offices throughout the city of Philadelphia with them; it is also exclusively used by the same Railroad Company at Harrisburg, and by the Union Transfer Company, Adams Express Co., and many others of Philadelphia.

The following description explains the instrument herewith illustrated. Any abnormal current that may be introduced into a building by reason of a telegraph, telephone or district wires coming in contact with electric light wires or lightning must first pass into the Protector, through the German silver or fusible wire, thence through the coil of Electric Magnet, magnetizing the core thereof, attracting the armature whereby the instruments protected are shunted from the circuit and the abnormal current is carried direct to the ground and concentrated entirely, upon the German silver wire which action causes the same to fuse and completely open the line.

A milder abnormal current which might by continuous and cumulative action injure the instrument and possibly cause fire, is automatically grounded until such current is broken, or reduced, and when at the point of safety the instruments protected are again brought automatically into circuit, this also applies to atmospheric electricity or lightning. The total resistance of the instrument is about ½ an ohm.

The Brown Electric Protector Company, of New England, with heaquarters at 54 Devonshine street, Boston, are the manufacturers of these valuable instruments.

INTERIOR CONDUITS.—The Interior Conduit and Insulation Company are making daily car-load shipmemts of tube throughout the country. The new underground tube seems to have met with a great deal of success. The tests made at Detroit have given a great deal of satisfaction. This company has a contract for furnishing the underground conduits for St. Paul and Minneapolis, and they have also sold several thousand feet to the Pennsylvania R. R. Co., for their underground work. They have made quite a shipment of material to Japan, on orders received from there, and will probably make a shipment to Germany during the coming week. The company's new and commodious quarters now enable them to turn out tube in large quantities although they have not as yet succeeded in catching up with the orders, but it is probable that this will be done before the middle of the coming month, as the output has been increased tenfold. The initial job of this company, the Shoreham Apartment House, Washington, D. C., owned by the Hon. L. P. Morton, has now been in operation about eight months and never has given any trouble since the plant was turned over to the purchaser. That it is an unqualified success is evidenced by the fact that Mr. Morton is now preparing to build an extension of the Shoreham house and it is specified by the architects throughout the entire new building. As this company is not doing any construction work, the architects desire, as a special favor that it shall be put in under their supervision.

AMMETERS AND VOLTMETERS.—We learn from Queen & Co., of Philadelphia, that in consequence of the great demand for Ayrton & Perry's Magnifying Spring Ammeters and Voltmeters, they have much increased their already large stock of these instruments and can fill orders for all the regular ranges without delay. The cardinal points in these instruments are portability, freedom from magnets, hence they are not affected by dynamos, direct reading scales, which are at the same time proportional throughout. That the Ayrton & Perry meters are appreciated is shown from the great demand for them during the last few years. They have been and are now used very extensively on electric railroads.

SUBWAY MANHOLE EXPLOSION.—On the morning of June 24th a subway manhole at the corner of 12th street and 6th avenue blew up and did some damage to the street in the immediate vicinity. One man was slightly hurt. The subway was used for telephone wires, none of which were harmed. The accumulation of gas was the cause of the explosion, and the manhole, which was of the old style, had no means for ventilation.

PLEASED WITH AMERICA.—"Zis is lofely," cried the Neapolitan immigrant as the manhole exploded. "So like ze Vesuvius. I feel quite at home."

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, June 28, 1890.

THE FINDLAY GLASS & CARBON CO. are moving their factory from Findlay, Ohio, to Peru, Ind. They will greatly increase their facilities and are putting in new machinery. They have secured three acres of ground for their factory and will be supplied with natural gas. Mr. C. H. Cone, the Chicago representative of this company, says they will probably be in full running order by the first of August.

THE WESTERN POWER CONSTRUCTION CO. are now settled in their new quarters at 144 Adams street, Chicago. A noticeable feature of the new office is the desk occupied by Mr. W. P. Adams the manager of the company. This is a handsome piece of furniture, of antique oak, and very large, and is one of the finest desks in any office in the city. The company report the closing of several contracts of considerable size this week, one with Edison Local Company for 200 H. P. capacity.

A BIG DYNAMO.—Mr. Foree Bain is constructing a machine of large size at his electrical works, for use in generating power for coal mining, at What Cheer, Iowa. This generator is designed to furnish a current of 300 ampères at a pressure of 250 volts, being of 100-horse power capacity. The armature of the machine is wound with No. 4 wire and the fields with No. 15, and the weight of the machine complete will be about 11,000 pounds. The dynamo is a constant potential one, and will run on 600 revolutions. It is provided with self-oiling boxes, and will be a handsome machine throughout.

NEW STORAGE BATTERY CAR.—In filling an order received from the Millborough (Kentucky) Street Railway Co., the Pumpelly Storage Battery Co., of Chicago, contracted with Mr. Rae of Detroit to put in his improved 15 H. P. motor and truck. The car was fitted out in Detroit with 99 Pumpelly batteries. The batteries themselves were connected up in a peculiar manner introduced by Mr. Osborne of the Pumpelly Co., that is in parallels of 25 and 48 and in series of 96. A switch of four sections, each section connected with the set of batteries in parallel is employed. These switches are placed one at each end of the car so that they can be used in whichever direction the car is running. This car made several trial trips in Detroit last week, which were entirely successful. The battery equipment of the car cost about $750, and Mr. Hill, manager of the Pumpelly Co, says it certainly represents a life of 2½ to 3 years. This car will shortly be running regularly on the Millsborough line, and will no doubt be watched with interest, as this is the first application of the Pumpelly battery to traction work.

MR. JAMES E. WILSON, Superintendent of the Western Power Construction Company, left for the East this week on a two weeks' business trip. Mr. Wilson will visit Boston, New York city, and will stop at the McIntosh & Seymour factory, Auburn, N. Y., in the course of his trip.

CHICAGO ELECTRIC CLUB.—The annual banquet of the Club was held at the club rooms, on the evening of June 27th, and was an enjoyable occasion. The banquet presided over by Vice-President Kempt, was served in Kinsley's large banquet hall. Covers were laid for a hundred guests. The menu was as follows: Cream of Asparagus, Sherry; Whitefish, Maitre d'Hotel, Cucumbers, Parisian Potatoes, Sauternes; Fillet of Beef Jardiniere, Pommes Chateau, Claret; Maraschino Punch; Cutlets of Green Turtle, Baked Tomato, Champagne; Cold Ham in Aspic, Lettuce Salad, Ice Cream, Cakes, Coffee, Cigars. After the banquet an adjournment was had to the club parlors where two very interesting papers were read, one by Prof. J. E. Siebel on "Thermo-Chemistry in Relation to Electro-Motive-Force," the other by Mr. J. K. Pumpelly, on "The Stor-

age Battery in Traction Work." As these papers appear in full elsewhere they need not be commented upon here. After the reading of the papers the club adjourned to Kinsley's ballroom, where dancing was the order of the evening. The affair was pronounced a success in spite of the extremely warm weather, and it is to be hoped will be repeated at more frequent intervals. Among those present were, Alex. Kempt and two ladies, S. J. Keese and wife, of Los Angeles, Cal.; M. A. Knapp and lady, W. J. Buckley and lady, K. McClennan and wife, J. B. Carney and wife, F. E. Degenhardt and wife. George Cutter, wife and lady, G. A. Harter, W. H. Harding, C. M. Spalding, H. L. Reiwitch, A. Scheible, J B. Payne, J. K. Pumpelly, T. G. Grier, W. B. Pearson, Ernest Hoefer, D. B. Dean, W. A. Kriedler, B. E. Sunny, C. G. Armstrong, E. R. Colius, F. DeLand, W. A. Hosey, R. E. Lee, H. A. Armstrong, J W. Dickerson, G. M. Smith, Geo. Buckley, H. R. Hickson, W. F. Collins, F. L. Perry, F. M. Ireland, W. W. Nichols, A. C. Durborow, Jr., Chas. E. Gregory, W. S. Boyd, Geo. C. Biley.

F. M. I.

THE STORAGE BATTERY IN TRACTION WORK.*

BY J. K. PUMPELLY.

When I had the honor of addressing you a short time ago, I attempted to show how useful storage batteries could be made, and to what extent economy could be effected by them. The question was then asked, why it was that storage batteries had thus far failed to realize the predictions made concerning them. This question I propose to answer, basing my remarks upon actual tests that have been made in street car traction, the most difficult probably of all work they have been set to accomplish. Allow me before we proceed to consider dry data that have been lately compiled with great care and expense, to lead you along a line of thought which, a short time ago, occurred to me, while watching the incandescent light hanging over my head late at night, long after the dynamo has ceased its rapid revolutions, when the fires had gone out beneath the great boilers, and the engineer had retired to his well-earned rest. Where did this light come from? Even the most advanced electrician might have asked this question. I was seated in my library at this late hour, but knew, of course, that four floors below me and several hundred feet away, fifty-five boxes, filled with water and lead and a little sulphuric acid, stood on shelves in rows, connected together like yoked cattle at the plow, and that at the opposite ends of these boxes were wires, to which the glass over my head was fastened, and through which passed a little thread of carbon fibre, and inside of this glass what nature abhors—a vacuum.

This little thread of carbonized fibre gave a steady, unchanging light throughout the room. What made it? The mysterious forces of nature had been at work. Electricity created by the dynamo had pushed its way into the liquid surrounding these plates of lead, piled up in the little boxes, and had torn apart the atoms and molecules of hydrogen and oxygen, of which water is made. It forced the one to seek something to contend with, at one side of the box. There it held them, constantly keeping up this tearing asunder of atoms, hour after hour, until there were no more atoms to be torn apart or fight with. These atoms constantly struggling to recombine, find a means through a bridge of wires, and although powerful obstacles are in the way in the shape of the arched carbon fibre, the struggle is so great that in the effort to cross the resisting bridge, light and heat are the results. And so these contending atoms, hundreds and even thousands of feet away, exerted nearly a twelfth of a horse power over my head.

To return, why with all this force at hand, and under control of man, has there been such failure in street car work? Let us study well the problem, and by the experience of practical, earnest men determine whether we ought not to charge ourselves with much of the failure; we may find that the obstacles to success come from the outside, and not from the batteries themselves.

We have given our young horse too much to do. Could we have understood the language of our straining overworked street-car horse or the more patient mule, we would have known long ere this how varying is the traction work on a street car. To show this I will read extracts from A. Reckenzaun's very elaborate paper on electric traction.

I have also enlarged two of his profile designs of the varying street railway horse power called out in a trip of forty-three miles and the corresponding current needed to supply this power, so that you may better realize the facts.

These data were made on a street car carrying sixty cells. The electro-motive force in starting was 160 volts, and an average throughout the entire trip of 257 volts, *i. e.*, 160 volts at starting and 154 at the end of the trip, occupying, with stops, a period of 6 hours.

Mr. Henry Hughes deduced from experiments on tramways a tractive resistance of about 26 pounds per ton; often more, occasionally less. Such high resistances as these are readily accounted for, when it is considered that the flanges of the wheels frequently take a bearing on the bottom of the grooves, or on the dirt imbedded therein, at the same time that the wheels roll on the surface of the rail, for thus the wheel rolls on two different radii simultaneously and grinding of surfaces in contact must result. It may occur that one wheel is running on its proper bearing surface, while the other, belonging to the same axle, has it flange touching the bottom of the groove, when, by virtue of different circumferential velocities, additional friction is introduced. Sometimes the rails are a little out of guage. All these circumstances augment the tractive force requisite with grooved rails. The horse, if he could speak, would be a good witness; but, failing his verbal evidence the dynamometer has been consulted. Better than the mechanical dynamometer, however, is the ammeter. A dead beat ammeter indicates instantly the slightest variations of tractive resistances, and I venture to say that it will be through the judicious and more frequent applications of this instrument that material improvements, both in the permanent way and in the rolling stock of electric tramways, will be effected.

In order to ascertain the amount of energy used on electric cars, I have made, in conjunction with the Electric Car Company of America, a long series of systematic tests both on an experimental track, built for this purpose, as also on the public roads under all sorts of conditions of traffic. Whilst on the experimental track we could run at any speed we liked, and without stoppages, on the public streets we were confined to the speed of horse cars in front and behind us, besides taking up and putting down passengers and regulating our vehicle to the general traffic of some of the busiest streets of Philadelphia.

This experimental track was laid in an irregularly shaped yard and it was intended to represent as difficult a line as is likely to occur in actual practice. Its entire length was 1.005 feet, the ends being so joined that the cars could circulate continually. Five and a quarter journeys round this track represented a mile run. There were four curves; two of 50 feet radius, one of 33 feet, and one of 100 feet. Tangent with the 33-foot curve was a gradient of 4.89 per cent. rise, which descended on the other side at the rate of 5.8 per cent., and joined the curve with a radius of 100 feet. If we have to overcome a gradient of 1 per cent., or 1 foot in 100, the resistance due to gravity will also be 22 4 pounds per ton; therefore we shall require about 5 H. P. to pull this car up a gradient of 1 in 100. With a 2 per cent. rise the power will be three times as great as on the level, and, roughly speaking, each per cent. of grade demands as much energy as the propulsion of a given weight on a horizontal road if the speed is to be constant.

Much that I have read to you may have been glanced over by most of you before; perhaps you may not have had the time to study and compare the various data, hence I presumed even at the chance of wearying you, to bring it before you so that it can be discussed at length. You will see, however, by the practical notes of Mr. Reckenzaun, that the condition of the track and road bed, and the quickness, watchfulness and coolness of the switchman on the car platform has much to do with the success of electric traction, especially when a stored power is used. This last quality in the driver or man who controls the out-put of current, who knows by experience what he needs and what is wasteful, can make use of storage batteries, economical or otherwise. A car has lately been filled up with batteries at the order of the Middleborough Land Co., of Kentucky, which is completely controlled by the switchman. The batteries are connected in parallels of 25 aside from the regular series connections, and as 100 cells compose the outfit, the switch is divided into sections of four with resistance between each section to prevent flashing when rapid changes are made under a strong current. Thus the switch acts much as does the steam throttle in the hands of the engineer.

To give the first impulse for a start, 25 cells of the battery are thrown into circuit with the motor, which is thus saved from heating or straining and at the same time feeds the impulse of magnetization which starts the revolutions. The counter E. M. F. which begins to be created as the armature revolves, permits of a stronger current and the movement of the switch to the next segment, throwing in 50 cells and then 75. When the car is well in motion the counter E. M. F. allows of the entire battery of 100 cells being switched in series. Thus it can be seen that although a current of 50, 60 or 80 ampères is needed to start a loaded car, this current is divided up so that one connection of batteries help each other by dividing up the load, taking less out of each cell and also saving the motor from heating. Still the question is asked why, if the success is such as represented on the above mentioned road, are not all doubts settled and the storage battery generally adopted? It is certainly the ideal method for street car traction, each car being independent of any other, motion can be forward or backward. A car can even be run off the track, and if out of order run over the main road to the car house, if not too far away. There are two reasons for this hesitation. First, some of the batteries heretofore used are not durable enough, their mechanical building up or putting together of the plates fail to resist the jar of the railway and the sudden increased draught of current to which the battery is often subjected. In these batteries any touching of the two opposite pole plates, destroys the efficiency of the entire set and nothing can be done to remedy the evil for the time, but to take out the one disabled cell and put in another. Now this tendency of the plates to get together is constant and comes very likely from the unequal expansion of the lead support which holds the active material and is a conductor for the electrolyting current. There is also a tendency of the blocks of active material to flake off or to fall out under a jar, the pieces or flakes often catching between the two plates, which are never over ¼ of an inch part, and thus short circuit the battery and render it useless. Fine crystals of lead sulphate are slowly forming like the zinc of pine spicular formation between the plates and in this way doing the damage in the most mysterious manner for these crystals can hardly be seen.

The second reason is to be found in the weight of the battery and as constant efficiency depends very much on the weight of lead and lead oxide of which the battety is made to-day, it cannot be avoided unless the managers of the road look at it in the right way and manage for shorter trips and more frequent changes. For instance, suppose a six hours trip of 40 or 50 miles (like the example mentioned above), needs a battery of 150 ampère hours capacity; to obtain this capacity we must have at least 80 batteries weighing 35 or more likely 40 pounds each; all this weight besides the car, motor and load must be supported and propelled by the forces excited in the battery itself. What would be the most practical and sensible way to improve this condition? Surely to shorten the trips, and as we learn by experiment that it needs a battery of 150 ampère hours capacity, and which capacity depends upon a certain weight of batteries, to run 50 miles at 8 miles an hour, then why not use a 100 ampère hour battery weighing, say 25 lbs., and run 30 mile trips. The batteries being lighter could more quickly and easily be slid into and out of the car, more quickly charged, and cost less money per cell. If the trip occupied four hours to run the 30 miles, then four hours would be sufficient to charge the exhausted battery with 100 ampères, the dynamo delivering a current in charging of 35 ampères per hour, which would be a fair normal current for a properly constructed battery. Most of the batteries of this size and weight will not bear a charging current of 35 ampères and this has been one of the troubles that the experimental street railways have had to contend with. I am sure, however, that a battery is now on the market which will take such a current, will not get out of order, will not be injured by jar or heavy current discharge, in which the plates lie horizontal in the cell and all opposing pole plates are separated from each other automatically by intervening sheets of porous absorbing and non-conducting cellular fiber, inert and non-corroding in the electrolyte, and by reason of which the internal resistance is not increased, although it has been contended by many that this latter objection would exist. I am also quite confident that another battery will soon appear in which faults before found in storage batteries will be overcome, not by lessening the weight of the battery but by avoiding uncertainties caused by buckling, etc. These batteries are mentioned here merely to show, when all the arrangements are made on the road, their ability through proper construction to do the work constantly, as well the thousandth time as the first time, can be depended upon. If, indeed, we have not this certainty of durability, all data, all estimates are useless; merely waste of time and money.

A word regarding the economy of traction by storage battery compared with that by means of the over head wire.

It takes an engine of at least 250 horse power and a dynamo of the same power, constantly running, to propel seven cars over the above mentioned route. To charge 560 batteries, that is, one set of eighty cells for each of the seven cars, would need an engine of 58 horse power, a dynamo of the same power of 1,340 volts, delivering a current of 35 ampères, and this dynamo would have to run four hours. If the trips were arranged for a change of batteries every four hours after the first set were charged, a 58 horse power dynamo and engine would do the work, or better, two 30 horse power dynamos running only part of the time.

The dynamo for the overhead system must keep the E.M.F. constant, whether seven cars are running or a less number. It must also supply such constant E.M.F. that the motor at the end of the wire, six miles away, shall receive the same electrical impulse as at the end near the source of power, and it is well known what the drop in the line is per mile, and the wastage of power. We find that ten per cent. yearly on the first cost of the batteries will make up for any deterioration in a well made battery, and that amount will keep in order the overhead wires. It might be of interest to mention here, in closing, the Patton motor system now being thoroughly tried at Pullman, in which great interest is taken by street railroad men, not only because it can be made quite independent of short stations, but avoids necessity of charging batteries, and can use as trailers, hundreds of street cars too lightly made or too old to support a set of heavy batteries.

The locomotive car is something like the grip car, although it carries in the center a gas engine of 7½ horse power, with a tank sufficient to supply fuel for many hours and a dynamo of 7½ horse power while underneath are sixty storage cells and a motor of 150 horse power. In front there is still room to seat twenty or thirty persons.

By referring to the data on traction just read you will appreciate the principle and economy of this plan. We learn that an average run on the generally used lines of street railway uses 4½ horse power of energy, and only in starting, ascending grades, or turning short corners, is much more power needed. Hence in the Patton system a current sufficient to charge sixty cells with fifteen ampères, under a pressure of 170 volts, would keep the batteries charged, although part of the current, sufficient to generate watts for 4½ horse power, was constantly drawn out from the battery while running on a level. Now, as the pressure is constant at about 2.4 volts for each cell, or about 170 volts for the current necessary to do the work is drawn from the battery, when the pull comes, such as ascending grades, going around curves, or starting, then the counter E.M.F. developed in the motor, which is wound to develop 20 horse power under the pull, would lower the voltage to that of the sixty cells on a discharge. The instant this takes place, the current flowing

* Paper read at the Annual Banquet of the Chicago Electric Club.

into the motor from the batteries is always sufficient to develop the full power needed, and this equilibrium is automatic. As the voltage of a battery on the first moment of discharge is always higher by 3.30 of a volt per cell, there would be developed from the battery of sixty cells, at the moment it was called up n, a higher efficiency than could be estimated upon a basis of average efficiency, and hence we learn from varied trials that the battery thus constantly charged exerts tremendous and unestimated energy at the moment, very much as a man or horse can exert unusual power under excitement or strain.

It is found that, on a level track, two loaded cars can be drawn at the rate of twelve miles an hour, around curves and up 3 per cent. and 4 per cent. grades, and often, when the longest runs have been made on a level, needing only 4½ horse power, and the cells have become so fully charged that the engine is shut off and many miles are run with the bat tery alone. In this case, also, the E.M.F. from the battery can also start the gas engine. Now, if a 7½ horse power engine and dynamo will do the work, by the use of the most condensed and convenient form of fuel, seven cars would need only 52½ horse power in engines. It is claimed that this car, with one loaded car attached, can be run at a cost of 1¼ cents per hour. The size of the oil tank, which it would be convenient to carry, would be the only limit to the distance run. Of course, stations, at proper distances apart could be made, to renew the tanks.

In a short time every day work, the only real test to success, will show just how practical and economical this, like other systems, can be.

THERMO-CHEMISTRY IN RELATION TO ELECTRO-MOTIVE FORCE.*

BY PROF. J. E. SIEBEL.

The quantitative relations between the chemical changes taking place in a galvanic battery and the quantity of electric power generated by such a battery are well understood. The amount of heat generated in the whole circuit is equivalent to the total electric power or volt ampères (electro-motive force times current strength), generated by the battery and also equivalent to the amount of heat which would be produced by the chemical changes going on in the battery, had the same not been converted into electric energy. Attempts have also been made to establish relations between the electro motive force and the chemical changes going on in a battery, and, according to Sir Wm. Thompson, the amount of heat due to the chemical changes going on in a battery while one molecule of zinc is dissolved is proportional to the electro motive force of such battery. This, indeed, happens to come out correctly in the case of some constant batteries having a depolarizer, but it can be readily seen that it is not generally applicable. Take, for instance, the case of several elements, each made up of zinc as the electro-positive metal acidulated water and another more electro-negative metal, say iron, copper, silver, etc. In the case of each of the different elements so formed the electro-motive force is a widely different quantity, while the heat equivalent to the chemical changes in the battery, while one molecule of zinc is being dissolved, is the same in all cases since no chemical changes take place at the negative electrodes.

Considerations of this kind and the convictions (based upon the result of certain deliberations the drift of which it is not desirable to enlarge upon at present) that definite relations of some kind must exist between the chemical changes in, and the electro-motive force of, a battery, have led me to the elaboration of a formula (which I think covers the subject quite satisfactorily). At present I will only consider its application to batteries consisting of two metals and diluted sulphuric acid. The electro motive force of such elements is, according to the inference drawn by me, nearly proportional to the difference of the heat which a molecule of each one of the two metals would evolve by being acted on by diluted sulphuric acid independent of the battery under favorable conditions. In order to establish the correctness of this assertion I submit the following table which also will more readily show the import of the rule referred to. The first column in the table gives the names of the various metals, the second column their electro motive force in juxtaposition to dilute sulphuric acid expressed in volts. In these figures the electro motive force of zinc may be considered as a number somewhat arbitrarily chosen, yet with reference to it the other figures represent the electro-motive force as established by Hockin and Taylor, J. Tel. Eng., 1879. The third column shows the relative amount of heat in calories generated by one molecule of the different metals in being dissolved by diluted sulphuric acid. It is readily seen that the heat evolved increases with the electro-motive force evolved in volts multiplied by 1,000 produced by the combination per molecule of the respective metal with sulphuric acid and the elements of water.

Iron	1.130	87200	0.0120
Copper	0.580	56000	0.0104
Silver	0.300	20400	0.0147
Gold	.280	not determ.	not determ.
Mercury	.260	"	"
Platinum	.150	"	"
Carbon	0.276	18500	0.0148
Potassium	3.560	196000	0.0180
Sodium	3.460	187000	0.0185
Zinc	1.580	106000	0.0140
Cadmium	1.220	89500	0.0137
Tin	1.050	not determ.	not determ.
Lead	1.060	73660	0.0143

Although the figures in the fourth column are by no means exactly alike, as they should be in accordance with the theory pronounced, yet they show plainly enough that a direct quantitative relation exists between the electro-motive force and heat of combination, moreover it should be considered that it would have been a very easy matter to make them correspond exactly with my theory by substituting the value of some electro-motive forces by such as have been obtained by some other observers. Furthermore it is also to be presumed that other atomic properties do in some measure affect the above relation; indeed the fluctuations in column four in some measure appear to follow the fluctuation in the atomic volume of the different metals.

So far as the limited amount of observations in regard to electro-motive forces and thermo-chemical phenomena have enabled me to go, I find the above relations maintained in batteries composed of other materials than the ones selected above, moreover the applicability of the law of Sir Wm. Thomson above quoted in regard to certain batteries would seem to be a special case falling under the above generalization.

As stated the value of electro-motor forces in the second column of the above table are based on the determinations made by Hockin and Taylor. They were however reduced to zinc, not amalgamated. In the case of sodium and potassium the electro-motor force had to be corrected also as a solution of sulphate of zinc was used instead of a diluted sulphuric acid in their case. Carbon not being mentioned by them, this item was supplied from the observation of Branly, (ann. sc. de l'ecole normal 2 page, 228, 1873). The thermo-chemical data, in the third column, were taken from a table in A. Maumann's Thermo Chemic, 1882, page 481. The item relating to carbon representing the heat evolved by carbon in compounding with hydrogen was taken from the same source, page 413. And this placed in the negative, representing as it does, not an actual change, but a demonstration of an affinity or tendency acting in opposite direction that of zinc and other more electro positive metals, the tendency of which is to form oxygen compounds under the circumstances in consideration. It will also be noticed that the relative electro-motor forces will not be changed by adding or abstracting the same number in case of each of the figures in the second column, and that by changing these figures in this manner the relations referred to may possibly be brought out more correctly.

Connected with the above force, at least as regards the theoretical consideration involved in both, is a method of producing refrigeration by means of electricity planned some time ago It contemplates the creation of cold in such a manner that the heat abstracted from the medium to be refrigerated is made a source of power, instead of being wasted as is done in the refrigerating machines of the present. Thus it is proposed to bring about by the decomposition of water under high pressure, by an electric current produced by a dynamo or otherwise.

The gases so produced that is, hydrogen and oxygen either singly or mixed are used to propel engines by reason of the energy they possess being under high pressure.

After having done work in this manner and having had their temperature reduced correspondingly, the gases can be used for refrigerating purposes by being carried through the rooms to be cooled. After this, the gases by virtue of their chemical affinity toward each other, still possess sufficient energy to be utilized in the form of electricity or mechanical force for the decomposition of the water. In this manner the power of the engine in which the compressed gases expand and the refrigeration would be clearly gained. This, of course, is speaking theoretically, practically there are certain losses of power the extent of which I have not yet undertaken to determine. Theoretically speaking, however, I have been unable to find any principal objection to the system proposed, but am very much pleased to have had an opportunity to lay the subject before a body of men some of whom, doubtless, would be able to point out such difficulties if they really exist.

To caution those who are apt to see an attempt at perpetual motion in the above method, I will distinctly state that it involves nothing of the kind. It is a system calculated to effect the conversion of low differences of heat potential into mechanical power, but it is not an attempt to create a power from nothing, which is the essential of perpetual motion as it is popularly understood. For, although theoretically speaking, such an arrangement would keep in motion forever under ordinary circumstances, after being once set in motion on the above plan, yet it would stop at once if the difference between the temperature of the expanded gases and that of the rooms or tanks to be refrigerated should be below a certain limit, as might indeed happen in cold weather or in a cold climate.

* Paper read at the annual banquet of the Chicago Club.

BIG THINGS.—Under the head of "This is the Day of Big Things," an exchange says: A Corliss engine of 5,000 horse power, was recently built to drive the Ferranti dynamos in London. The engine is of the vertical type and stands forty-eight feet high. The West End Electric Railway Station, in Boston, is to have thirteen engines of one thousand horse power each. They are to be triple compound, with cylinders twenty-one, thirty-six, and fifty-two inches in diameter. The power is transmitted by two belts for each engine, each belt five feet wide Steam will be furnished by twenty-four water-tube boilers, each rated at five hundred horse power. The Ferranti dynamos used in the Deptford lighting stations weigh five hundred tons each, and are forty-five feet in diameter. Two dynamos of ten thousand lamp capacity, are being made for Berlin, each of which will require about one thousand horse power. There are no data now existing which will enable any one to predict what will be the size of boilers, engines, dynamos, steamships, bridges, cars, locomotives, office buildings, and other structures ten years hence.

NEW YORK NOTES.

W. H. Gordon & Co., of 115 Broadway, reports an increased demand for all their goods. Although a comparatively new firm in this city, their business ranks among the foremost.

A very successful test was made by the Desant Electric Company last Saturday of their audible signal, a description of which will appear in our next issue.

Adamite trimmings for electrical goods are receiving a boom in all sections of the country, as is evidenced by the enormous orders which are piling up on Mr. Bernard Dreyfuss, 79 and 81 Duane street, New York, who reports that his shop is kept running to its fullest capacity to take care of the orders. With the improved machinery used, Mr. Dreyfuss is enabled to make special dies when necessary, without extra cost.

R. J. G.

COPYING DEVICES.—In all places of business it is frequently desired to obtain a large number of copies of a letter, plan, statement, etc., etc., and the question naturally arises, "Which is the easiest way to get them?" A number of inventions have been brought forward to do such work as this, and they all have some objectionable features. The ordinary gelatine pad is very generally used, but the objection to this is that the ink must be washed off after a sufficient number of copies have been struck. The washing process is considered an objection by a great many, and in order to overcome this drawback E. C. Bensinger & Co., of 5 Dey street, New York, have brought out a device that is entirely free from all the objections raised against the gelatine pad copying devices. The Bensinger Copying Pad is of the gelatine class, but it differs from all others in the important respect that it does not require washing after being used. After the impressions are taken off the pad is allowed to remain unused for a few hours, and in that time all of the ink will be found precipitated to the bottom of the pad, leaving the surface of the gelatine as clear as it was originally and ready to receive another ink impression. In order that it shall not be necessary to wait for the ink to settle to the bottom, three pads are supplied with each order. In this way they can be used in rotation. These goods have been giving very general satisfaction wherever used, and the demand for them is constantly increasing. E. C. Bensinger & Co., 5 Dey street, are the sole proprietors of this invention.

ELECTRICITY VS HORSES.—Here are some facts for horse car railway managers to ponder over. A Boston paper in comparing hor e power with electric power in the operation of street car lines says: The added pull upon the electric motor for the starting of a street car amounts to twenty-five or thirty horse power on a level track, and on an up-grade to start uses up sixty or seventy horse power. Yet the electric motors start, of course, more promptly and surely than the horses. This shows that a cruel temporary overstrain of horses must be employed every time they are made to start up a car. Calculation shows that it would probably be necessary to set fifteen horse power per car as the minimum limit needed for the efficient working of the system, for while one car was going up-hill another might be coming down, and except under circumstances to be considered later on, all of the cars would not probably be brought to a standstill at the same time. If a number of cars were employed, considering that on a level track ten horse power was all the amount required, the minimum limit might perhaps, be reduced to twelve or thirteen horse power, but this would be sailing pretty close to the wind. To run 500 cars it would, during the warm months of the year, be probably necessary to utilize steam force to the extent of 7,500 horse power—a large amount, and yet, probably, so far as expense is concerned, involving a much smaller outlay than the application of power by means of horses.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
ROOM 10, COOK BUILDING,
BOSTON, June 27, 1890.

The West End Railway Company will open the new electric line to Oakland Garden on Monday next.

The Electrical Safety Company are constantly in receipt of letters from men largely interested in electrical affairs all over the country, inquiring about their safety devices.

At a meeting of the Board of Aldermen in Malden, last Tuesday night, the committee on street lights was authorized to make a contract for electric street lighting for the ensuing year.

The Standard Electric Company, of Vermont, have sold a 500-light plant to Geo. C. Hetzel, of Chester, Penn. The work of installing the same was done by H. B. Cutter, of Philadelphia.

The Jamestown and Newport Telegraph Company is once more attempting to place the island of Jamestown in telegraphic or telephonic connection with the mainland of Rhode Island.

C. E. Bibber, of the Holtzer-Cabot Electric Company, will take a deserved vacation of a month, beginning July 7th. Mr. Bibber proposes to travel through Maine and the Provinces.

The Boston Electric Club took their third annual outing on Saturday in a trip to Marblehead Neck. The sport of the occasion was base ball, boating and fishing, concluding with a dinner at Nampashanat House.

Mr. E. E. Norvell, for six years telegraph operator for the Boston and Maine Railroad and Associated Press correspondent at Exeter, N. H., has been appointed superintendent of the Dover and Great Falls Electric Street Railway.

A successful trial was made at Providence, R. I., last week of a storage battery street car. The car was propelled by a Thomson-Houston motor, fed by a storage battery of 180 cells, and its speed was about that of the ordinary horse car.

At a meeting of the Gloucester Board of Aldermen, held last Tuesday evening, an order to remove all dead wires and poles not in use, to make all dangerous wires safe, and to place all wires used by companies and corporations four feet below the fire alarm was adopted.

The efficient working of the police system of the Boston Municipal Signal Company is best shown from the fact that, in eight minutes from the time of notification from headquarters of the escape of a prisoner, Captain Gaskin, of Station 15, had notified every officer in his precinct of the fact.

Nearly 200 employés on the second floor of factory C of the Thomson-Houston electric works, Lynn, quit work on Tuesday afternoon, demanding the discharge of an alleged "spotter." Work was suspended for over two hours, when the matter was satisfactorily adjusted.

Among patents granted this month to inventors who are assignors to the Thomson-Houston Company, is one to R. M. Hunter, for an electric railway with a working-conductor made in sections insulated from each other, in combination with a supply conductor and circuit closing devices to connect or disconnect the section with the supply conductor from which a travelling electric motor receives it. By this device the wire only has the current when the car is traveling upon it, and at any other time, if a crossing wire should fall upon it no harm can result. Mr. Hunter has also received a patent upon another electrical railway device, the rails and roadbed being in combination with a conduit with electric conductor therein, an electrically-propelled vehicle, and a laterally movable current-collecting device extending into the vehicle.

The Pittsfield Illuminating Company are to erect a new station 50x100 feet, with basement and one story. A new engine and a new 450 horse-power boiler will be put in. The company, in addition to supplying light and power proposes to furnish steam heat for business houses in its vicinity, using for its purpose the exhaust steam from its works.

Mr. Howard Wheeler, who has for the past year been acting as an agent in the railway department of the Thomson-Houston Electric Company, has recently been transferred to the New York office. If Mr. Wheeler's past success can be taken as an example of what his future will be, we can predict his building up a large business in New York and vicinity.

Messrs. J. A. Grant & Co., the successful agents of the McIntosh Seymour Company, Auburn, N. Y., have secured a contract for the entire steam equipment necessary for operating the new electric light and power station which the Thomson-Houston Electric Company is about to install at Kingston, Jamaica. The success attained by the McIntosh-Seymour engine is simply phenomenal.

A committee of three, representing the employes of the electrical divisions of the West End Railway Co., called upon Mr. Charles H. Macloskie, their superintendent, at his residence, 137 West Chester Park, last Thursday night, and presented him with a finely executed life-size crayon portrait of himself, also with a signed testimonial from the men, expressing their appreciation of Mr. Macloskie's consideration and friendliness.

Mr. H. C. Spaulding, Manager of the Thomson-Houston Motor Company, was united in marriage at Nashua, N. H., on Tuesday last, to Miss Lucille Brisbine. The ceremony was performed at the Church of the Good Shepherd, Rev. W. H. Moreland officiating. After the ceremony the bridal party left in a special car for Boston and a wedding dinner was held in Young's. The tour will constitute a month's trip to California, after which residence will be taken up in Boston.

John Dean, Jr., Electrican of the *Herald* office, was elected president of the Electrical Engineers and Mechanics Association, on last Thursday night. During the evening Mr. Dean was presented with a gold badge symbolic of the Association. It is of solid gold, a fac-simile of Franklin's kite, supported by a key of the same metal. On the face of the badge, which is elaborately chased, is a medallion bust of Franklin, over which are the initials of the association, and underneath the name of the recipient.

Linemen are at work in Providence, R. I., laying an anti-induction telephone wire 3½ miles long. The wire consists of two wires, one of copper, the other of iron, separated at a space of one inch, yet connected at certain points by a plan of interlacing. The claim is made for this wire that it can be strung in the midst of wires of high current without interference with conversation. A line of this construction recently laid in another part of Providence is said to give most satisfactory results.

The aldermen of Newton, Mass., gave a further hearing on June 23d to the Garden City Electric and the Central Street Railway Companies for respective locations between Newtonville and Newton Centre. J. B. Goodrich appeared in the petition of the Central Company, and S. L. Powers in opposition on the part of the New England Telephone Company. A petition was received remonstrating against the proposed crossing by the Garden City road at Newton Highlands and at Newton Centre of the tracks of Boston & Albany at grade, and to the desired location in Walnut and Centre streets, at Newton Highlands and Newton Centre. Hon. J. F. C. Hyde appeared on behalf of this remonstrance. The hearing was adjourned in order to give Sherman Hoar, counsel of the Boston & Albany an opportunity to be heard.

The Thomson-Houston Company has secured the estate of John Welch, on Berkeley street, Lynn. This will enable the company to run a spur track from the Sawyers Branch of the B. & M. Railroad, to the shipping department in factory H. The latest factory to be built has been named Factory J. It stands on Center street and will be used for the manufacture of electric coal cutting machinery. The walls are up and the roof on.

Business men at Athol are beginning to think that the electric street railway matter will never materialize. The Dunham and Brown combination has a year in which to build the road before the franchise is void. It seems unfortunate that the parties from the eastern part of the State who made the first move toward a railway gave it up so easily, as they undoubtedly would have had at least an even chance to get the franchise, and would have done something with it. Most folks think that the franchise was secured by the New York parties to sell again, and that Athol will wait another year for a road.

Professor Thomson and Superintendent Rice together have patented an electro magnetic cut-out for electric lamps. The claim is for the combination in the cut-out of a cut-out lever, shunting contacts controlled thereby, the primary actuating coils for the lever, the connections of which are independent of the contacts, closed by the operations of the lever, so that they act in conjunction in establishing the cut-out circuit. Professor Thomson has patented a regulator for dynamo-electric machines, a combination of a demagnetizing coil wound over the armature, and means responsive to current charges for varying the current.

The Tropical American Telephone Company will close its books July 1st for the annual meeting July 8th. The company reports its business increasing and its field broadening every month, and the management hopes to earn 10 per cent. on $4 per share of capital stock in the new year, to begin on the 1st prox. It starts out with an order for 500 complete sets of instruments for one sub-company, an order of 100 sets for a second, and 300 sets for a third, beside a large order from Brazil. There has been acquired to be turned over to the Tropical Company July 1st, control of the Williams Annunciator Drop patented April 8th, 1890, used in all small exchange switchboards. This will enable the company to manufacture its own switchboards and levy a royalty on all drops of the above pattern used in the United States.

W. J. P.

OBITUARY.—The death is announced, on the 29th of May, of M. Daniel Napoli, head of the laboratory of the Eastern Railway Company of France. He was born at Naples on the 27th of April, 1840. In the field of electricity M. Napoli was the inventor of several skillful contrivances. He took an active part in organizing the first Electrical Exhibition of 1881. M. Napoli was no mean sculptor, and several of his works found a place in the *Salon*, amongst which were busts of Ampère, Gramme, and Graham Bell. He was Chevalier of the Legion of Honor, officer of the Academy, President of the Société de Navigation Aérienne, and "Secrétaire-fondateur" of the Société Internationale des Electriciens.

ELECTRIC TRACTION AT LIVERPOOL.—The Electric Traction Company has completed an installation for the Liverpool United Tramways, and recently the first experimental run was made. The car has been specially equipped to meet the heavy gradients and proved entirely successful. Sir David Radcliffe, the chairman, and other directors and officials of the line were present, and expressed their satisfaction.

ELECTRIC HEADLIGHTS.—Experiments will soon be made on the Connecticut River Railroad, with a view to lighting engine headlights by electricity. Storage batteries will be used.

ARTISTIC ELECTRIC LIGHTING. — An English contemporary thus describes the lighting, by electricity, of the new house of Mr. J. E. H. Gordon in London: "As might have been expected," it says, "Mr. Gordon made the utmost of the artistic possibilities of the electric light. The house is provided with about 115 lights, many of which are of high candle-power, and the fittings not only exhibit great originality, but are also of great variety. In the drawing-room for instance, the ceiling of which is panelled with gold Japanese embroidery, the room is illuminated by reflection, the light being thrown against the ceiling by four high candle-power incandescent lamps, beneath which is placed a mass of muslin held up by figures of flying storks. In another part of the same room a window of Cairene lattice work is lighted from the outside in the most artistic fashion. Wall plugs have been most extensively employed, and it is possible to obtain the current for a portable lamp in almost any part of the house. The whole of the electrical fittings were carried out by Messrs. Faraday and Son, and the current is obtained from the Kensington Court mains, and the supply has given every satisfaction."

OVERHEAD WIRES IN LONDON.—The overhead wires in London are the subject of legislative consideration. A bill has been introduced in the House of Commons for their control. Chop down the poles. That is the quickest way to get the wires under control. We in New York have had experience.

ELECTRIC LAUNCHES AT EDINBURGH. — The result of the first week's running of the electric launches on the Union Canal to and from the Edinburgh Exhibition has proved highly satisfactory. Some days only two boats were on the service, and the weather was unfavorable, but the receipts amounted to £100, and 6,500 passengers were carried.

THE MARIOTTI MULTIPOLAR DYNAMO.—The Société des Téléphones de Zurich have just brought out a dynamo designed by their chief engineer, M. Mariotti. The machine is of the multipolar type, with a ring armature embraced alternately by external and internal pole-pieces. Some tests with a 20 horse-power dynamo of this type are said to have yielded very satisfactory results.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED JUNE 24TH, 1890.

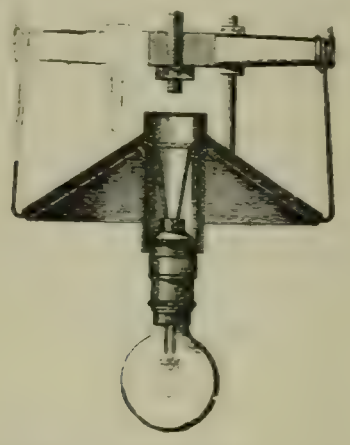
430,606. Magnetic Power Equalizer. Wm. W. Alexander, Kansas City, Mo., assignor to the Gill-Alexander Electric Manufacturing Company, same place. Filed April 23, 1889.

430,607. Electro Mechanical Combination Lock. Wm. W. Alexander, Kansas City, Mo., assignor to the Gill-Alexander Electric Manufacturing Company, same place. Filed May 7, 1889.

430,608. Electro Mechanical Combination Lock. Wm. W. Alexander, Kansas City, Mo., assignor to the Gill-Alexander Electric Manufacturing Company, same place. Filed May 17, 1889.

430,622. Electric Lamp Support. James Chase, Rochester, N. Y. Filed September 21, 1889.

430,633. Electric Temperature Regulator. Lucien F. Easton, La Crosse, Wis. Filed March 31, 1888.



NO. 430,645. INCANDESCENT LAMP HOOD.

430,634. Regulator for Dynamos. William H. Elkins, Boston, Mass. Filed June 10, 1889.

430,636. Electric Circuit Controlling Apparatus. Edwin R. Gill, Jr., Pleasant Hill, assignor to the Gill-Alexander Electric Manufacturing Company, Kansas City, Mo. Filed March 30, 1888.

430,637. Automatic Signal and Switch Controlling Apparatus and Verifying Mechanism. Edwin R. Gill, Jr., Pleasant Hill, assignor to the Gill-Alexander Electric Manufacturing Company, Kansas City, Mo. Filed April 16, 1888.

430,645. Incandescent Lamp Hood. John Heath, Plymouth, Mass. Filed February 21, 1890.

430,675. Trolley Carrier. David C. Nelson, Quincy, and Walter R. Eaton, Cambridge, Mass. Filed March 25, 1890.

430,686. Switch for Electric Locomotives. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed March 28, 1890.

430,688. Commutator for Induction Generators for Telegraph Lines. Walter S. Richards, Boston, Mass., assignor of one half to George B. James, same place. Filed Oct. 11, 1889.

430,690. Electric Railway. Wm. Robinson, Boston, Mass. Filed Oct. 24, 1889.

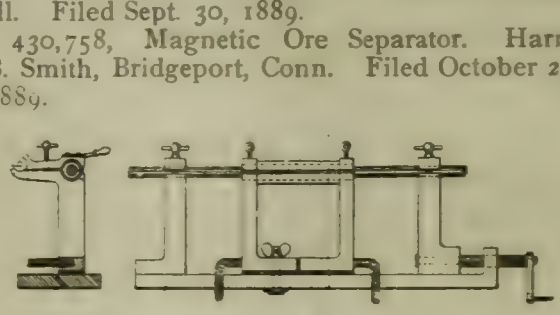
430,696. Insulator. Wm. H. Seamon, Rolla, Mo. Filed Feb. 17, 1890.

430,722. Arc Lamp. James J. Wood, Brooklyn, N. Y. Filed April 7, 1890.

430,747. Telephone Exchange Apparatus. Joseph J. O'Connell, Chicago, Ill. Filed Sept. 30, 1889.

430,748. Telephone Exchange and Key-Board Apparatus. Joseph J. O'Connell, Chicago, Ill. Filed Sept. 30, 1889.

430,758. Magnetic Ore Separator. Harris B. Smith, Bridgeport, Conn. Filed October 23, 1889.



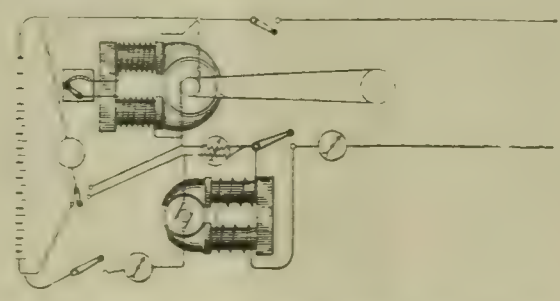
NO. 430,839. APPARATUS FOR WORKING METALS BY ELECTRICITY.

430,759. Graphophone. Roswell H. St. John, Cleveland, Ohio. Filed Feb. 4, 1889.

430,764. Electric Lock. Charles B. Beers and Wm. B. Tuttle, Bridgeport, Conn. Filed Nov. 16, 1889.

430,804. Electrical Calculating System. Herman Hollerith, St. Louis, Mo. Filed January 4, 1887.

430,838. Method of Electric Welding or Metal Working. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed Oct. 14, 1889.



NO. 430,868. REGULATION SYSTEM FOR ELECTRIC CIRCUITS.

430,839. Apparatus for Working Metals by Electricity. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed April 9, 1890.

430,846. Insulating Joint. Emil F. Gennert, New York, N. Y. Filed November 23, 1889.

430,865. Electrical Indicator. Harry W. Leonard, New York, N. Y. Filed March 24, 1890.

430,868. Regulation System for Electric Circuits. Cyprien O. Mailloux, Brooklyn, N. Y. Filed Aug. 29, 1889.

430,913. Telephone Mouth-Piece and Holder. Elizabeth B. Bell, Washington, D. C. Filed Nov. 6, 1889.

430,926. Suspending Device for Electric Conducting Wires. Wm. M. Davis, East Weymouth, Mass. Filed Jan. 23, 1890.

430,932. Manufacture of Incandescent Lamps. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Oct. 20, 1882.

430,933. Filament for Incandescent Lamps. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Nov. 9, 1882.

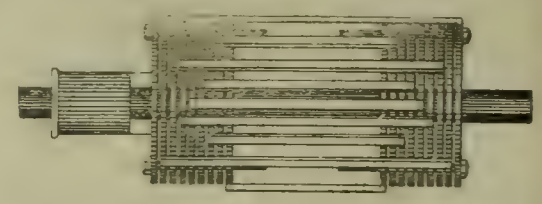
430,934. Electric Lighting System. Thos A. Edison, Menlo Park, N. J. Filed June 29, 1883.

430,960. Telephone System. Isidor Kitsée, Cincinnati, Ohio, assignor, by direct and mesne assignments, of one-half to Jerome Carty and John A. Wiedersheim, Philadelphia, Pa., and Charles J. Kintner, New York, N. Y. Filed Oct. 25, 1887.

430,967. Fusible Cut-Out. Isaac N. Miller, Cincinnati, Ohio. Filed Mar. 13, 1890.

430,974. Electric Connection. Hercules Sanche, Detroit, Mich. Filed Dec. 9, 1889.

430,979. Burglar-Alarm. James Winegarden, Grand Rapids, Mich. Filed Sept. 21, 1889.



NO. 431,018. DYNAMO OR MAGNETO ELECTRIC MACHINE.

430,990. Galvanic Battery. John H. Davis, Findlay, Ohio, assignor of one-third to Yeatman Bickham, same place. Filed Feb. 14, 1890.

430,991. Carbon for Electrical Purposes and the Process of Making it. John H. Davis, Findlay, Ohio, assignor of one-third to Yeatman Bickham, same place. Filed Feb. 14, 1890.

430,992. District Police and Fire Telegraph. Charles C. Drake, Trenton, N. J. Filed Nov. 4, 1889.

431,011. Electric Railway Signal. William J. Smith, Charlottesville, and James W. Fox, Lexington, Va., assignors of two-thirds to Asher Ayres and George C. Jordon, both of Staunton, Va. Filed Jan. 21, 1890.

431,017. Block Signaling System for Railroads. Mahlon S. Conly, Hyde Park, Ill. Filed Feb. 15, 1889.

431,018. Dynamo or Magneto Electric Machine. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Feb. 21, 1881. Patented in England, Mar. 21, 1881.

431,020. Dental Engine Motive Gear. Peter Brown, Montreal, Quebec, Canada. Filed May 5, 1890.

ANSWERS TO INQUIRIES.

Editor ELECTRIC AGE.—Will you please inform ıe the process of manufacturing the Lane-Fox ırbons. Is the material used metallic or vege- ıble?

LEVELAND, OHIO. T.

Answer—Lane-Fox carborns are manufactured om the bass broom, which is a species of grass. ıfter the outside of the fiber has been removed ıe material is carbonized in plumbago crucibles. ıfter being carbonized are gauged and sorted nd afterwards subjected to flashing. This con- ists in rendering the filaments incandescent by ıe heat of a furnace. The gas in contact with ach filament being decomposed, a layer of ard carbon is deposited, which renders the fila- ıent denser, smoother, more homogenous, more urable and more uniform in size. During the rocess the smaller parts become hotter than the ırger, thus acquiring a thicker deposit.—Ed. LECTRIC AGE.

E. W. H. asks what "forming" means in onnection with secondary batteries?

Answer—"Forming" the plates of a second- ry battery means the obtaining of a coating of ead monoxide on them by repeatedly sending ıe charging current through the cell alternately ı opposite directions.—Ed. ELECTRIC AGE.

C. D. Sumner—Probably the easiest way to ffect the "setting off" would be to run two eparate wires to the gun. Connect the ends ith a small piece of fine platinum wire, and rrange the wires so that the platinum connection ill be embedded in the powder of the prime. ı the electric circuit provide a switch. When ıe current is turned on the platinum will be- ome red-hot, which will in turn fire the powder. d ELECTRIC AGE.

MUNICIPAL LIGHTING.—Macon, Georgia, wilt issue bonds for $25,000, for the establishmenl of a municipal electric light plant.

NEW INDUSTRY.—A manufactory of electric light masts, arms and hoods, is to be erected in New Britain, Conn., by T. H. Brady.

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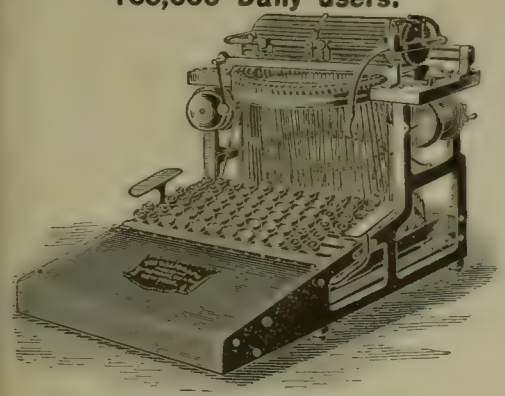
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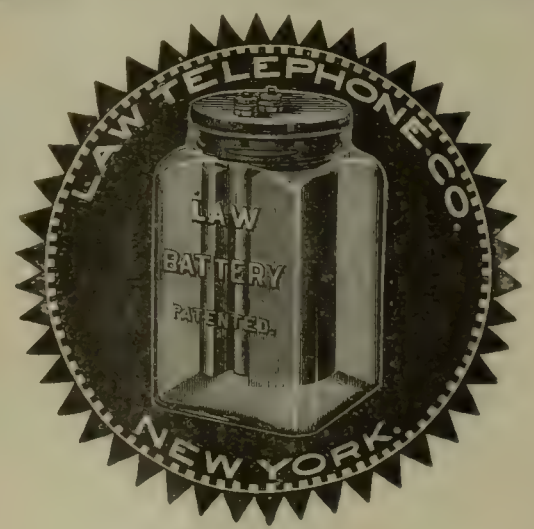
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The Crosby Battery is not affected by temperature; whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for **Open Circuit Work.** If, however, through an accident, it becomes **Short Circuited, it recoups itself.** This cannot be said with equal truth of any other Dry Battery known.



Crosby Electric Company.

TRADE SEMI CROSBY DRY BATTERY CHARGED MARK

CROSBY DRY BATTERY,

(Patented April 2d, 1889.)

NEW YORK, U. S. A.

This Battery is Sold Semi-Charged.

To Fully Charge Battery:—Remove the cover and pour in **SLOWLY** through the holes in the top **ONE GILL** of pure water, divided equally between the two holes. In a few minutes the battery will be ready for use. If found necessary, after a long period of service, the battery may be recharged in the same manner. To prevent corrosion, care should be taken not to wet the brass connections.

The Crosby Dry Batteries are manufactured in **different sizes and forms,** to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery. For ringing bells and work of that character, the Cylindrical Batteries are to be preferred; but in instances where very low internal resistances is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in the **Crosby Dry Batteries varies from one to ten amperes,** according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.

Dr. Schuyler S. Wheeler, in writing **of the Crosby Dry Battery,** says: "I have examined the Batteries sent to me from your office, and take pleasure in assuring you that you are manufacturing a first-class Battery for Open Circuit Work which, for convenience and portability has no equal. Its qualities of simplicity of construction, cleanliness, finish and general adaptability to the work which such batteries have to perform are at the same time equal to those of any battery yet brought to my notice."

OFFICE OF FLEMMING'S ELECTRO-MEDICAL INSTRUMENT MANUFACTORY. No. 1009 ARCH STREET, PHILADELPHIA, MARCH 8, 1890.

CROSBY ELECTRIC COMPANY, NEW YORK:

GENTLEMEN: The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate describing my experience with some of them. I charged and connected one of your No. 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coil starting it January 28, 1890, at 4 P. M., kept running all night and following day, January 29, when at 4 P. M. it became accidently short-circuited, and remaining so unt 6 P. M. The cell was then released and allowed to recuperate 'till January 30: 7.30 A. M., started again, and left running until February 13, stopping during night tim Thus, in defiance of a two-hour short circuit, the cell functionated = 371 consecutive hours, a result never before attained in all my experience with open circuit batte cells. The same cell, being recharged afterwards, still retains its working capacity, apparently as good as previous to its testing. Very respectfully,

[COPY.] (Signed) OTTO FLEMMING.

CYLINDRICAL.
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No. 3	7¼	x	2½ inches.	$1.20

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NEW YORK, JULY 12, 1890.

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CONCENTRIC INTERIOR WIRING.

On another page we fully described a system of interior wiring invented by Mr. J. D. F. Andrews, of England. His system is based on the concentric conductor principle; and while it probably is a good thing as it goes, it does not fulfill every requirement of a perfect system of wiring the interior of buildings. In this one respect America can justly brag of being ahead of England. America may be a new country but in some things she leads the world, including England. Interior wiring is one of these. We have in this country a system of wiring building interiors that is much superior to the concentric system referred to. While the concentric plan undoubtedly renders *nil* many of the dangers incident to inferior wiring and abnormal currents, it does not provide for easy repairs after damage has been done. Our American system covers the valuable features of the concentric method, and goes much further. By the American plan a tube of non-combustible, waterproof, and insulating material is laid down in the building during, or after its erection, in exactly the same manner that gas pipe is put in. Through these tubes electric wires are drawn with great facility and connected with lamps as easily as a gas fixture can be applied. In case of short circuiting, etc., the damaged wires can be as easily drawn out of the tube as to pull a wire across the floor, and a good wire can be inserted as easily. It is evident, therefore, that the only pecuniary damage done is the cost of the wire, which may be of the ordinary kind. The two or more wires lay together side by side in the tube, and any abnormal currents will do the damage to the wires within the tube. In no possible way can any damage result to the building or anything in exterior contact with the tubes. In the English system, in case of short circuiting between the two conductors, or burning out, or any other damage that will impair their conductivity, the cable is to a certain extent ruined. Repairing faults in such a cable must necessarily require the attention of an expert, besides consuming a good deal of valuable time. There are other valuable features in the American system that the English method does not in any degree possess. These will suggest themselves upon very little thought. We do not wish to create the impression that our friends claim for their system superiority over all others. They are quite modest, and make no claims whatever except that it is a system superior to the ordinary methods of wiring, which is all true. We only wish to state that while their system is good we have a much better one.

NAMING UNITS AFTER AMERICAN SCIENTISTS.—Very properly the largest and most important body of electricians in the United States has taken the initiative in the manner of naming certain electrical units after the eminent American scientists and investigators, Henry and Franklin Now that the American Electrical Institute of Engineers has put its official stamp on the proposition there is no reason whatever to suppose that the project will fail. Foreign electricians do not, and can not, question the propriety of honoring the memory of these eminent men in this manner, and as the naming of the units in question is simply a matter of official acquiescence on the part of the various bodies of electricians, we trust that there will be no delay in according to these investigators the honors to which they are justly entitled. They have long since passed away from their sphere of usefulness to mankind, but the use of their names in connection with the electrical phenomena which they discovered and revealed to their fellow-men would be a deserved tribute to American genius.

ELECTRIC POWER AT COAL MINES.—One of the dreams of electrical engineers is to generate electric power at coal mines and distribute it by wires wherever needed. This would save the cost and time of handling and shipping coal to the various manufacturing centers. The idea of burning the coal at the mouth of the pits and there transforming its energy into electrical energy to be applied at distant points where power is required will, when carried out, have a most important effect on the coal trade and may possibly work a general industrial revolution. And yet there is nothing any more practicable than this very thing. The advantages gained would be enormous, and there seems to be no reason whatever why the scheme could not be successfully carried out. It is impossible to predict what changes would be wrought by the proposed method of supplying power. The cities of the West, frequently referred to as the "dirty, smoky places on account of the soft coal burned," would enjoy the great blessings of clear sunlight, and the manufacturing establishments in these places would be free from the annoyances attending the handling of coal. Boilers would be fewer in number, and taking it altogether the change would be wonderful. This state of affairs no doubt will be fully realized in many cases, particularly in mountainous regions where the shipment and handling of coal are attended with extraordinary difficulty. To extract the power of the coal at the mines and transmit it by wire to where it is needed is indeed a possibility which is well worth attaining.

THE NIAGARA TUNNEL.—The Niagara Falls Power Company has invited proposals for the construction of a tunnel of about 8,000 feet in length. Proposals will be received until July 19th. This looks like business, and the utilization of Niagara's tremendous power for electric lighting and other purposes is but a question of time. All capitalists recognize this fact.

THE ELECTRIC MOTOR IN MILITARY OPERATIONS.—An important application of the electric motor is to be put to a test soon in England. One of the latest schemes of carrying on military operations during warfare is to build a railway at the scene of hostilities for the transportation of ordnance, etc. The trains used on these occasions are armor plated, and carry Gatling guns. During hostilities the ability to move these destructive weapons from one point to another on the field of battle, in as short a space of time as possible, is a very important consideration. Hence the railway with its iron-clad train. These trains have been propelled by steam power, but there are many grave objections to this method of propulsion. One, and an important one, is the presence of coal smoke just at a time when it would be of the utmost importance to be rid of it. A moving train could be located by the enemy by the smoke from the engine, and it would become at once a target for hostile guns. This serious objection will be entirely overcome by the use of electricity as the motive power, as is proposed. This will enable the railroad operations to be carried on in a manner that will insure reasonable certainty of escaping detection by the enemy. The electro-motor gives out no smoke to expose the position of the train. No doubt it will be found far superior to the noisy and smoky steam engine for the prosecution of such work.

FIRE ALARM WIRES.—At a meeting of the Fire Commissioners in this city, on July 2d, a communication was received from the superintendent of the fire alarm system objecting to the plan of laying the wires of the Fire and Police Departments in the same subway ducts as proposed by the Board of Electrical Control, for the reason that derangement of either would render both systems useless and endanger the safety of the city. The Board ordered a copy of the communication to be sent to the Mayor and Board of Electrical Control, and ordered that the further burying of the Fire Department wires be stopped, pending action in the case.

LIGHTNING'S WORK.—A curious accident occurred on the Pennsylvania Railroad on July 3d. While a train was on its way to New York from Philadelphia, it ran into a storm near Bristol, Pa. Lightning struck the telegraph lines alongside of the road and knocked thirteen poles down in front of the advancing train. The train ran into the tangled wires and poles but was stopped without any more damage than the smashing of the headlight and pilot of the engine. In a short time the debris was cleared from the track and the train resumed its journey.

TELEPHONIC COMMUNICATION WITH SHIPS.—The proposition to establish telephonic communication from shore at Havre, France, with arriving ships will indirectly serve as a protection against the introduction of disease, or the escape of law breakers who may be held prisoners on board. The primary object of this method of intercommunication between ships and shore, however, is said to be for the purpose of notifying the vessel's agents or owners of the condition of the cargo, and the giving of orders regarding the disposition of the same. This means of communicating with ships off-shore would be valuable here in New York.

GROANS INSTEAD OF CHEERS FOR THE QUEEN.—The Employés of the Central Telegraph office, London, on July 1st, expressed their regard for Queen Victoria by groaning instead of cheering, when invited by the officials to cheer in honor of the postal jubilee. The Postmaster-General received a like compliment.

PROPELLING CANAL BOATS BY ELECTRICITY.—Some Albany capitalists are discussing plans for the use of electric motors as the driving power of canal boats. They propose to run overhead wires and by means of trolleys convey the current to the motors on the boat. This plan seems to be perfectly practicable, and no doubt would effect a considerable saving in operating expenses.

BERLIN'S ELECTRIC LIGHT STATION.

One of the largest electric light stations in the world is that of the Allgemeine-Elektricistatsgesellschaft, Berlin, which supplies the current for lighting the German capital. Our illustration shows the dynamos of this station. They were supplied by Messrs. Siemens & Halske, of Berlin, and each supplies electricity for incandescent lamps aggregating 90,000 candle power. The ring armature of these dynamos has a diameter of from 2½ to 3 meters. The dynamos are coupled directly to the shafts of the steam engines, thus avoiding a complicated system of belting. In order to allow for driving the dynamos in this direct manner, they had to be arranged for a much smaller number of revolutions than had been customary, and therefore they were constructed to deliver the required electric current while operating at the rate of 85 revolutions per minute.

A very important part of the plant is the switching apparatus, with the switch board. By means of the levers of this apparatus the different groups of lamps are brought into the circuit or cut out, as is desired or required, while the measuring and controlling apparatus attached to the switch board permits an oversight of the supply of the current delivered by the dynamos to the different sections of the system. Other apparatus serve for equalizing the current in the network of wires, for testing the insulation of the conductors, etc.

The electricity produced by these dynamos is first carried by heavy copper conductors to the switch board, and from there to the cable vault, from which it is carried to the street conductors. These street conductors, which are embedded sufficiently deep below the pavement, consist principally of cables, the twisted copper wires of which are properly insulated, incased in lead pipes, and then protected from external injury by iron bands.

The driving power of the entire electric plant of Berlin will amount to 18,000 horse power, when the central stations are completed, which corresponds to an addition of 200,000 lamps, that will have a lighting power equal to 25 per cent. of all the gas lights in Berlin.

Five years ago the Edison-Gesellschaft, now the Allgemeine-Elektricitatsgesellschaft, erected a little plant for 2,000 lamps at No. 85 Friedrickstrasse. When the Allgemeine-Elektricitatsgesellschaft obtained permission from the city to use the streets for laying electric cables, a second central station was built in Markgrafenstrasse, which was much larger than any similar plant. It had a capacity of 1,000 steam horse power. A third small station, with three engines of 270 horse power each, was erected in Mauerstrasse, but in 1887 three more engines of 300 horse power each had to be added to the plant at this station. In the beginning of 1888 the station in Markgrafenstrasse was found to be too small, and had to be enlarged by the addition of four steam engines of 300 horse power each. Then a fourth, a fifth, and finally a sixth station were erected, and they were each provided with vertical engines of 1,000 horse power. The engines of this station are vertical and of the compound type, with two cylinders placed one above the other.

Our facts and illustration are taken from the *Illustrirte Zeitung*.

EXTRACTING GOLD BY THE AID OF ELECTRICITY.

Mr. Molloy, a member of the British Parliament, has recently patented, in England, an invention for separating gold from the ore by electricity, in connection with mercury.

After describing the ordinary process of extracting the gold from the crushed ore, by amalgamation with mercury on copper plates, the *Pall Mall Budget* says:

There are, however, two difficulties, the familiar bugbears of every mining community.

1. The difficulty of bringing every particle of gold into contact. The mercury does not attract the gold as a magnet would iron. If the particles of gold come and touch it, it gobbles them up, but it declines to go running after them. Now, if you don't crush fine enough, many of the particles will carry a speck of gold within a shell of ore. In that case the mercury cannot crack the nut, and it flows away, kernel and all, into the "tailings." If, on the other hand, you crush too fine, you get "float gold," that is, particles so tiny that they are carried on the top of the water without touching the mercury at all. But even if this difficulty be overcome, and contact with the mercury secured, you have a second to face.

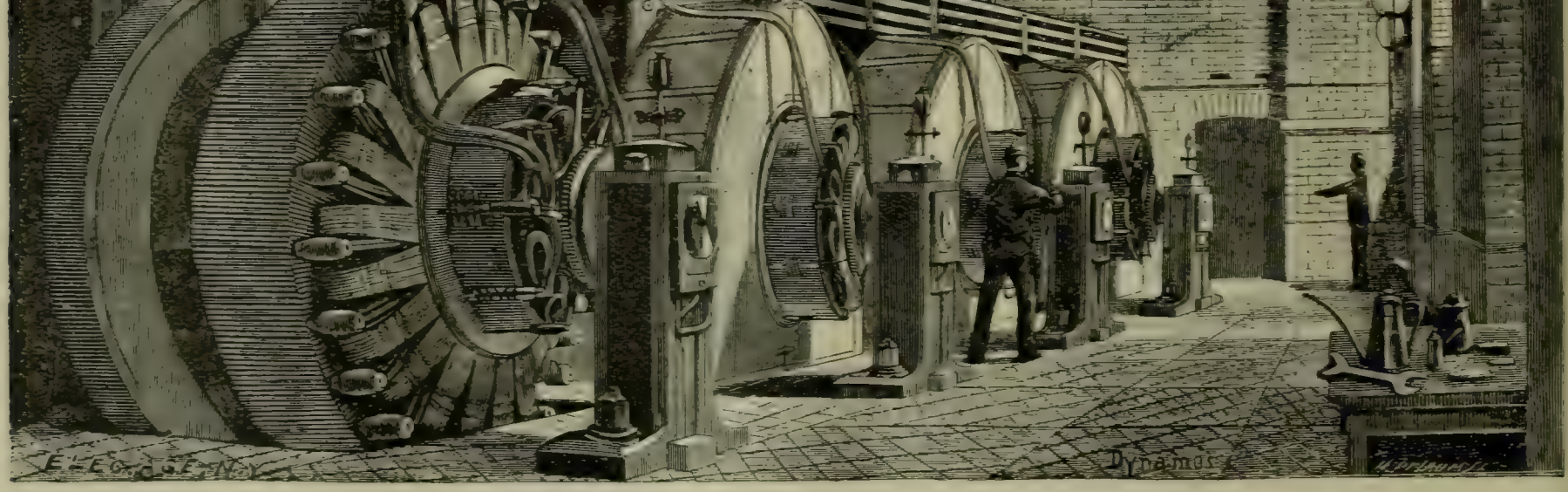
2. The demoralization of the mercury itself from contact with the ore. There are certain "refractory" ores which contain properties inimical to mercury (such for instance as arsenic, iron oxide, sulphur, antimony or zinc), under the influence of which the mercury oxidizes. It "sickens" as the miner puts it, and "flours," forming into a sort of scum on the surface, which interposes between the "quick" mercury and the gold with which it ought to be in contact, and which also keeps flaking off and running to waste with the water. In this way not only is there a great loss of gold, but there is a loss of mercury, too, which is not the least part of the miner's trouble, seeing that it is a most expensive metal.

On these two difficulties, in many cases depends the question whether a gold mining enterprise does or does not pay. It is clear then, that to dispose of them forever would mean something like a happy revolution in the conditions of the industry. And that, no less, is Mr. Molloy's ambition. What he claims for his invention is shortly this, that it keeps the mercury absolutely "quick," and insures the absolute contact with it of every particle of gold. The point at which Mr. Molloy steps in is after the crushing of the ore. His invention is a substitute, not for the "stamps," but for the "plates." As, however, for his purpose, the finer the ore is crushed the better, he prefers a crushing apparatus consisting of two great rollers playing in a circular box, with the double action of a carriage wheel when the carriage is both moving and turning round. That, however, has nothing to do with his invention, which will now be described.

Reduced to its simplest elements, the machine is an iron disk spinning in a shallow iron saucerful of mercury, on the surface of which the disk floats. In the middle of the disk is a hopper, through which the flow of water and crushed ore descends upon the mercury. There the centrifugal force due to the rotation of the disk drives it from the center to the rim, pressing it down upon the surface of the mercury all the time, and insuring that every particle of gold shall be absorbed. The residue is driven to the edge of the saucer, and there, freed from the pressure of the disk, it continually wells up, overflows, and runs away as "tailings." All you have got to do, then, is to crush as fine as possible to begin with.

The bugbear of "float gold" loses its terrors. However light the particles may be, they are spread, and squeezed, and scrubbed, and radiated over the surface of the mercury between it and the revolving disk which floats upon it. So much for difficulty No. 1. As for No. 2, Mr. Molloy appeals to the powers of chemistry and electricicity to rescue him from that. He cannot prevent the hostile elements in "refractory" ore from coming in contact with his mercury, nor can he deprive them of their "sickening" influence. But he can prevent the mercury from oxidizing under that influence by keeping it constantly charged with a supply of nascent hydrogen which has absolute power to cure, to counteract, and to prevent its oxidization. Nothing easier. In permanent contact with the mercury he places a solution of certain salts. This solution is connected with the positive pole of a battery, the negative pole of which is connected with the mercury.

Under the influence of the electric current the solution is being constantly decomposed, sending a constant supply of oxygen into the air and a constant supply of hydrogen into the mercury. This being all a bubble with nascent hydrogen never gets a chance of "sickening," but is always kept "quick" and fit for work. This electrical process Mr. Molloy manages in the



THE DYNAMOS AT THE BERLIN ELECTRIC LIGHT STATION.

center of his gyrating disk, the solution being contained in a sort of little ebonite moat within the hopper. One horse power suffices to drive both the machine and the dynamos required for the electrical process, and it can put through ten tons in a day. The salts required are "dirt cheap," and the mercury practically lasts for ever, and the whole apparatus weighs only five hundredweight.

TELEPHONE CONVENTION.

General C. H. Barney, Secretary of the National Telephone Exchange Association, announces in that association's monthly *News-Letter*, that the next annual meeting of this association will be held at the Russell House, Detroit, Mich., commencing on Tuesday, September 9th, next. It is expected that the business of the association will be concluded in two days, but the secretary has received a hint that it will be advisable for the delegates to make their plans so as to remain in Detroit until Thursday evening at least.

The Russell House is conducted on the American plan. The rates are $3, $3.50, $4 and $4.50 per day, according to location and accommodations desired. It is requested that members of the association intending to be present at the meeting, engage their rooms at an early date, so that the most desirable locations may be secured. Messrs. W. A. Jackson and F. A. Forbes, of the Telephone and Telegraph Construction Company, of Detroit, have kindly consented to act as a committee on quarters, and a note addressed to either of them will receive prompt attention.

General Barney adds: "It is not too soon to commence the preparation of papers to be read at the meeting. Members of the association are earnestly requested to send such papers to the secretary by the first of August, if possible, so that the executive committee may have sufficient time to examine them."

THE EPSTEIN METHOD OF FORMING STORAGE BATTERY PLATES.—The object aimed at in this method is to form the plates of a storage cell with greater rapidity than hitherto, without diminishing their durability or capacity. Lead plates of any shape suitable for use as electrodes, are put into water rendered acidulated by the addition of about 1 per cent. of nitric acid. The plates are kept from coming in contact with each other, and the water is always kept up to the boiling point, the boiling being continued till the lead has assumed a dull gray appearance. The plates are then taken out of the water and dried in the air. This treatment produces a grayish yellow deposit of lead compounds which has the appearance of mildew. This deposit adheres very firmly, and is insoluble in the electrolyte used for the subsequent treatment in dilute sulphuric acid. In addition it has a great capacity for taking up the gases engendered in the formation process, so that the latter may proceed quickly, without the necessity of reversing the current. It is these "raw" plates, as they are called, from which the positives as well the negatives are formed. In order to form positive electrodes a number of raw electrodes forming a group are put into the electrolyte, together with positive electrodes, that have to be transformed into negative electrodes. The raw electrodes that have to be formed into positive electrodes are then connected with the positive pole, and the intervening plates with the negative pole of a dynamo or battery. In the process of forming positive electrodes, the former grayish-yellow color of the raw electrodes changes into a deep dark-brown, almost bluish-black hue, and the process is completed as soon as the electrodes have assumed that color, and an abundant development of oxygen takes place. The oxygen of the peroxide of lead produced on the positive electrodes which are to be reduced to negatives is absorbed by the effect of the electric current, and the bodies are reduced on their surface to porous metallic lead. The process of forming negative electrodes is finished when the deep dark-brown or bluish-black color of the positive electrodes used for the purpose has changed into a bluish-gray hue and an abundant development of hydrogen takes place. A few hours only are necessary to form a plate by this method, and the reversing of the current is unnecessary, so that in a very short space of time a great number of positive as well as of negative electrodes can be produced.

THE BLATHY ALTERNATING CURRENT ELECTRIC METER.*

The Blathy electric meter for alternating currents, which is being made by Ganz & Co., of Buda-Pest, for their alternating current electric works, and a diagrammatic representation of

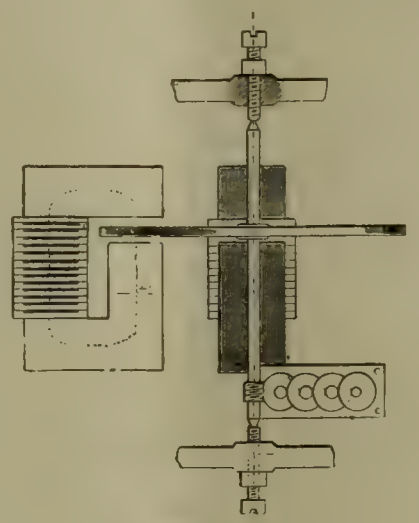


FIG. 1.

which is given in Figs. 1 and 2, consists essentially of a horizontal copper disc which turns very easily upon a perpendicular axle. This disc sets in motion, by means of a spiral and several transfer wheels, a counting arrangement similar to those employed in gas meters.

The copper disc is exposed to the inductive action of two systems of electro-magnets. One of these systems is magnetically excited by the alternating current to be measured, and the magnetism developed in this system (main current magnet) is proportional to the current transmit-

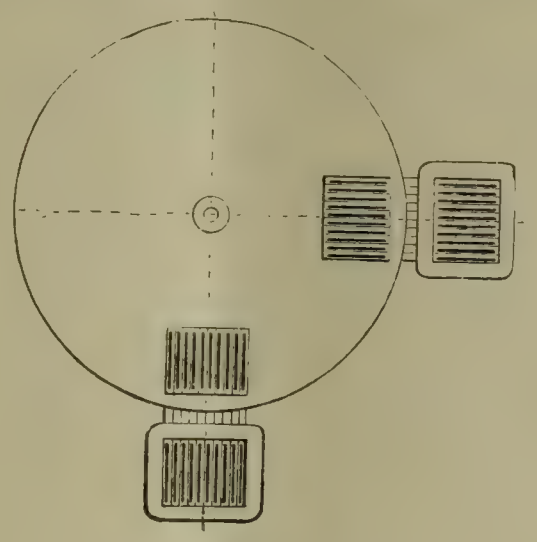


FIG. 2.

ted. The second magnetic system is wrapped with a very thin wire and connected to the two main leads conveying the current, whereby the magnetism of this second system becomes proportional to the tension of the main current. Both systems produce in the copper disc induced currents and act upon it dynamically setting the copper disc in rotation. In consequence of the movement of the disc through the magnetic fields, currents are again induced in the same, which act in opposition to the movement of the disc or counteract it. At a certain velocity an equilibrium is established between the propelling and the arresting forces; this velocity—under otherwise equal conditions is proportional to the intensity of the main current, whereby it must be remarked that with a rational distribution of the current the tension is kept practically constant. The transmissions of the wheels to the counting works are so arranged that the fingers show directly on the dial plates the number of ampère hours which have been transmitted. The accuracy of this electricity meter is quite equal to that of the gas meter (not better?) and the simplicity of the arrangement guarantees accurate and durable work.

This electricity meter was closely tested last year by the International Commission of experts in Frankfurt-on-Main, and subjected to repeated practical investigations.

According to the statement of Herr Blathy, the meter is calculated for currents up to 150 ampères. Within the limits from 20–150 ampères the deviation is only 3 per cent.

* London *Electrical Review*.

AMERICAN NAMES FOR ELECTRICAL UNITS.

At the regular monthly meeting of the American Institute of Electrical Engineers, held June 17th, 1890, the following resolution, recommended by the Council, was introduced by Mr. Francis B. Crocker, with the request that it be taken up for action at the next meeting of the Institute in September.

WHEREAS, It has been the custom in the nomenclature of electrical units to perpetuate the names of men who have contributed most to electrical science; and

WHEREAS, In the names thus far adopted, the eminent services of Americans have not been recognized; therefore

Resolved, That in the opinion of the American Institute of Electrical Engineers, a just distribution of the honors thus bestowed necessitates a recognition of the splendid contributions to electrical science of one or both of America's great electricians, Benjamin Franklin and Joseph Henry; and

Resolved, That this Institute will gladly co-operate with other bodies in this country and abroad to secure the general adoption of these names for electrical units; and

Resolved, That the name of Henry should be given to the practical unit of self-induction, since he was the discoverer and greatest investigator of this phenomenon, and because this unit at the present time is called a quadrant, which is merely a numerical value and not a suitable name.

Resolved, That this Institute recommend to Electrical Societies and Electrical Engineers the general use of the name of Henry for the unit of induction as being the quickest and surest way to secure its final adoption.

It is unfortunate that the name of Henry for the unit of induction was not adopted at the Paris Electric Congress of 1889. If the attention of the Congress had been forcibly called to the fact that Henry discovered self-induction, and that his work on both self and mutual induction was of the greatest importance, his name would probably have been adopted then. Henry's discovery of self-induction, which is, of course, the fact that gives the strongest claim, was made in 1832, and published the same year in Silliman's Journal. In this paper he describes experiments showing that the spark obtained by breaking a circuit composed of battery and a long wire is greater than with a short wire, and that the spark is further increased by coiling the wire. He then clearly states that the phenomenon is due to the *action of the current on itself*, all of which is perfectly correct and would be a good statement of the facts even at the present time.

DIED.—M. Frey, director of the International Telegraph Bureau at Berne, is dead.

SHIP PROJECTORS AND PLANT.

Electrical engineers are giving much attention to ship lighting by electricity. The use of projectors on shipboard is of the utmost value, and the call for instruments of this class has led to great improvements in these lamps. The following description and illustrations of a ship projector and plant, manufactured by an English firm, are taken from a London contemporary:

The engraving, fig. 1, shows one of a number of search light projectors specially constructed by Messrs. Charlesworth, Hall & Co., Oldham,

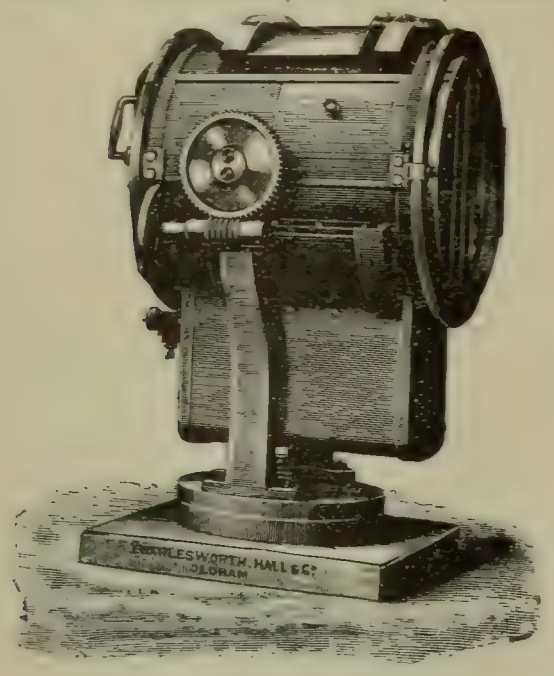


FIG. 1.—SEARCH LIGHT PROJECTOR.

for use on small vessels in the night navigation of rivers, canals and narrow channels. The projector barrel is 16 inches diameter, rolled out of steel sheet and tin-plated, making a very strong piece of work. The mirror is one of Chance Brothers' best quality and is 16 inches diameter and 8 inches focus, fitted in a strong brass frame with a bayonet socket attached to the barrel to facilitate removal for cleaning, etc. A dispersing lens, also by Chance Bros., having an angle of dispersion of 16°, is attached by means of a hinged frame to the forward end of the barrel

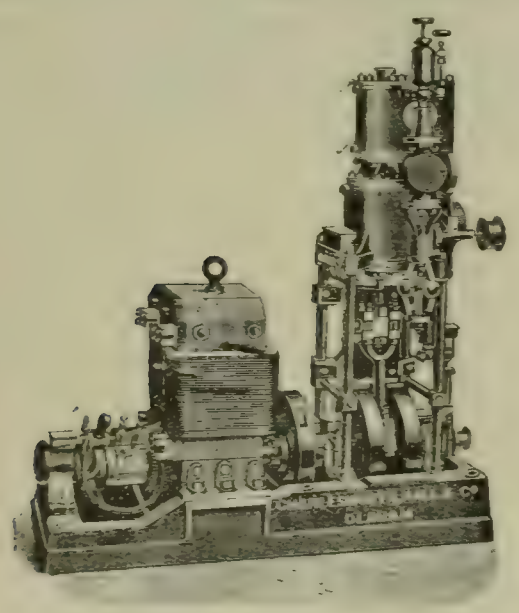


FIG. 2.—STEAM ENGINE AND DYNAMO.

in order to fan-tail the light so as to spread it on the banks. The arrangements for ventilation are very complete, both the mirror frame and projector barrel being so arranged that a constant stream of cold air passes through, so preventing overheating of the mirror and destruction of the silvering. An instrument similar to a camera is provided at one side of the projector for viewing the arc. The hand lamp is made detachable and quite independent of the projector itself. The feed of the carbons is obtained by a right and left hand thread screw in the usual way. A screw is provided for raising and lowering the carbons, and adjustments are arranged for setting the points of the carbons from below, without having to put the hand in the barrel, as is necessary with other projectors. With carbons 20 mm. diameter and a current of 45 ampères these projectors will illuminate a distance of about 1,200 yards. Fig. 2 shows a very light and compact set of electric light machinery also made by Messrs. Charlesworth, Hall & Co., specially suitable for ship lighting (supplied with the above projectors). A set, comprises an engine with cylinders 4 inches and 5½ inches x 4¾ inches stroke, driving a Hall dynamo direct at 500 revs. per minute, with an output of 65 volts 50 ampères, the steam pressure being 60 lbs. per square inch. As will be seen, the engines are of the open frame type, the cylinders being supported on four steel columns, which also carry the cross-head slide. Both cylinders are fitted with piston valves, operated by one eccentric, the high pressure cylinder exhausting direct into the low pressure steam chest, thereby doing away with connecting pipe joints and stuffing boxes for the valve spindle. The pistons are steel castings fixed on one piston rod, of Whitworth steel, by means of cones and nuts. The piston rod glands are tightened by screwed caps, so as to prevent galling, through one side being screwed more than the other, as sometimes happens with glands tightened with studs. A play of 3½ inches is allowed in the gland for any slight bend in the piston rod. The end of the piston rod is passed through a cast steel slipper slide block and there screwed by two nuts which are pinned in position. This slide block has slips for taking up wear. The connecting rod is of cast aluminium steel. Both the large and small ends are of the usual marine type. The crank-shaft is of Whitworth steel with circular crank webs and cast iron balancing discs shrunk on. In order to reduce wear, the crank-shaft and all other bearings are made of very large surface, and all parts can be lubricated while running. The dynamo is one of Messrs. Charlesworth, Hall & Co.'s inverted type. The magnets are of best soft iron, tooled all over. The armature shaft is of Vickers's steel. The resistances are as follows: armature, .21 ohms, shunt, 20.65 ohms, series .0318 ohms, and giving an electrical efficiency of 79.6 per cent.

ELECTRIC APPARATUS IN GAS WORKS.

It is a matter of frequent observation in gas works that the governing arrangements of the exhausters are liable at times to be neglected unless under constant supervision; and as a result, considerable loss and inconvenience are caused. To obviate this, an apparatus, embodying an ingenious application of electricity to checking the governing and exhausting arrangements of gas works, has been devised and put in operation at the works or R. Dempster, at Penmaenmawr, North Wales. The *Journal of Gas Lighting* refers to it as follows: It is fixed in such a manner that, when the pressure or vacuum varies from the regulation standard, a bell is set ringing; thus bringing the matter directly before the notice of the engineer or manager.

The apparatus may be described as follows: A small boxwood case, with glass front, is fitted against the wall of the exhauster house. In this box are placed two gauge tubes of about two inches in diameter. These are connected at the bottom like an ordinary pressure gauge. A glass bell is made to float in the tube exposed to the atmosphere; the other tube being connected with the gas. The float rises or falls in proportion to the changes in pressure or vacuum, and is suspended to the end of a balance lever, the other end having an adjustable screw weight for regulating its position. This lever is pointed with platinum, and is connected to three cells, between which a switch turns the current on or off at pleasure. When the instrument is brought into action, the lever moves in position, and the platinum-pointed end is brought into contact with a platinum-pointed adjustable screw at either side—one representing pressure and the other vacuum. These screws can be adjusted to give warning of alterations of pressure varying from $\frac{1}{10}$ of an inch to any degree required. It will be at once seen that immediately the end of the lever is brought into contact with either of these screws, an electrical circuit is formed, causing one or more bells to be rung. These bells may be placed in a convenient position in the works or offices, and will continue ringing until the pressure or vacuum is adjusted.

It is suggested that there are many other purposes on gas-works to which the invention could be applied with advantage; such, for instance, as giving notice of undue pressure on the station governors, etc.

NEW YORK NOTE.

The New York Insulated Wire Company, of 649 to 651 Broadway, have several large wiring contracts to be executed. These include the wiring of the new *World* building, the Imperial Hotel, New York; the residence of Ogden Goelet, at Newport, R. I., and the buildings of the New York Life Insurance Company, now being erected at Kansas City, Minneapolis, St. Paul, Omaha, and Montreal. These buildings are to be wired with the Grimshaw white core wire, of which the above-named company are sole manufacturers. The Grimshaw white core wire has been before the public many years and has the approval of the fire underwriters and inspectors. It is especially valuable for house wiring.

THE KOUSMINE DIFFUSION BATTERY.—The diffusion battery of M. Kousmine, which was shown at the recent Galvano Plastic Exhibition at St. Petersburg, has been much used in Russia. By making use of the phenomenon of diffusion M. Kousmine has succeeded in overcoming the increase in internal resistance of the bichromate of potash battery due to the formation of crystals on the positive electrode. The positive carbon electrode consists of four strips attached to the lid of the battery. The negative zinc electrode consists of a circular grating, resting on the bottom of the battery. By means of a funnel a 15 deg. Beaumé solution of sulphuric acid is introduced, until it just reaches the lower end of the carbon strips. A 6 to 7 per cent. solution of bichromate of potash is next introduced. The two liquids do not mix on account of the great difference in their densities. When the battery is short-circuited it is easy to see that chemical action only takes place close to the lower end of the carbon strips, which are gradually surrounded by a violet ring 2 or 3 millimetres deep. Above this region the bichromate solution retains its original color. The bichromate solution being very weak, the chromic crystals dissolve as soon as they are formed, and the positive electrode is not covered by a deposit as in other batteries. The solution of these crystals, having a greater density than the surrounding liquid, falls to the bottom. The sulphate of zinc also falls to the bottom of the cell, causing more sulphuric acid to rise. A cell having the following dimensions was tested by a committee of experts at the Exhibition in question: Height 20 cms., diameter 15 cms., surface of zinc 176 sq. cms., bichromate solution 6 per cent., sulphuric acid 15 deg. Baumé. The committee reported that after having been circuited for 8½ hours on an external resistance of .32 ohms, and then left on open circuit for 10½ hours, the cell continued to work for 4½ hours, when the circuit was again closed, and that it gave during 13 hours 36 ampère-hours for an expenditure of 48 grammes of zinc.

THE INEVITABLE RESULT.—It is reported that engineers are at work upon plans for an electric system to take the place of steam on some of the branches of the Old Colony road.

THE PENNOCK PRIMARY BATTERY.*

There is a general concurrence of opinion at electricity has a great future before it, but ere is still a considerable unconsciousness of me of the best and most remarkable achieve- ents that persevering inventors have made in veloping the great practical side of this sci- ce. Among many who ought to know bet- r there are certain strong prejudices, and the sult is that many of the most excellent propo- tions do not receive the attention to which eir merits justly entitle them. The dynamo of a later date than the chemical battery, and s received abundant eulogy and has enlisted army of enthusiasts into its service who pre- ct a great future for it. The dynamo method producing ele tricity is an expensive one, re- iring a great consumption of coal and a costly ant. It simply transfers mechanical energy to electrical energy, and that too in a manner parently far removed from economy. The stribution of the electrical energy is then ac- mplished by wires, the majority of which could entirely abolished if some other method of oducing electricity were followed.

For electric railways and electric lighting a turn might profitably be made to the principle producing electricity by carbon z nc and acid mpounds. Proceeding upon this idea Mr. eorge B. Pennock has perfected a system which npletely distances every other for oviding electricity for electric motors railways and for the purpose of ctric lighting. The ordinary e'ec- c railway, such as we see it in several ge cities, is far from being perfect. e overhead wire system is particu- ly cumbrous and even dangerous, pecially so during electrical storms en the lightning will strike the over- ad wires and rush through every on service on the line, and not ly destroy the motors but may l or severely shock the passengers. The ex- nse of maintaining great power houses is also ry considerable. Mr. Pennock, by his pri- rv batteries, can do away with the necessity storage batteries, dynamos, overhead wires, ., altogether, and yet run the cars as fast as er, and at a mere fraction of the cost. The tteries are placed on the motor car and the ter can thus be run on any track. No cells e wasting when out of service and no local ac- n is allowed in the Pennock porous cup. ere are comparisons of a ten-mile road com- ete with fifteen cars :

ELECTRICAL OVERHEAD WIRE SYSTEM.

st of road bed,	$ 75,000
st of wiring,	35,000
st of motor cars,	55,000
st of power-plant,	50,000
(No fuel counted)	
Total,	$215,000

STORAGE BATTERY SYSTEM.

st of road bed,	$ 75,000
st of cars,	75,000
st of power-plant,	50,000
(No fuel counted)	
Total,	$200,000

CABLE SYSTEM.

st of cable construction,	$750,000
st of power-plant,	120,000
st of cars,	15,000
(No fuel counted)	
Total,	$885,000

PENNOCK SYSTEM.

t of motor cars, including fuel for 60 days,	$45,000

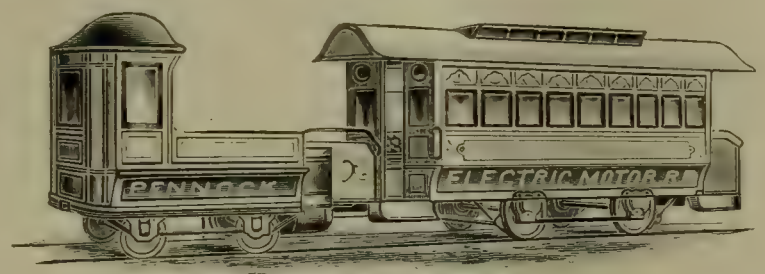
Extra track or new road bed not necessary.

The Pennock is thus about a fifth of the cost other systems, and about a twentieth of that

Chicago Illustrated Century.

of the cable system. The speed and power attained are far greater than with the steam engine as will shortly be shown by a train to be run between here and New York by the inventor himself. For electric lighting the system is exceptionally convenient and can be used in private dwellings and hotels or on a large scale. The erection of central station plants is particularly suitable and is very profitable to the enterprising investors who own stock in the Pennock Battery Electric Light & Improvement Co., the investment paying many hundred per cent. per annum. The company some time ago sold Capt. John Hall of Peoria exclusive rights in the county there, and he has secured the right of running motor cars of this kind in that important city. Their success will lead others to adopt them and their extension throughout the country is only a matter of time. Mr. George B. Pennock is the able President and General Manager of both companies, and full particulars may be obtained by addressing him at the Sherman House, Chicago, or on calling at the office you will see a working model of the railway.

WESTINGHOUSE.—The Westinghouse Electric Company have received a contract for supplying a central station of 100 arc lights and 6,000 incandescent lamps, at Barnsby, England. This was in the face of sharp competition with English and other companies.



PENNOCK ELECTRIC LOCOMOTIVE.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, July 4, 1890.

PEOPLES GAS AND ELECTRIC LIGHT AND POWER Co., has been formed at St. Louis, with capital stock of $50,000; incorporators, Jno. Maguire, R. D. Walsh, Rolla Wells.

THE UNION DEPOT RAILROAD COMPANY, St. Louis, Mo., have added two 80 horse power Thomson-Houston generators and five cars with two 15 horse power motors on each car to their equipment.

MR. G. A. EDWARD KOHLER, western agent for the Eddy motor, reports closing contract for two electric motors of 2 and 4 horse power respectively, to be placed in the offices of the National Bank of Illinois, for driving ventilating fans.

THE MISSOURI RAILROAD COMPANY, St. Louis, Mo., will equip their line with 36 electric motor cars of the Thomson-Houston system. There will be two 15 horse power motors on each car. Five 100 horse power generators will furnish the current.

MOUND CITY RAILWAY COMPANY, St. Louis, Mo., will employ five 80 horse power generators to furnish the power for their lines. Twenty-five cars equipped with two 15 horse power motors each will be in use. The Thomson-Houston system is used.

FORT SCOTT RAPID TRANSIT RAILWAY CO., has been formed at Fort Scott, Kansas, with capital stock of $500,000; directors: E. W. Brady, O. W. Brady, A. B. Brady, Wm. M. Smith, C. A. Nebeker, A. L. Hughes, Davenport; A. A. Harris, L. P. Mosher, N. B. Pearsall, Fort Scott.

THE THOMSON-HOUSTON ELECTRIC CO., through their Chicago office, report the following sales for the month of June: Capitol Elec. Co., Nashville, Tenn., 7 motors, from ¼ horse power to 50 horse power. Mt. Clemens Elec. Co., Mt. Clemens, Mich., 650 light alternating incandescent. Salt Lake Power, Light and Heating Co., Salt Lake City, Utah, 170 arc. Atchison Gas and Elec. Lt. Co., Atchison, Kas., 650 light alternating incandescent. B. Nugent & Bro., St. Louis, Mo., 1 horse power motor. Logan Light, Power and Heating Co., Logan, Utah., 650 light alternating incandescent. Gogebic Elec. Co., Bessemer, Mich., 1,950 alternating incandescents. Dodge Mfg. Co., Mishawaka, Ind., 650 alternating incandescents. Inter-Ocean Publishing Co., Chicago, two motors. Capitol Elec. Co., Nashville, Tenn., 350 arcs. Huntington Cotton Mfg. Co., Huntington, Ark., 750 direct incandescents.

F. M. I.

TEST OF RAILWAY SIGNALS.

On Saturday, June 28th, a practical exhibition was given of the operation of the Desant Electric Audible Danger Signal. Governor Jas. E. Campbell, of Ohio, President of the Desant Electric Company, Mr. Wm. F. Z. Desant, the inventor, and a few representatives of electrical journals, witnessed the test. A section of the suburban rapid transit road between the Southern terminus and the 138th street station is equipped with the system, and the test on this occasion was entirely satisfactory. In our issue of June 28th we described this system at length, and there pointed out its valuable features. In the Desant system an audible and visual signal is placed in the cab of a locomotive, and when the block ahead of the one occupied by a train is clear, no signal will be given on the cab instrument; but when the block is not clear the instrument is operated in the manner described in the article referred to. The advantage of this can be appreciated when it is remembered that, at times, such as during foggy weather, in snow storms, etc, it is quite difficult and sometimes impossible for the engineer to see the semaphores which are his only guides. With the Desant apparatus, however, the engineer is apprised of any danger ahead in a manner that cannot leave any room for doubt. Fogs and snow storms are no hindrance whatever, and a train equipped with this instrument can run ahead with as much safety in thick weather as though the semaphores were perfectly visible. At the test the party rode on the engine and witnessed the operation of the apparatus, and were thoroughly satisfied with the efficiency of the system. Its simplicity is one of its striking characteristics, and there is no gainsaying the fact that any road equipped with this system of signals stands a better chance of averting collisions than can be done in any other way. The fact that the danger signal, which is both visible and audible to the engineer, can be placed in the cab of the locomotive, is a very important feature. The Desant Company certainly have a very valuable and efficient system of signalling, and besides covering the features indicated herein, the system can be connected so as to operate the usual railway semaphore signals. It can also be connected with drawbridges, etc.; in fact, wherever visual or audible signals are needed, it is applicable.

DYNAMO WRECKED.—According to a somewhat vague report published in a San Francisco paper of June 16th, an alternating current dynamo at the California Electric Light Company's new station burst and the flying pieces did considerable damage to the building and neighboring dynamos.

OBITUARY.—The death is reported of Mr. Thomas Brown Jordan, in London, at the age of 82. About 1838 Mr. Jordan invented a declination magnetograph and a self-recording actinometer. He devoted considerable time to electro-metallurgy.

THE GERMAIN DRY CELL.*

The material made use of by M. Germain in his dry cell consists, as we have previously mentioned, of cellulose prepared from cocoanut fibre, which contains, besides pure cellulose, mineral salts, an organic coloring substance, and some fatty substances. The fibre is first of all treated by a process which deprives it of the fatty substances. It is then possible by various methods, which do not alter the physical nature of the fibre nor destroy the cellules, to obtain several kinds of cellulose, possessing greater absorptive and retentive properties than does cellulose in its natural state. These varieties of cellulose are not, moreover, affected by the active agents commonly employed in primary batteries. The particular variety of cellulose employed in dry cells is almost unaffected by ammonium chloride air or the ammonia to which the reaction of the Leclanché battery gives rise. Its apparent density is about .06 to .105. Without external pressure it absorbs from 10 to 11 times its own weight of liquid, and when subjected to a pressure of 100 grammes per square centimetre. it still retains 7.6 times its own weight of liquid.

The greater the compression of the paste the greater is the internal resistance of the battery, and with excessive pressures the resistance of the paste may amount to three or four times that of ordinary liquid. Some accumulators, however, furnished with this fibre have been found to have a smaller resistance than if liquid alone was employed. M. Meylan is of opinion that this is



THE GERMAIN DRY CELL.

due to the fact that the accumulator plate is not a purely metallic electrode, but that it consists partly of oxides of relatively poor conductivity in a state of variable aggregation, and often making bad contact with the lead grid. The pressure of the fibre has the effect of ensuring a better contact so that while the resistance of the electrolyte increases that of the plate diminishes, the diminution, however, being greater than the increase. In the particular case of the dry Leclanché cell, the effect of pressure is to ensure a uniform consumption of the zincs and to notably diminish the resistance of the mixture of carbon and binoxide of manganese, at the same time effecting more perfect depolarization—phenomena which were observed some years ago by MM. D'Arsonval and Abdank-Abaknowicz. Moreover, the property which cellulose possesses of absorbing gases pervents the formation of a layer of gas on the surface of the electrodes. On the other hand, the evaporation of the liquid, if permitted, would give rise to non-conducting efflorescenses, and at the end of a short time the battery would have such a high resistance that it would be no longer capable of being used.

The annexed figure represents an ammonium chloride dry cell, as arranged by M. Germain. The case is of oak, well boiled in paraffin, and rendered water-tight by a coating of tar. A zinc plate, which is well amalgamated on one side and varnished on the other, rests at the bottom of the box. The fibre is laid on the zinc plate layer by layer, having previously been saturated, when warm, with solution of ammonium chloride (density 1.1) in the ratio of 1 by weight of cellulose to 3.5 or 4 of liquid. When this first layer is completed the carbon is placed upon it, surrounded with pieces of carbon and binoxide of manganese. A second layer of fibre is then laid upon the carbon, and upon this a plate of zinc. The wooden lid, to which are fixed several strong varnished steel springs, is then screwed down. The pressure usually employed is about 200 grammes per square centimetre, at which pressure the liquid slightly exudes against the zinc plates. The E.M.F. of the dry cell is uniformly 1.5 volts, the internal resistance varying, of course, with the size of the cells. Thus, a cell (Type B), 12x7x7 centimetres, has an internal resistance of 1 ohm. The cell (Type G), which is 30 centimetres long, 20 centimetres broad, and 11 centimetres high, has an internal resistance of .09 ohms, intermediate sizes having corresponding resistances.

*From *L'Electricien*.

ANDREW'S CONCENTRIC WIRING.

Notwithstanding the application of excellent workmanship and good material in connection with electric light wiring in buildings, we cannot but admit, says the London *Electrical Review*, that the system, as generally in use, is greatly wanting in substantiality and safety from fire risk and extinction of the light. It was with a view to improving this state of affairs that Mr. J. D. F. Andrews, some six or seven years ago, commenced to introduce concentric wiring into interiors, and has ever since continued its application whenever possible, gradually developing the innumerable accessories to the system.

In order to treat the subject effectually it will be necessary to introduce some of the remarks made by Mr. Andrews in a paper he read last year at the Philosophical Society of Glasgow.

The causes of fires in electric wires may be classed under three headings—the short-circuit, the partial short circuit and the opening circuit. An excellent provision against the dangers of the short-circuit is found in the fuse or cut-out, and it is only in case this appliance is badly constructed, or has been tampered with, and consequently must fail to act, that this fault need be considered. In the case of a partial short-circuit the increase of the current is generally insufficient to melt the fuse, and in such an instance this protector (the fuse) has been found to be a source of danger, for, although it may not melt, it may become so hot as to ignite imflammable substances that come against it. This may take place even if the fuse is constructed on the most approved lines, because of the long duration of partial short-circuits and consequent accumulation of heat in the fuse. The partial short-circuits themselves are often very curious and interesting developments. The most common form is a general leakage from one wire to the other through damp woodcasing over a long length. If this continues the casing is liable to become charred at the best conducting place and begin to glow and flame. Many curious instances of this kind have been known, and we will describe one peculiar instance that occurred on an Atlantic liner. The casing was saturated with moisture for a length of about 6 yards, but the course the electricity preferred was a diagonal line about 18 inches from one wire to the other, along which the wood was deeply charred. This suggests the theory that wood conducts better with the grain than against it. Under the heading of opening circuits come all those faults where the conductor carrying the current gets ruptured, and an arc or bad conducting bridge is established across the break. These are generally the result of moisture on the wires, in a similar way as partial short-circuits are. The wire at the attacked place gradually thins until it is incapable of carrying the current without heating. The casing thereby becomes charred, and by the time the wire is corroded through there is a bad conducting bridge prepared through the charred wood, by which the current passes, setting the wood aglow and gradually increasing the breach in the wire. The length of charred wood through which the current will pass in this way has been known to reach 10 inches to 12 inches.

Electrolysis also plays a part in producing opening circuits. The writer was shown a length of wire taken from a ship installation with copper deposited near one end that had obviously been removed electrolytically from a point near the other end, where it was reduced in thickness. This wire had been taken from a wood casing in which salt water had continually lodged in a length of about eight feet. Opening circuits, in the case of small wires, are also produced by the wood casing drying and contracting and breaking the conductor, generally at the joints. The twisting of ships and vibration and settling of buildings have been known to cause the same fault. The opening circuit has probably caused more fires than any other fault, and it is the most difficult of all faults to provide against.

It has been necessary to consider the nature of the faults in electric wires to the above extent, in order clearly to understand the real advantages of the system of concentric wiring as introduced by Mr. Andrews. It must be obvious that to avoid the serious fire-producing faults in electric light wires, the moisture-harboring wood casing must be abandoned, the tensile strength of the conductors must be increased, and a means of automatically indicating or detecting all faults must be provided.

Mr. Andrews claims to have fulfilled all these functions completely by his system of concentric wiring.

The usual construction of the wire, as hitherto used by Mr. Andrews in most of his installations, consists of a core of vulcanized India-rubber insulated copper wire, surrounded by an armoring of iron wires seven times the cross-sectional area of the central conductor. In cases where the wires are not exposed to view, or where they are likely to be exposed to moisture, the outside conductor is also enveloped by an insulating material sufficient to resist any effect of water. The armoring forms the return conductor, and is of great strength and rigidity, and capable of resisting all the strain that might tend to break or crush the wire.

The principle upon which the claim of safety against fire risk is based is the fact of the two conductors being so close together that there could not be an arc or any excessive heat in one without its influencing the other, and the consequent establishment of a dead short-circuit. It would not be sufficient, in order to gain this purpose, simply to bring the two ordinary conductors side by side close together, because in the first place, the conductors could not be brought sufficiently near to each other to cause a completely-fused junction, should an arc take place in one of them; and, in the second, the fire would be exterior to the conductors, and could ignite anything in the neighborhood. Nor would it be sufficient to make the surrounding conductor only the same weight as the central one, because in such a case of an insufficient of metal, the defect would exist with two wires side by side. To increase the copper in the outer conductor to sufficient dimensions renders the concentric cable too costly, hence the ordinary iron armoring is found in every respect most satisfactory. The double copper concentric with lead armoring also, does not present the same advantages with regard to safety as the iron armoring. The lead is only a slight protection against exterior damage, and it might be a serious source of danger if an arc struck across between the copper conductors, and caused the lead to melt and flow.

With concentric wiring, opening circuits and partial short circuits practically disappear entirely with all their serious damaging influence and leave behind only the short circuit, which is easily met by the fuse. The fuse, therefore plays the part of complete protector of the system, as well as indicator of faults.

The great difficulty to overcome in perfecting the system has been in making perfect electrical and mechanical continuity in the joints, especially of the surrounding conductor or armoring. Mr. Andrews, under his recent patents, has s

eded most effectually and in an exceedingly mple way in surmounting this difficulty. The ncentric principle is carried into all the details the fittings. There is consequently no por- on of the system where the conductors are suffi- ently far apart to admit of the formation of an ening circuit or a short circuit. Every detail the system is constructed watertight, and the me high class insulation that is employed on e core is also used on the wires passing through e fittings. And this, we may add, is one ofthe eatest safeguards, as hitherto with the double iring the insulation has been greatly reduced the fittings, in consequence of the confined ace not admitting the heavier quality, with e result that fires have often originated in the ttings.

It would be ambiguous to say, continues the ticle, that concentric wiring for interiors is ultless. There is at least one objection to it, ut this is not relating to the system in itself so uch as to the telephonic system. An earth onnection with concentric wiring is almost un- oidable, and conductors in the neighborhood e liable to assist in the return conduction of e current. If alternating currents are used ere is the well-known influence on telephones; ith continuous currents the effect is exceed- gly slight, if at all. It is, however, only under ecially favorable circumstances that this in- uence can take place; and up to the present me, there has been no trouble with it. For ses where it is important to consider this point, r. Andrews takes the two conductors, equally ell insulated from earth, up to the lamp; but this destroys the simplicity and substantial haracter of the various devices, it would be bet- r, if such a case arises, to put the telephone pon a metallic circuit, which would be an ad- antage for other reasons. Beyond this one ob- ction, nothing derogatory can be said regard- g the system which, on the other hand, has any conspicuous points of advantage, such as eat simplicity and practicability, besides the fety from fire risk above referred to.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
ROOM 10, COOK BUILDING,
BOSTON, July 4, 1890.

A new insulation in the shape of moulded ate is soon to be put upon the market.

The county commissioners have been called on to make a survey for an electric railway etween Lowell and Tyng's Island.

Henry C. Buck has been chosen president, d Joseph B. McDonald one of the vice-presi- nts of the electric light company in Woburn.

C. J. Van Depoele, electrician of the railway epartment of the Thomson-Houston Co., has st returned from a weeks' trip to Chicago and ashington.

The Newtown aldermen have unanimously oted to accept the police signal system recently stalled by the Gamewell Fire Alarm and Police gnal Company.

The holders of the franchise for the Holbrook reet Railway report that they are willing to rrender the same to any reliable parties that ean business.

There is a strong prospect that the Middleboro lectric Light and Power Company will buy out e Middleboro Gas and Electric Company as a sis of trade has been substantially agreed upon.

President Smith, of the Brown Electric Pro- ctor Company, says: "Tell the people we e in it." Judging from the orders and many ttering letters they have received, there is no ubt of it. They are in constant receipt of tters from some of the largest electrical supply uses in the country who desire to handle this ficient protector.

It is possible that the Waltham Electric Clock Company, which has been lately organized under the New Hampshire laws, with a capital of $10,000, will locate their plant in Natick, Mass., as the officers with one exception are Natick people.

Plans are well under way for a proposed line of electric railway between Attleboro and the Rhode Island line, and which will ultimately enter the city of Pawtucket. The proposed line will run from Attleboro to Dodgeville, thence to Hebronville and Lebanon to the State line.

Mr. William Scales, of Scales and Beals, Everett, Mass., has invented a new battery which he is using to supply the current for two small incandescent lamps on a soda fountain in his store. Mr. Scales contemplates forming a company for the manufacture and sale of this battery.

It is expected that work will be begun on the new electric road at Milford within a month. It is not yet decided whether the power will be derived from the overhead wire or accumulator system. The latter is thought to be somewhat cheaper, and, under certain circumstances, will be adopted.

When the contract between the town of Stoneham and the Woburn Electric Company expired, an agreement could not be made, and the electric company shut off the light. Since then the town has been in darkness. President Buck and J. B. McDonald have made several efforts to get a settlement, but the selectmen would not accept any of the references proposed. The People's Company, of Wakefield, are now in the field as bidders, but it is not known what decision the selectmen will make.

Professor Thomson, Superintendent Rice and Electrician Rohrer will leave Lynn for a few days' tramp among the mountains, their objective point being Mt. Lafayette. They will go prepared to camp out and the schedule for each man's knapsack includes a woolen blanket, rubber blanket, hatchet, one pound of tea, one box sardines, half dozen lemons, half pound crackers, some matches, cigars or cigarettes, a tin cup and a spoon. Several men from the Boston office will accompany them, following an annual custom.

C. J. Van Depoele, electrician of the Thomson-Houston Co., has recently taken out three important patents. One is for an electric connection, consisting of conductors composed in part of a railway track with the rails united by strips of soft metal, as zinc or tin. Another invention is a motor truck, a combination with the carrying wheels and axles of an electric motor, supported at the field-magnet end upon said axles. The third is an electric railway conductor system, comprising sectional working conductors connected at the ends to adjacent systems by an insulating support and electrically connected to each other by a fusible connection, to be blown when the currents in any one section exceeds the desired intensity.

A continued hearing on the petitions of the Garden City and Central street railways for location for their tracks through Walnut and Homer streets, from Newtonville to Newton Centre, was held at the meeting of the Newton Board of Aldermen, last Monday.

Samuel Hoar, counsel for the Boston & Albany road, appeared and remonstrated to the proposed crossing of that company's tracks on Walnut street, Newtonville, and also on Homer street. In regard to the Newtonville crossing, over which are laid four tracks of the Boston & Albany railroad, Mr. Hoar argued that the railroad commissioners had refused to allow the Newton Street Railway Company to cross the Boston & Albany railroad at that point, and that it would be unjust for a municipality to grant such authority, especially as the request was made by a company desiring to evade the ruling of the commissioners. The Newton board of aldermen, added Mr. Hoar, ought not to grant this right, unless a great public exigency demands it.

Mr. George W. Morse, representing the Central Street Railway Company, read an opinion of a former board of railroad commissioners, to the effect that rights over grade crossings were peculiarly a question to be decided by local tribunals—boards of selectmen and aldermen. A remonstrance was received from 57 residents, objecting to the location through Walnut street, Newton Highlands; also from 16 residents, objecting to the location through Homer street, Newton Centre.

Hon. J. F. C. Hyde appeared and remonstrated to the location through Newton Highlands. He stated that there was no public demand for a street railroad through that section, and that it would be an injury to the streets. Mr. H. W. Holbrook and Mr. E. Moulton also opposed the Newton Highlands location.

W. B. Young appeared favoring the location through Homer street. He said that three-fourths of the residents of that street wanted the railroad, which was also wanted by many citizens who desired a means of reaching Newton, Newtonville and West Newton at a low rate of fare.

At 9.30 o'clock the hearing was closed.

There is a lively war in Providence over the proposed introduction of electricity as a motive power for street railways. Some favor the single trolley, others the double, while yet another set favor the storage battery. Those who object to the overhead system are being ably seconded by the telephone people.

The selectmen of Peabody have voted to lay on the table the petition of the Naumkeag road for an extension of time in locating poles and wires. The petition of the same road for a location for tracks was also laid on the table. The selectmen desire that the Essex electric and Naumkeag roads should come to a better understanding concerning parts where the roads cross each other before any further petitions are granted.

The Lynn and Boston R. R. is planning for an electric line to nearly encircle the entire city of Lynn, starting from the Myrtle street stable, the cars will run through Boston and Cottage sts., Western ave., Market Sq., Common, Market and Oxford sts., Central ave., Chestnut, Boston and Lynnfield sts., to the park, thus accommodating every ward in the city. The poles and wire have been purchased, and a new power station will be built large enough to accommodate 2,000 horse-power.

Mayor French, of Gloucester, has notified the Gloucester Street Railway Company that the Way Committee intend to ask the Board of Aldermen to apply to the courts for an injunction to restrain the company from erecting and maintaining poles said to be set in violation of the city permit. The company has also been notified to file a bond of $10,000 as a guarantee that poles shall be erected according to terms by which the permission to do so was granted. The Gloucester Electric Company have also been requested to file a bond of $7,000 for the same purpose.

The American Electrical Works, of Providence, are erecting an addition to their building, 100 x 40 feet. W. J. P.

LIFE-GIVING ELECTRICITY.—By submitting different seeds to the action of the electric current, their development is rendered more rapid. Experiments made in Russia show that when the electrical treatment is applied to vegetables there is a larger crop and the vegetable grows to a much larger size. Barley ripened ten days quicker; potatoes were better and not so prone to disease, and vines that have been treated have been cured of the diseases which have attacked them. It is also suggested as a remedy for the evil of the potato bug.

THE EXPLORATION OF MAGNETIC FIELDS BY MEANS OF TUBES OF RAREFIED GAS.*

The influence exerted by magnetic fields upon rarefied gases has from time to time received much attention. Amongst the many physicists who have studied the interesting phenomena which are due to such influences, the following are at once suggested, namely, Plücker, De la Rive, Trève, Daniel, Le P. Secchi, Chautard, Crookes, Goldstein and Boltzmann. They have described and variously commented upon the luminous phenomena which are observed in tubes of the Geissler type which have been placed within the influence of a magnetic field.

One of the facts upon which all observers have been fairly unanimous in their description is, that when a tube containing rarefied gas is brought within the sphere of influence of a magnet, an increase in the degree of electrical resistance is produced.

The investigations of those scientists whom we have named, have chiefly been of a *qualitative* character; however, they have so added to our knowledge of these phenomena that they are now ripe for *quantitative* investigation.

Amongst those physicists who at the present time have been engaged in the study of this subject, Mons. A. Witz must be especially mentioned, and it is to a recent communication of his to the Academy of Science, at Paris, France, that we wish to direct the attention of our readers.

Mons. A. Witz has been especially devoting himself to the measurement of the intensity of the magnetic fields, the difference of potential between the electrodes of the tubes of rarefied gas, and the intensity of the electric current which was made to traverse these tubes.

In these experiments a fine electro-magnet, specially made by Ducretet, was used, of such a strength that it was possible to obtain with it a magnetic field of from 100 to 14,000 units.

The intensity was determined by observing the rotation of the plane of polarization in carbon bisulphide. Between the poles of the magnet were placed either Geissler tubes or a cylindrical tube of 20 mm. diameter, having movable electrodes such that it was possible to vary their distance and also the pressure of the gas within it: the tube experimented upon was excited with a Rhumkorf coil. Into the induced circuit a galvanometer was introduced which had to be placed at a distance of nearly 35 m. from the electro-magnet in order that the latter might exercise no appreciable influence over it. The intensity of the induced current, which was always full, was estimated in milliampères.

In order to estimate the difference of potential between the electrodes of the tube, a sparking micrometer was employed; when the sparks were passing continuously at the same time in the tube and in this micrometer, it was assumed that the differences of potential were equal. It will at once be recognized that this method is really an adaptation of one originally employed by Faraday, and applied by Schultz to the study of the electrification of tubes containing rarefied gas.

Whilst measuring simultaneously the intensity of the magnetic field and that of the difference of potential between the two electrodes, Mons. Witz arrived at the conclusion that this difference of potential increases with the intensity of the magnetic field; but for a given field and tube, the difference is independent of the intensity of the discharge.

In order to demonstrate this, the following are some specimen figures extracted from Mons. Witz's laboratory note book; they refer to a tube containing air situated in a uniform magnetic field influencing almost its entire length:—

Intensity.		Difference of potential in volts.
Of the field in C.G.S. units.	Of the current in milliampères.	
(a) 0	4.12	1.860
(b) 2,200	2.58	2.781
(c) 3,200	2.39	4.146
(d) 4,300	2.20	5.064

In these experiments the intensity of the "inducing" current remained constant, and the influence of the magnetic field created, as it were, a resistance to the flow of the electricity. To maintain the intensity of the "induced" current constant it sufficed to increase the "inducing" current, and the difference of potential was not perceptibly raised.

This phenomenon is exhibited in the case of each of the ordinary gases but, as might be supposed, to a variable extent. It appears to be most marked in the case of these gases, of which the spectrum is most modified whilst under the influence of the magnetic field. And it varies with the conditions of the tube.

If the experiment be carried on between circular poles of 20 mm. diameter, it can be proved that different points of the tube are not equally sensitive, so that in exhibiting the effects obtained with a tube containing bromine vapor, it is desirable to cause the tube to move between the poles.

The following are typical results:—

Field.	Intensity of current.	Difference of potential.
	Milliamp.	Volts.
C.G.S. units	4.58	1.495
At the positive pole	2.87	4.864
Beginning of the capillary	2.62	4.464
11,500 units	2.45	4.78
.....	2.80	4.935
At the negative pole	2.25	5.066

The maximum effect is produced at the ends of the capillary tube on the same side as the positive pole: it is greater at the positive pole than at the negative pole.

The same has been observed for fluoride of silica, but the action is the reverse in the case of air.

Whatever the position of the tube in the field may be, it is always observed that the current is displaced according to the laws of electro-magnetism. The tube being arranged so that it cuts across the lines of force the luminous thread which traces the course of the current is thrown to one side. When the tube is placed as it were parallel to the lines of force the luminous thread proceeds in a straight line from one electrode to the other. If the tube be laid upon one of the poles of the magnet the luminous thread appears to have the form of an s, being turned towards the right by one pole, and towards the left by the other — phenomena which might be foreseen from what has already been stated.

Mons. Witz noticed one exceedingly curious phenomenon which appears to be quite new, and which can be taken advantage of with good results in the exploration of the magnetic field. When the tube is carried into the magnetic field, it is observed that the appearance of its poles changes according to the intensity of that part of the field which it then occupied. A bluish disc appears, which changes its position and appearance, as the tube is moved about in the field in such a way that the direction of the lines of force in the field become actually visible to the eye. The phenomenon must be seen before it can be properly appreciated, and, without having it to appeal to, it becomes a matter of great difficulty to give any intelligent verbal description of it.

This phenomenon is shown with great brilliancy if *small* tubes filled either with chlorine, bromine vapor, hydrogen, or fluoride of silica are employed, and Mons. Witz states that it can be used with great accuracy in the exploration of intense magnetic fields.

* *London Electrical Review.*

THE EDINBURGH EXHIBITION.

Among the various electrical instruments displayed at the Edinburgh Exhibition by Woodhouse & Rawson, United, of London, is one Commander Percy Scott's flash-signalling lanterns, which has been designed with a view to enable flash signals to be sent on the Morse system with greater rapidity than has heretofore been possible, and from a point where the present mechanical arrangement of shutter could not well be employed. The lamp is surrounded by a number of vertical shutters, pivoted above and below, and engaging by means of short arms or toothed wheels a central wheel. The motion of the latter is produced by an electro-magnet action against the force of spring. When the magnet is energized a rapid but short movement of the wheel takes place, opening the shutters for a longer or shorter period as desired, and producing thereby longer or shorter flashes of light. The action of the spring carries the wheel back to its original position as soon as the current is broken in the electro-magnet. The electrical circuits are arranged in a special manner, with the view of avoiding running the lamp at full incandescence during the time the shutters are closed. The magnet coils are therefore put in circuit with the lamp, the resistance of the former acting so as to dull the incandescence, but only to such a point as will allow the thick filament necessary for the 100 candle-power lamp employed to rise to its full incandescence during the period of the shorter flash which may be found possible to use in practical working. In order to further reduce the strain put upon the lamp by the heat developed during continuous running, a special switch is employed. The handle of the switch is hinged in such a way that under normal conditions a strong spring is pulling upon the end of it and breaks the main circuit to the lantern. In order to commence signalling it is necessary to pull down the handle against the force of the spring. This completes the circuit to the lantern, and a further depression similarly to a telegraph key operates the shutters. The contacts are so arranged that in the act of opening the shutters the lamp and magnet circuits are momentarily in shunt to one another; and as the E.M.F. absorbed by the magnet coils is only 4 volts, the amount of sparking during the signalling is very small. Extra contacts are attached to the switch to enable a Morse instrument to be added whereby the signals may be automatically recorded in the same way as in telegraphy. The lantern has been in work for several months on board H.M.S. Northumberland. It is hoped that by means of this lantern it may be possible to attain to such speed in flash signalling that the two services may be able to interpret each other's signals, which at present is found to be impossible owing to the widely different rates at which the signals are sent by the two.

Delicate Experiments.—The patter of the feet of the baseball players on the adjoining Holmes Field so disturbed the instruments with which some delicate electrical experiments were being made in the Harvard laboratory, that they had to be performed at midnight when baseball players and railroad trains were not out. Finally a remedy was found by placing a very heavy stone, separated by a thick layer of rubber, on the top of the independent brick pier on which the experimental apparatus was placed.

Street Names.—The inspector of streets of St. Louis has adopted a novel method of marking the names of streets, so that the darkest night will not render the way difficult to find. The names of the streets are painted upon the electric light globes and the shadow resulting throws the name upon the ground so plainly that it can be read fifty feet away. The letters on the globe are three-quarters of an inch, and the shadow name is five feet wide.

PREVENTING BUCKLING OF PLATES.—Some public experiments took place in Paris recently with a new Reynier accumulator at the works of M. Durafort. M. Reynier, not having been able to prevent buckling in any of the ordinary types of lead plates hitherto employed, set to work to render buckling innocuous. With this view he now separates the electrodes by means of porous sheets of silica, which only increase the resistance of the cells to a very slight degree. The cells are composed of two positive and one negative plate, and of four sheets of silica, the two end sheets of silica being fluted so as to increase the space available for the electrolyte, the quantity of which, however, is small. The containing vessel is of sheet iron, lined with India-rubber, and it is therefore light and elastic. A battery of 20 elements is about 50 centimetres long; during discharge the plates increase in volume, the cells expanding till a length of 53 or 54 centimetres is reached. As the cells shown were of recent construction, it is impossible to say anything as regards their durability. No official test has been made as to their storage capacity or their output for weight, but the inventor asserts that they have an output of 30 ampère-hours per kilogramme of plate, or 20 ampère-hours per kilogramme of total weight. The plates themselves are the old lead plates of M.M. Reynier and Simmen, of 1885. They consist of very fine lead wires woven into a net, and slightly compressed. These lead wires are obtained by passing melted lead through a fine colander. The plates, so made, are by no means solid, but they are supported by the sheets of silica. Owing to the extreme lightness of this accumulator, M. Reynier anticipates that they will be largely used for traction work and certain forms of domestic lighting.

THE ROYAL MILITARY TOURNAMENT.—At the Royal Military Tournament, this year, in England, the armor-plated train, with Gatling gun, is drawn by a self contained electro locomotive, constructed by the Electric Construction Corporation, of London. The use of electricity in this connection will be watched with interest.

LIGHTING PARIS.—At the meeting of Société Internationale des Electriciens, M. Fontaine, the president, gave some interesting particulars with regard to the lighting of Paris. The consumption of tallow for candle-making had fallen from 1,200 tons in 1885 to 300 tons last year; the number of candles other than tallow had also declined from 220 burnt per head of the population in 1885 to 190 per head last year. The use of petroleum is rapidly superseding that of vegetable oil for lighting purposes. The quantity of gas burnt has risen from one hundred and five millions cubic metres in 1877, and one hundred and fifty two millions in 1883 to one hundred and eighty-nine millions, while the application of the electric light, which did not exceed twenty-two, of 230 horse power, in 1887, had risen to over 500, with 17,400 horse power last year, this being exclusive of the electric light used in the exhibition. It is estimated that in two years' time, when the central stations are completed in Paris, the total amount of horse power will have risen to 32,000. Even now the electric light is distributed by 6,800 arc regulators and 118,000 incandescent lamps, while if gas supplies 573-1000 of the total lighting of the city, the electric light shows already a proportion of 189-1000.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED JULY 1ST, 1890.

431,035. Electric Cut-Out. Leo Daft, Plainfield, N. J., assignor to the Daft Electric Light Company, New York, N. Y. Filed Oct. 16, 1885. Renewed May 4, 1888.

431,073. Electric Battery. Myron W. Parrish, Detroit, Mich., assignor, by direct and mesne assignments, to Junius A. Bowden and the Graphite Electric Company, same place, and John Hutchinson, Jackson, Mich. Filed Dec. 2, 1889.

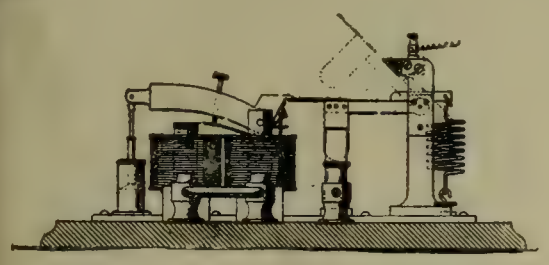
431,088. Individual Call Devices for Telephones. Charles H. Vincent, Lynn, Mass., assignor to Frederick W. A. Bergengren, same place, and John V. Spalding, Boston, Mass. Filed Aug. 2, 1889.

431,092. System of Electric Locomotion. Frank Wheeler, Meriden, Conn. Filed Mar. 2, 1889.

431,093. System of Electric Locomotion. Frank Wheeler, Meriden, Conn. Filed Mar. 27, 1889.

431,094. Switches for Electric-Railway Systems. Frank Wheeler, Meriden, Conn. Filed Dec. 23, 1889.

431,095. System of Electrical Locomotion. Frank Wheeler, Meriden, Conn. Filed Dec. 28, 1889.



NO. 431,035. ELECTRIC CUT-OUT.

431,104. Protective Covering for Electric Cables. John H. Cheever, New York, N. Y., assignor to the Okonite Company, same place. Filed Mar. 19, 1890.

431,118. Electric Switch. Osborn P. Loomis, Somerville, Mass., assignor to the Loomis Electric Manufacturing Company, New York, N. Y. Filed Sept. 3, 1888.

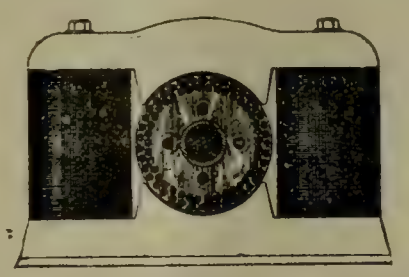
431,134. Dynamo-Electric Machine. Charles F. Winkler, Troy, N. Y. Filed Sept. 16, 1889.

431,141. Electrical Call-Box. George F. Gale, Winthrop, assignor of one-half to Arnold B. Holmes, Boston, Mass. Filed Feb. 27, 1890.

431,170. Electro-Magnetic Drill System. Harry N. Marvin, Syracuse, N. Y., assignor to the Marvin Electric Drill Company, same place. Filed Dec. 17, 1889.

431,181. Electric Bell. Patrick B. Delany, South Orange, N. J. Filed Mar. 17, 1890.

431,185. Multiple Fusible Cut-Out. Lorenzo B. Favor, Bridgeport, Conn., assignor to the Thermal Electric Company, of Maine. Filed Jan. 18, 1890.

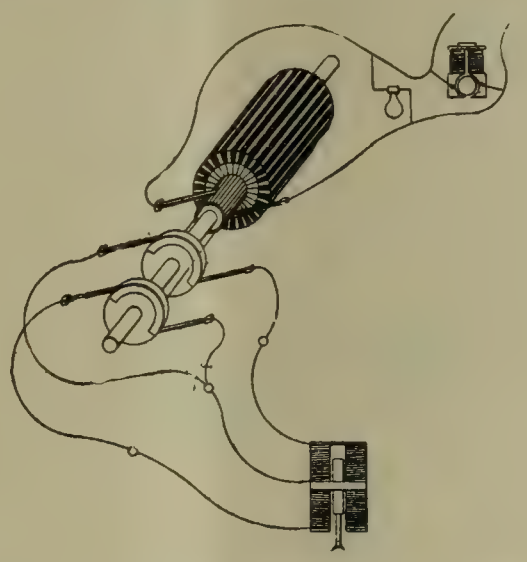


NO. 431,134. DYNAMO ELECTRIC MACHINE.

431,186. Multiple Thermal Cut-Out. Lorenzo B. Favor, Bridgeport, Conn., assignor to the Thermal Electric Company, of Maine. Filed Apr. 14, 1890.

431,213. Electric Motor for Railway Cars. William M. McDougall, East Orange, N. J. Filed May 16, 1889. Renewed May 22, 1890.

431,216. Regulation of Dynamo-Electric Machines. William Stanley, Jr., Great Barrington, Mass. Filed July 29, 1889.



NO. 431,170. ELECTRO-MAGNETIC DRILL SYSTEM.

431,217. Self-Regulating Dynamo-Electric Generator. William Stanley, Jr., Great Barrington, Mass. Filed Sept. 23, 1889.

431,218. Self-Exciting Alternating Current Electric Generator. William Stanley, Jr., Great Barrington, Mass. Filed July 29, 1889. Renewed Mar. 29, 1890.

431,235. Dynamo-Electric Machine. Oliver B. Shallenberger, Rochester, assignor to the Westinghouse Electric Company, Pittsburgh, Pa. Filed Jan. 24, 1889.

431,248. Electric Meter. Jules Cauderay, Paris, France. Filed Aug. 17, 1889.

431,256. Suspended Electric Railway and Car. Frederick E. Drown, Pawtucket, R. I. Filed April 6, 1889.

431,320. Electric-Lamp Fixture. Sigmund Bergmann, New York, N. Y. Filed Mar. 3, 1890.

431,341. Secondary Battery. Theodore M. Foote, Allston, assignor of one-half to Charles J. Pillsbury, Boston, Mass. Filed July 5, 1889.

431,414. Electric Railway Conductor. Elihu Thomson, Lynn, Mass. Filed March 22, 1890.

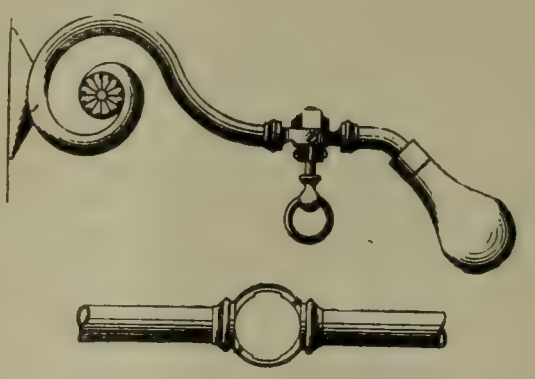
431,439. Electric Soldering-Iron. Charles L. Coffin, Detroit, Mich. Filed Jan. 18, 1890.

431,447. Secondary Battery. Theron S. E. Dixon, Chicago, Ill. Filed February 6, 1890.

431,460. System of Electrical Distribution. Ludwig Gutmann, Fort Wayne, Ind. Filed Jan. 25, 1889.

431,492. Reciprocating Electric Engine. Charles J. Van Depoele, Lynn, Mass. Filed April 3, 1890.

431,493. Reciprocating Electric Engine. Charles J. Van Depoele, Lynn, Mass. Filed April 3, 1890.



NO. 431,320. ELECTRIC LAMP FIXTURE.

431,494. Reciprocating Electric Engine System. Charles J. Van Depoele, Lynn, Mass. Original application filed June 26, 1889. Divided and this application filed April 17, 1890.

431,495. Reciprocating Electric Engine. Charles J. Van Depoele, Lynn, Mass Filed April 18, 1890.

431, 496. Reciprocating Electric Engine System. Charles J. Van Depoele, Lynn, Mass. Filed April 18, 1890.

431,519 Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Original application filed Feb. 23, 1887. Divided and another application filed Oct. 18, 1889. Again divided and this application filed April 23, 1890.

431,531. Telephone Signal Apparatus. John A. Seely, Brooklyn, N. Y., assignor to the Western Electric Company, Chicago, Ill. Filed Jan. 31, 1888.

THE INSUMGRAPH.—This is an instrument which by the aid of electric currents presents at a predetermined time a clear space of paper for signatures at an opening in a suitable desk, and at the end of the time of grace allowed moves it past the opening. The tell-tale and time-checking systems at present in use, owing to the fact that the necessary signals are made by electric currents set in motion by discs, or plugs, or press buttons, fail to ensure that the proper individual is actually performing his rounds. The insumgraph, however, by making an autograph necessary greatly diminishes the possibilities of fraud.

OVERHEAD WIRES IN LONDON. — The Select Committee of the House of Commons has passed the Bill promoted by the London County Council for regulating overhead wires.

TELEPHONE COMMUNICATIONS WITH ANCHORED VESSELS.—Experiments are to be made at Havre of telephoning between vessels at anchor and the town. As soon as a vessel arrives in the roads it will be connected to the municipal telephone lines. In this way the captain and passengers can immediately enter into communication with the merchants of Havre and even of Paris.

BERTHOUD-BOREL CABLES.—The latest type of Berthoud Borel cable is insulated with layers of celluloid tape, over which a layer of hemp is wound, the whole being then plunged into a bath of hot liquid insulating compound.

THE LIGHTING OF THE EIFFEL TOWER LIFTS.—The lifts at the Eiffel Tower are now lighted by the electric light.

AGRA.—There is every hope, says the *Indian Engineer*, that within the space of two months the Tâj will be permanently lit up with the electric light. It is proposed to place 1,200 candle-power lights on each of the front minarets, and 1,000 candle power lights on each of the back minarets and on the Musjid and Jawab. The main building will have no light stationed upon it, and so will be magnificently thrown into relief. The expense has been computed at Rs. 12,000.

CABLE FOR WEST COAST OF SOUTH AMERICA.—The Silvertown Telegraph Company is manufacturing about 1,750 miles of cable for the Central and South American Telegraph Company. This cable will be laid on the West Coast of South America, connecting Valparaiso with Iquique.

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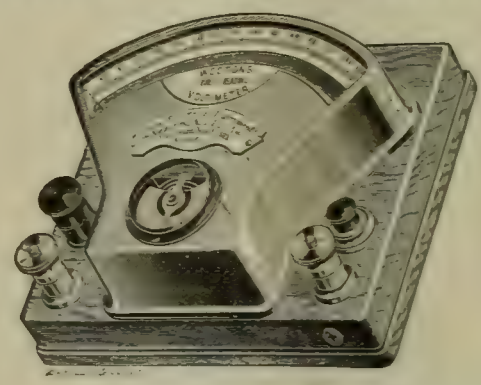
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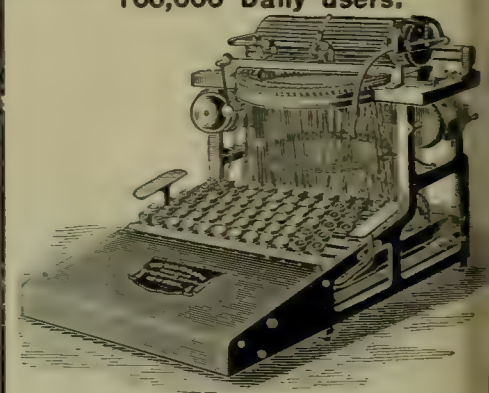
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NEW YORK, JULY 19, 1890.

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ELEMENTS OF ELECTRIC LIGHTING

There is an evident demand for elementary formation on electric lighting, and the books at have been written on the subject are too far dvanced for popular understanding. Beginners e frequently discouraged in their efforts to udy this most interesting subject, simply ecause the so-called elementary works are not ementary enough. A great many questions e likely to arise in the mind of a student that ooks do not answer directly; and in many orks it is assumed that he already knows me things about machinery, etc., used in ectric lighting. The fact is the first steps in e study of this subject, which should be made easy as possible, are frequently the hardest all, simply because the mechanical details of ectric lighting are too meagerly described, if ey are described at all. With a view to supying this growing want we are preparing a ries of articles which are intended to cover e simplest facts and things in connection with ectric lighting. The manner in which the formation is given is not entirely new, but we lopt this method because it is the simplest way imparting the desired knowledge.

The first of this series of articles appears on nother page of this issue, and it will be observed at the information is given in the shape of nswers to questions, and each question is nswered as comprehensively and clearly as ossible. The advantage of this method of nparting information lies in the fact that only ne thing is explained in each answer, and each uestion and its answer are entirely independent of all others, and complete in themselves. o appreciate the value of this method of conveying information, let it be remembered that, as ooks are usually written, it is necessary frequently to go through a great portion of their contents before the explanation of any one subject can be found.

These articles will cover electric lighting completely, from beginning to end, and we have no doubt that they will be heartily welcomed by thousands who are anxious to know all about this interesting subject, but who are deterred from taking the matter up as a study, because the existing books are too deficient of elementary facts.

ELECTRIC POWER.—Business buildings in order to be readily rentable these days must be equipped throughout with all of the modern conveniences. "Modern conveniences" means a good many things. It means steam heat, elevators, electric bells, electric lights, etc.; all of which a few years ago were regarded as luxuries. Buildings intended for manufacturing purposes are not equipped with steam plants any more. Boilers are things of the past in many places. The steam necessary to drive the machinery is obtained from supply pipes laid under the street, and the inconvenience and annoyance incident to the maintenance of steam boilers are entirely done away with. The steam engine itself is now beginning to yield to its formidable competitor, the electric motor. It is not an uncommon thing these days to see in the windows of vacant premises such notices as these: "Steam or electric power supplied;" "electric power readily obtained," etc., etc. It will not be long before steam engine plants will be curiosities in downtown business establishments. In their places will be found little machines placed in a corner or by-way, which on investigation will prove to be electro-motors, doing their work noiselessly but surely, and getting their power from outside sources.

SEARCH LIGHTS IN FOGS.—The discovery that when the rays from an electric search light are projected upward they can be seen at a much greater distance than when projected horizontally was a very important one, and one that will be found of great value on shipboard Navigation in foggy or thick weather is always attended with great danger, and when the electric search light was invented it was thought that the terrors of fogs would disappear. But this was not the case in fact. In practice it was found that, while an electric light had greater penetrative power than the ordinary ship light, it did not, after all, come up to expectations, and its beams did not penetrate fogs as much as was expected. This statement refers particularly to horizontally projected light rays. When, however, it was found that when the rays were projected vertically they could be seen at much greater distance, the problem of minimizing the dangers of navigation in fogs was at once solved.

On another page we describe and illustrate a search light, which is designed for the purpose of projecting its rays horizontally or vertically, as desired. Some tests of the operation of this light are also described and illustrated, and, from all accounts, they were entirely satisfactory to a special Naval Board, appointed by the Secretary of the Navy, for the purpose of witne-sing the same, and reporting on the efficiency of the light for naval purposes.

COMING EVENTS CAST THEIR SHADOWS BEFORE.—Mr. Henry Villard the other day expressed the opinion that great discoveries in electricity are at hand. In five years, he said, there will not be a steam locomotive on any railway in the United States; and every kind of machinery will be driven by electricity. Just what he means by his intimation that great discoveries are imminent is hard to say. Inventors keep their secrets to themselves until they can raise bulwarks of protection, but somehow the public usually get an inkling of what is forthcoming, notwithstanding these precautions, and if, as Mr. Villard intimates, something really new and wonderful is pending, the people are ready for it. So much the better for these great things if they involve the use of electricity in any way as the people look to electricity to accomplish everything some of these days.

LINKED TO THE REST OF THE WORLD.—One of the greatest charms of Bermuda used to be its complete isolation from the rest of the world. It used to be the Mecca of those who were weary of business and the bustle of active life on the main land. It was about the only place left, that was convenient, where a person could really in one sense, get away from the rest of the world and be quiet. But this charm has gone. Bermuda has been linked to the outside world by a submarine cable, and henceforth it will feel the throbbing pulse of the rest of the world. Nothing can be allowed to stand in the way of business necessity these days, and thus it is that this fair isle of the sea has been compelled to fall in line with the progress of the world. There is hardly any doubt however, that the Bermuda onions will be as delicious to us in future as they were in the days when there was no Bermuda cable.

PHONOGRAPH AT STANLEY'S WEDDING.—A novel use was made of the phonograph at the wedding of Henry M. Stanley at Westminister Abbey, London. The chimes of the Abbey's bells, the notes of the organ, the singing of the choir, and the words of the marriage ceremony were all recorded on the wax cylinders, and the whole presented to Mr. and Mrs. Stanley by Colonel Gourand. This is indeed a unique wedding present, and one which, no doubt will, in one sense, be more highly prized than all others. We trust that the married life of the great explorer will be one of unalloyed bliss and happiness, and that he and his wife will derive great and frequent pleasure in reproducing the music and the singing of the joyous occasion when they were made one.

MUSIC BY TELEPHONE.—The Long Distance Telephone Company will soon inaugurate a branch of the service that will find a large field for its operation. Experiments have been carried on for some time, through the aid of a recent electrical device with a view to furnishing music at a distance for private balls and receptions from some famous orchestra. The idea is to make New York the musical centre. We understand that much success has attended the experiments, and that the enterprise is a practical one. In a few weeks the public will likely hear more about it.

FIGHTING FOR A FRANCHISE. — In Spokane Falls, Wash., a serious outbreak occurred on June 24th, between the city and county authorities over the right of two rival street car lines to lay tracks on a certain street. One of the contending companies intended to adopt electricity on their line. All of the city authorities, from the mayor down, including city council and the entire police force, were arrested by the State authorities. The franchise over which the fight took place is a valuable one.

ABSORPTION.—The Electric Light and Power Company in Newark, N. J., lives by the absorption of small companies. On July 2d, it absorbed the Thomson-Houston plant in that city, and now enjoys a virtual monopoly in the electric light field. It has a capital of $2,000,000. It was originally the Weston Electric Light Company, and two years ago it absorbed the local plant of the Schuyler Electric Light Company.

STEADY ELECTRIC LIGHTS.—Storage batteries used in connection with a dynamo for lighting, serve to steady the light. They are to dynamo currents what fly-wheels are to engines. The light, by the use, is unaffected by variations in the dynamo current.

COMPLIMENTS BY BERMUDA CABLE.—On July 11th, the Mayors of Hamilton and St. Georges, Bermuda, sent congratulations to Mayor Grant of this city, on the completion of the Bermuda cable. The sentiments were reciprocated in the same manner.

THE HUNTINGTON SEARCH LIGHT.

On the night of July 9th the steamer "Massachusetts" of the Providence Line, carried on her trip as guests of Mr. J. W. Miller, President of the Company, a naval board to witness from that vessel the operation of the Huntington Search Light which is in regular service on the steamer Connecticut of the same line. They will submit a report on the observations to the Secretary of the Navy, and while, of course, it cannot be said with certainty what will be the character of the report, there is no reason whatever to presume that it will be otherwise than favorable.

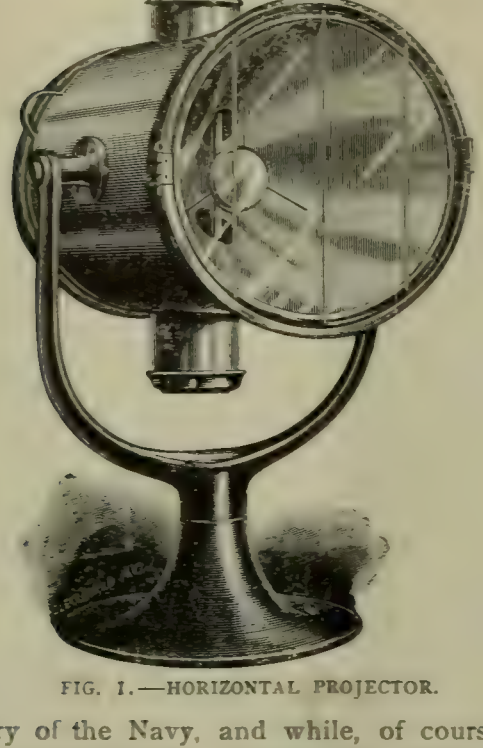


FIG. 1.—HORIZONTAL PROJECTOR.

The Huntington Search Light possesses features which render it far superior to other search lights for use on ship board.

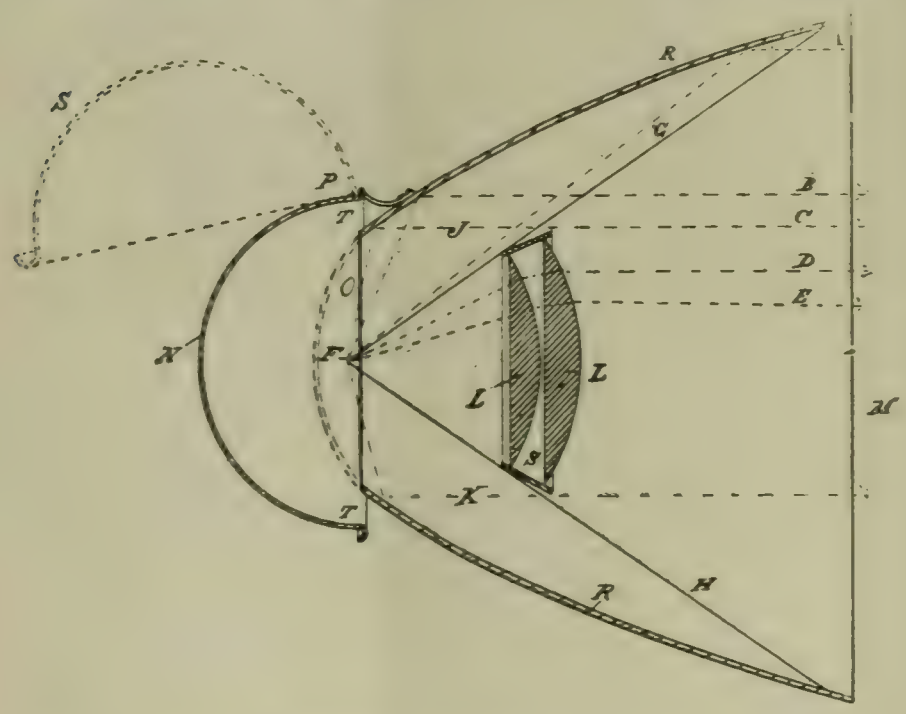


FIG. 2.—HORIZONTAL SECTION OF PROJECTOR.

The instrument (Fig. 1.) consists of a parabolic reflector of novel construction, containing a series of condensing plano-convex lenses, (Figs. 2, 3.) with a new arc-focusing lamp, which works automatically, being so constructed as to feed at any angle or position, working on any continuous or low potential current, dynamo, or storage battery.

The reflector and lamp are enclosed in a substantial weather-proof cylinder, constructed of brass, steel, or iron and copper, mounted on a standard which can be rotated, elevated or depressed to any angle almost instantly, on account of the simplicity of its mechanism. The total weight of the instrument is about one hundred and thirty pounds; it can be moved about without risk of breakage or disarrangement of any of its parts. It has been discovered that in thick or foggy weather if the beam of light from a search light be projected upward, it can be seen much further than the same light could be seen when projecting its rays horizontally. This fact has been taken advantage of in the construction of the Huntington Search Light. The vertical beam of light serves to indicate the position of the boat in foggy or thick weather. The light can be flashed or allowed to show for as long a time as may be required, being controlled by means of a switch located inside the pilot house. When the beam is projected vertically to indicate position the column of light rises to a height of from ½ to ¾ of a mile, which in clear weather can be seen miles away. In thick weather by the use of the vertical beam in connection with the steam whistle collisions are absolutely avoidable. Various colored glasses may be used to give the light beam a tint.

The Huntington Search Light is valuable for other purposes besides the uses just described. For out-of-door work at night in streets, or in railway building, the light is valuable. In cities electric currents can always be obtained, and the use of the light for night work effects a saving of money and time, besides causing the least interruption to traffic. The light is also a valuable aid in carrying on mining operations, and for such purposes as locating wrecks, coast defense work, and dredging it is admirably applicable.

Figs. 2 and 3 represent respectively a horizontal and vertical section of the parabolic reflector used in the Huntington Search Light. The combination of the two lenses, as shown in the figures, is a necessity because the focus required is so short that a single lens to obtain it would have to be double convex, and a large portion of the radiated light would impinge on the inner convex surface at angles greater than that of total reflection, and would not, therefore, pass through the lens, but would be reflected from its inner surface, scattered, and lost.

Figure 4 shows the Huntington Search Light in position to cast a vertical ray, and figure 5 shows its application to steamers. In the latter illustration both the horizontal and vertical beams are seen, and a very clear idea is given in the manner of using the light on shipboard.

Figure 6 illustrates a photo-engraving lamp manufactured by the same company. These lamps are especially designed for photogravure, photographic and copying work on dark days, at night, or when skylight is unavailable.

The Lens Attachment enables the operator to enlarge or diminish the *area of focussed light*, from a focal spot to a circle several feet in diameter according to the size of work to be photographed or printed. The wide and general dispersion of light is thus obviated, and the illumination *concentrated* where it can all be utilized.

Any low potential continuous current may be used on this lamp. It gives a steady white light. It is claimed that when high potential currents are used, the sputtering of the light impairs the

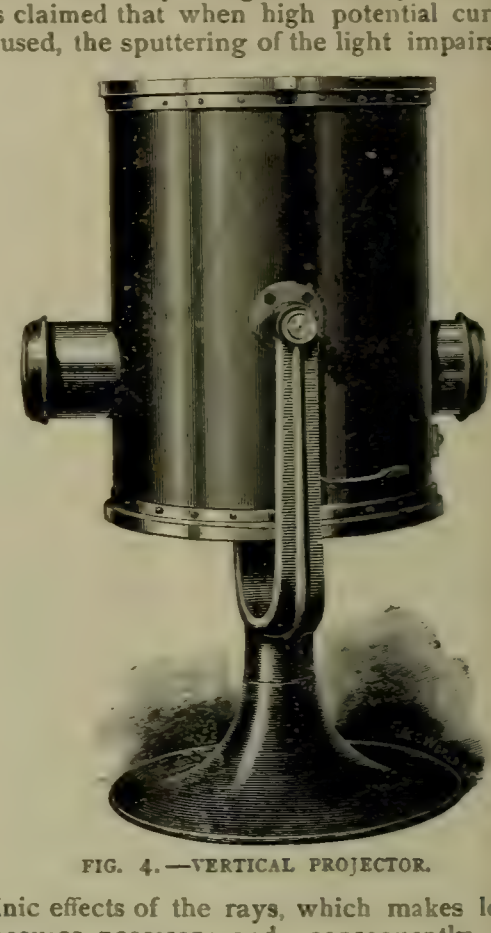


FIG. 4.—VERTICAL PROJECTOR.

actinic effects of the rays, which makes long exposures necessary and, consequently, take longer time to complete the work.

The Scott Electrical Works, 26 Liberty st., N. Y. are the manufacturers of these goods, and

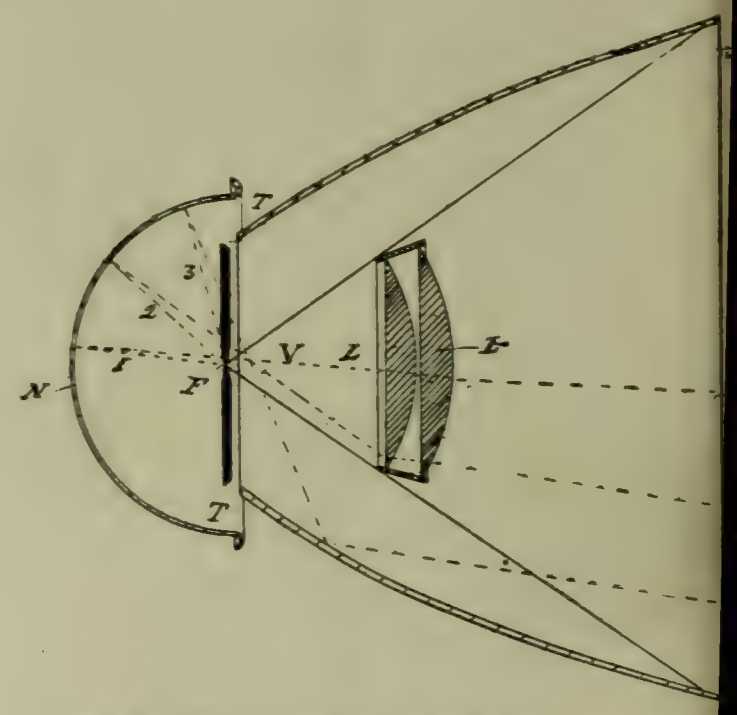


FIG. 3.—VERTICAL SECTION OF PROJECTOR.

reputation the firm has attained through quality of their wares, is a substantial and torious one. They stand at the head of the of manufacturers of this class of instruments

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The National Electric Manufacturing C pany, successors to the electrical departmen the New Haven Clock Company is now set in their new building. The two floors occupied the company at 14 & 16 Vesey street are fitte in hard woods. Two large rooms are used, for an exhibition room and the other for sto and a small room in the rear, which is ha somely fitted up, as a directors room.

FORTY PER CENT. SAVING IN FUEL.

This is the astounding statement made by the cIntosh & Seymour Engine Co. It has refer-ce to their compound condensing type of en-ıe, a cut of which is herewith presented to our aders. The phenomenal favor with which this gine has been received by the trade in general, monstrates that the manufacturers are able to bstantiate their claims.

When a number of engines of smaller powers is such that every part is of the simplest form. They run at the highest speeds used with high pressure engines, in a perfectly quiet and satisfactory manner, and require no more care or attention. This is the universal testimony of those who have these engines in use, who also report a reduction of coal consumed in all cases of over 40% in actual every day service where they have supplanted first-class automatic cut-off high pressure engines. This speaks conclusively as to their economy and means a large dividend in itself from saving in cost of fuel. Add to this the ability to use direct belting and divided power with their convenience, simplicity, lessened first cost, and the absence of shut downs from slight accidents, friction and other evils of shafting, while only enough engines need be run to do the work, avoiding long runs under light loads, so wasteful of fuel.

These engines are not in any sense experimental. They have been running for a long period, with marked success, and their advantages from every view-point are shown by the great demand for them. It is a significant fact that a majority of those sold have been installed in old stations, for those who have had long experience.



6. THE HUNTINGTON SEARCH LIGHT—PHOTO-ENGRAVING LAMP.

belted direct to dymamos or generators iously, they must be of the simplest form, re-re the minimum of attendance and be capable unning at high speeds; requirements which der inadmissiable the complexity which has ays been considered necessary with an eco-nical type of engine. However, the advan-es of direct belting and divided power are so at that notwithstanding the acknowledged eriority in economy of the engines adapted them, a large majority of electric light stations e been arranged upon this plan.

The pecu'iar design and arrangement of the Intosh & Seymour Standard Compound Engines

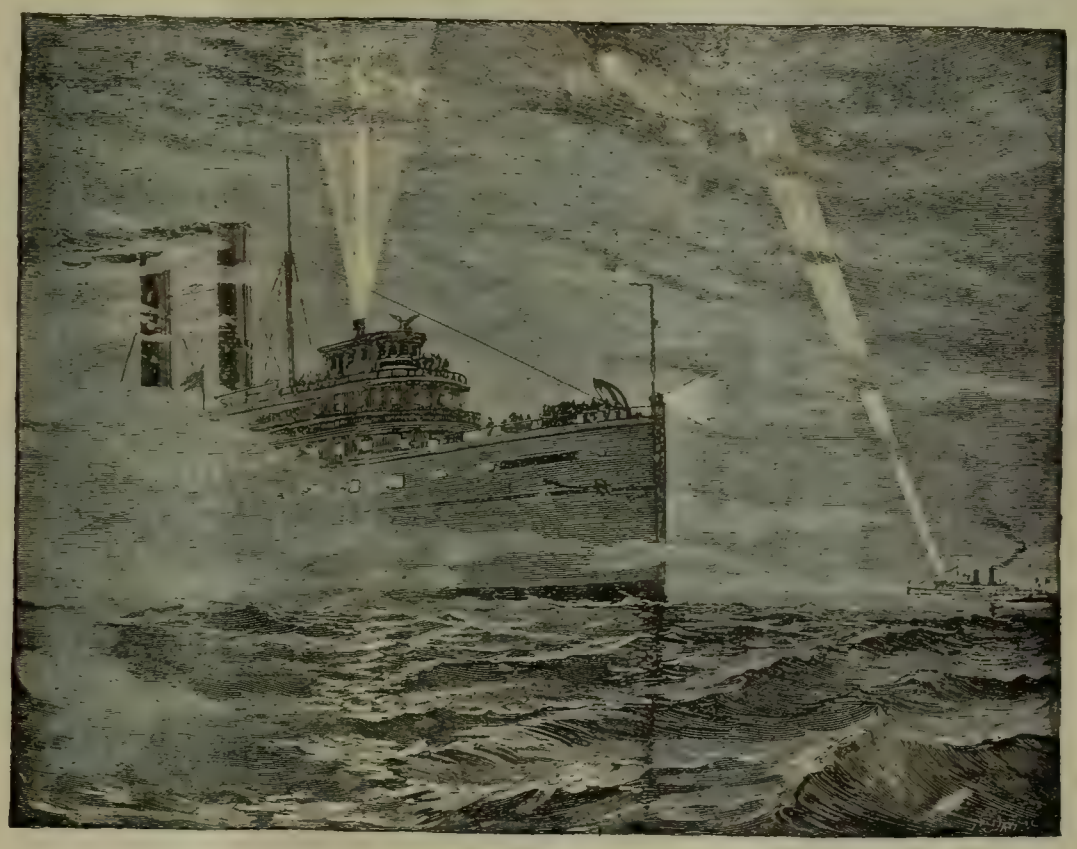


FIG. 5. THE HUNTINGTON SEARCH LIGHT—VERTICAL LIGHTS ON STEAMERS.

The saving in fuel effected by these engines will amount to their entire cost in a short time, but, since they require only six-tenths as much boiler capacity, with a corresponding reduction in the other portions of the steam plant, their actual first cost is not above that of high pressure engines.

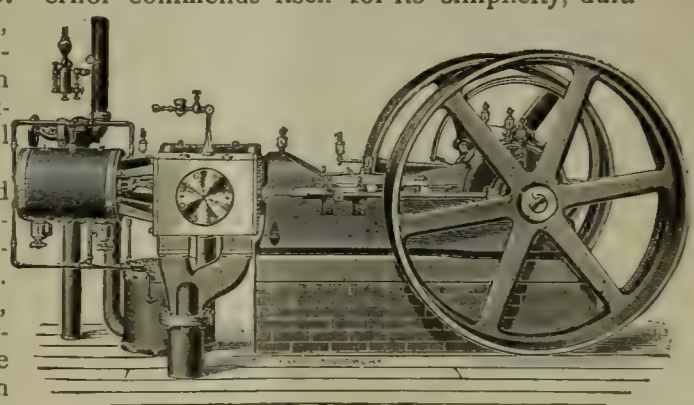
When water for condensing purposes is not available, these engines can be furnished, adapted to run non-condensing. While the saving in fuel made by these is not as great as with the condensing engines, it is well worth effecting. The coal consumption of both types will be guaranteed.

The McIntosh & Seymour Standard Compound Engine, as will be seen from the cut, is a horizontal tandem compound engine, with high pressure cylinder and receiver, steam jacketed. This is considered the most economical type, with as high pressures as can be ordinarily carried. The chief peculiarity of this engine is the position of the high pressure valve together with its actuating gear upon the opposite side. This allows each valve to be driven in the most direct and simple manner, separates and makes easily accessible the moving parts, and is the only arrangement possible with a tandem engine, which avoids a very complicated and unsatisfactory valve driving gear. It is considered that this arrangement, which is patented, is a very valuable feature in a high speed compound engine for electric lighting purposes.

Since the low pressure cylinder exhausts into a vacuum it is impossible to "cushion" satisfactorily, on this side of any form of double engine. This prevents smooth running and renders necessary frequent adjustment and attention. Since both pistons are on the same rod, this difficulty is avoided in the tandem engine, and the compression, obtained in the high pressure cylinder, gives remarkable smoothness and quietness to the running of the engine.

Live steam, after passing through the jackets of the high pressure cylinder, is used to jacket the receiver. The low temperature of the steam in the latter causes considerable condensation in its jacket and this induces the brisk circulation through all the jackets, which is so essential to their efficiency. The water condensed is returned to the boiler.

The low pressure valve is moved by a fixed eccentric and the high pressure valve by our governor or automatic cut-off regulator. This and also the valves, frame, solid steel shaft and moving parts generally, are precisely similar to those of the McIntosh & Seymour Standard High Pressure Engine, which have become so well and favorably known, that they need no special description. The simple, perfectly balanced piston valves are prevented from leaking by adjustable seats, the efficiency of which has been fully proven in actual service. The governor commends itself for its simplicity, dura-



MC INTOSH & SEYMOUR COMPOUND CONDENSING ENGINE.

bility and power. Without any tendency to over sensitiveness, it will regulate the speed of

Concluded on page 8.

ELECTRIC LIGHTING FOR BEGINNERS.

BY THE EDITOR.

PART I.—DYNAMOS AND ARMATURES.

1.—What is a dynamo?

A dynamo is a machine for the conversion of mechanical energy into electrical energy by means of electro-magnetic induction (see Fig. 1).

2.—What are dynamos used for?

Dynamos are used for the economical production of powerful electric currents, such as are required for electric lighting, electric traction, electro-plating, etc.

3.—How many classes of dynamos are there and what is the difference between them?

There are two classes of dynamos—direct current and alternating current. A direct current dynamo is one which supplies a current of an unchanging polarity; an alternating current dynamo is one in which the current produced is constantly alternating its polarity.

4.—What are the principal parts of a dynamo?

The principal parts of a dynamo are: (1), the armature; (2), the field magnets; (3), the pole pieces; (4), the commutator, and (5), the collecting brushes (see Figs. 2, 3, 4 and 5).

5.—What is the function of the armature?

It is to generate the electric currents.

6.—Describe the armature?

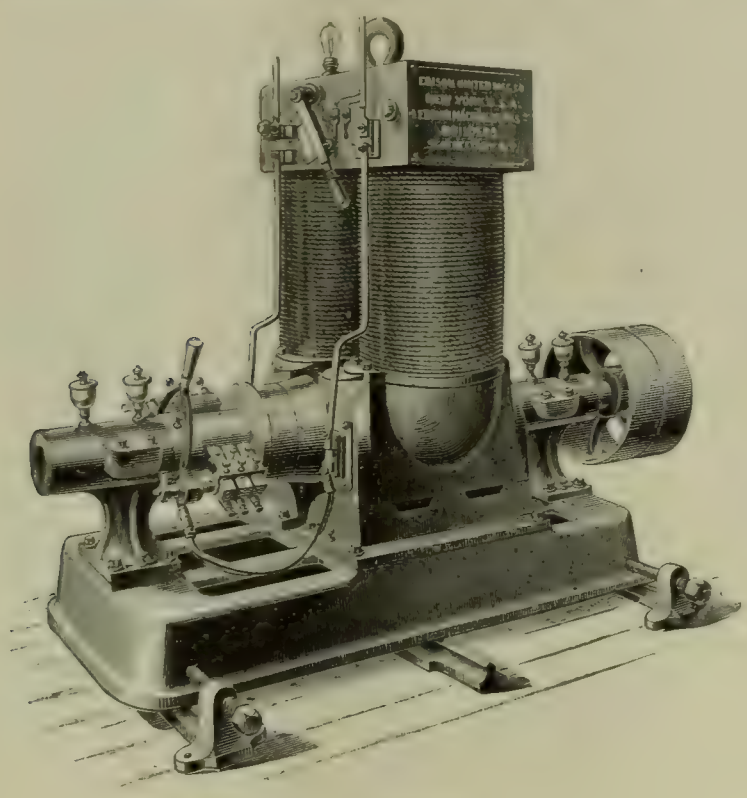


FIG. 1.—DYNAMO.

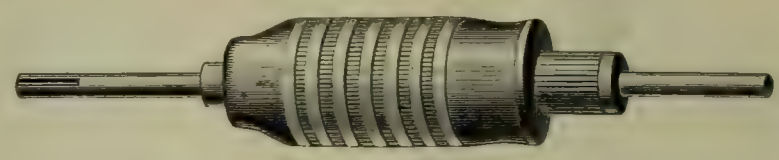


FIG. 2.—ARMATURE.

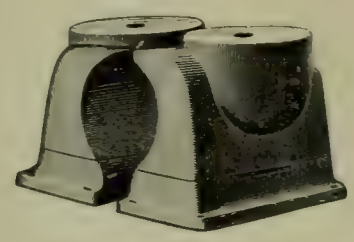


FIG. 3.—POLE PIECES.

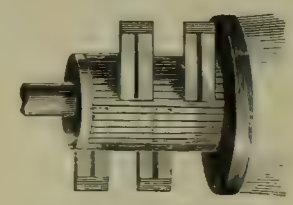


FIG. 4.—COMMUTATOR.

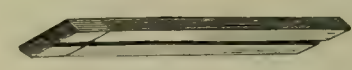


FIG. 5.—BRUSH.

The armature usually consists of a series of coils of insulated wire, that are wrapped around or grouped upon a central core of iron.

7.—How are currents generated in the armature?

When the armature is rotating the insulated wires referred to in the preceding answer move through the magnetic field of the machine, and electric currents are produced therein in accordance with the laws of electro-magnetic induction.

8.—Are armatures always made of one form?

No. They are constructed in a variety of forms.

9.—What are the forms in which armatures are usually constructed?

There are cylindrical or drum armatures; disc armatures, pole or radial armatures, and spherical armatures.

10.—What are cylindrical or drum armatures?

They are armatures in which the wire is wound parallel to the axis of rotation, or longitudinally, on the core.

11.—What is a disc armature?

Disc armatures are those in which flat coils are supported on the surface of a disc.

12.—What is a pole or radial armature?

A pole armature is one in which the armature coils are wound on radial projections or cores on the surface of a disc.

13.—What is a ring armature?

A ring armature is one in which the coils are wound around a ring-shaped core.

14.—What is a spherical armature?

A spherical armature, as its name implies, is one in which the wires are wound on a core that is nearly spherical in form.

15.—In a dynamo is the armature always the part that is rotated?

Usually it is; but in some machines the armature is stationary and the field magnets revolve, while in others both armature and field revolve.

16.—What is the core of an armature?

The core of an armature is the iron frame on which the wire of the armature is wound.

17.—Are all cores made alike?

No. There are a great variety of methods of making armature cores. Most all cores are alike in one respect, however, and that is, that they are laminated.

18.—What is meant by lamination?

Lamination is the sub-division of the core into separate insulated plates or strips, according to the shape of the core.

19.—Describe the construction of a laminated core?

In the case of a ring armature it may consist of a number of iron wire rings, electrically insulated from each other, and in the case of a drum armature, may consist of flat rings or washers stamped out of thin sheet iron, and placed vertically side by side on the armature shaft and insulated from each other. Cores of the latter class are sometimes made by laying insulated iron hoops over each other.

20.—What quality of iron is used for the core?

The best soft iron.

21.—Why is soft iron used for the cores?

Because it acquires and loses its magnetism rapidly.

22.—What material is used for insulating the laminae of the core?

Any first-class insulating substance. In practice a variety of substances are used, such as varnish, asbestos, mica, etc.

23.—Are cores ever made solid? If not, why?

No; chiefly because they become heated.

24.—What is the cause of heating?

Heating is caused by counter or local currents induced in the mass of the core by the variations in the currents produced in the wire of the armature.

25.—What effect has lamination of cores on these currents?

Lamination has the effect of preventing the formation of or reducing to a minimum these local currents on account of the small mass of iron that can be acted upon. Each of the iron rings composing the laminated core being insulated from the adjacent ones, there can be no communication of local currents from one ring to another.

26.—How is the wire wound on the armature?

In coils. The coils of the ring armature are wound transversly around the ring—shaped core; those of the drum armature are wound longitudinally over the surface of the cylinder or core; radial armature coils are wound on separate poles projecting radially from the circumference of the core or disc, and disc armature coils are flat and supported on the surface of the core.

27.—Are the coils connected with each other or are they independent?

The coils of some armatures are all connected with each other, and in others they are independent of one another.

28.—Give examples of each of these classes of armatures.

The Gramme ring armature is an example of the first class, and the armature of the Brush dynamo represents the second class.

29.—What is the distinguishing name of each of these classes of armature?

The first is known as "closed circuit armatures," and the second as "open circuit armatures."

30.—Do the armatures of all dynamos have the same number of coils?

No. The number depends upon the character of the work to be performed by the current.

31.—What is the effect of few coils and a large number of coils?

Few coils give an uneven current, that is, it rises and falls in intensity; a large number of coils give a steadier current, and the fluctuations in strength are much smaller. In general, the greater number of coils in the armature the steadier and less fluctuating is the current, and conversly, the fewer the coils the greater the variations in strength.

32.—Give examples of the uses of these two classes of current.

The steady currents are required for electric light purposes, and the fluctuating current is used in electro-plating, where the steadiness is immaterial.

33.—What size of wire is used for armature coils?

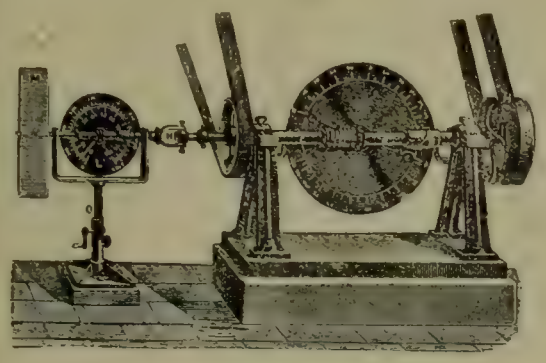
The sizes of wire used in armature coils vary according to the intensity and volume of current required.

(To be Continued).

THE TROUVÉ DYNAMOMETER.*

The following is a brief description of a simple dynamometer designed by M. G. Trouvé, which can be used either as an absorption or transmission instrument.

Power may be considered either as the product of the force exerted and the speed of displacement of the point of application of this force; or, again, as proportional to the product of a couple and an angular velocity. If, therefore, we can measure these two quantities separately, their product will give us the power absorbed or transmitted. M. Trouvé's dynamometer consists of two parts, one serving to measure the couple and the other the angular velocity. The measurement of the couple exerted is obtained by means of a flat spring arranged along the axis of the dynamometer, in order to eliminate the effects of centrifugal force. The spindle is hollow at this point, and consists of two concentric tubes. The ends of the flat spring are fixed to these tubes, which are able to follow the rotary and longitudinal movements which the torsion gives to the spring. One of these tubes carries a fixed sleeve B, cut as shown in the annexed figure. The second has a sleeve B′, free to move on it, and which is kept pressed against the fixed sleeve by the spring F, so that when the instrument is at rest B and B′ are pressed one against the other. B′ is provided with a slot, which only allows it to move longitudinally. Under the action of the torque exerted upon the axis of the system the longitudinal motion of this sleeve is utilized to rotate the indicating needle on the dial A, which is empirically graduated. In order to effect this registration the movable sleeve B′ is furnished with a deep groove, G, which engages the extremity of a bent lever connected to the needle.



TROUVÉ DYNAMOMETER.

The dial is graduated empirically in the following manner: The axis of the dynamometer spring being solidly connected to one end of the shaft of a motor, a double-balanced lever is fixed to the other end. Weights are then suspended to one end until the maximum degree of torsion which it is proposed to give the spring (180 deg.) is reached. The motor is rotated at the same time, so as to keep the lever in a horizontal position. The arm of the lever is 15.92 centimetres long, so that each kilogramme applied to the end of the arm of the lever is equal to 1 kilogramme metre of work per revolution. Opposite the place occupied by the needle on the dial, the weight in kilogrammes applied to the end of the lever is marked. The lever is then unloaded, and the graduation continued.

After having tried several methods, M. Trouvé has adopted as a speed-counter an apparatus identical with that we have just described. The instrument employed by him is based upon the principle that in order to turn a rigid fan in the air it is always necessary to exert the same couple for the same angular velocity. This tachometer is shown at L in the figure.

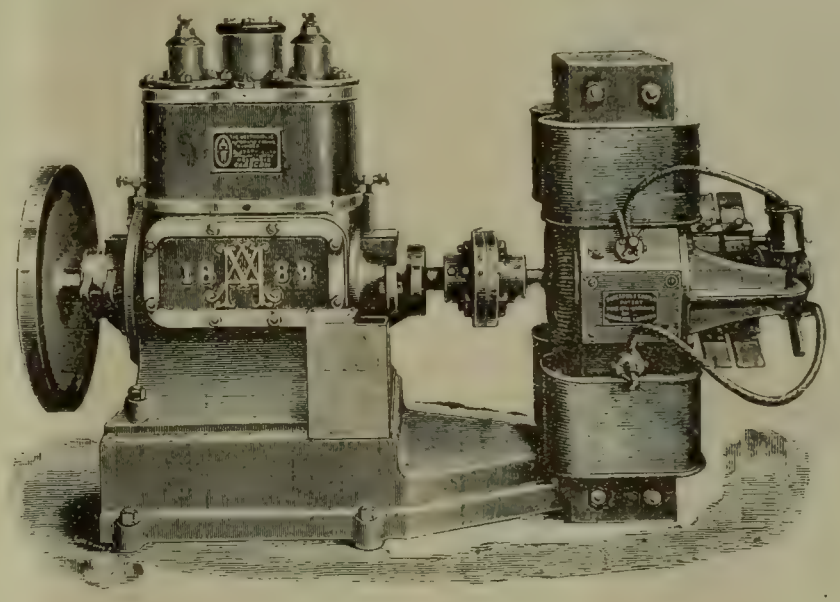
When the apparatus is used as an absorption dynamometer, one end is fixed to the motor by means of a Cardew coupling, and the other is connected to a fan of suitable size. A graduation of the dial such as described above will enable us to read off the couples exerted. By means of a speed-counter we can estimate the angular velocity which it is necessary to give to the apparatus in order that the same needle may indicate couples of 1, 2 and 3 kilogrammetres. The product of these two indications will give the power developed. We can, therefore, mark directly on the dial the value of the power developed in the case of a given fan. Three curves obtained once for all enable us by one single observation to determine the angular velocity, the couple exerted, and the product of these two, the power. By means of different fans we can vary the power absorbed between wide limits.

The simplicity of this transmission and absorption dynamometer is a guarantee of good working, and the altogether negligible friction of the measuring organs is a reason why the indications should be exact.

* From *L'Electricien*.

COMBINED DYNAMO AND ENGINE.

The following illustration is of the Combined Phoenix Dynamo and Westinghouse Engine made to Mr. Timmis's order, says the London *Electrical Review*, for the lighting, on his system, of the trains on the Central Argentine Railway. The dynamo made by Paterson and Cooper, is of the double magnet type, shunt-wound with four magnetizing coils. The cast iron bedplate, on which the engine sits, is prolonged to form a support for the wrought iron vertical magnet bars, which are 8 inches wide by 3½ inches thick. This bed also forms the bottom yoke, a block of cast iron being placed between the bars at the top to furnish the top one. A gun-metal bracket ties the bars together in the centre, and also forms the outer bearing. At 600 revolutions per minute the machine gives 85 ampères at a difference of potentials of 52 volts. The engine made by Alley and Maclellan, of Glasgow, is a "Westinghouse Special," having cylinders 4½ inches diam., and a stroke of 4 inches. The steam is derived from a locomotive boiler at a pressure of 120-140 lbs. per square inch. It will be observed that the combination is very neat and compact, and seems well adapted for the purpose intended.



COMBINED DYNAMO AND ENGINE.

THE FRITSCHE DYNAMO.—In some tests of this machine recently undertaken by Herr Uppenborn, he states that he ran an 8-pole machine, giving an average of 112 volts, 177 amperés at 180 to 182 revolutions for three hours, and found the rise in temperature of the armature to be 14.7° C., and in the field magnets 19.0° C.

ELECTRIC RAILWAY IN SWEDEN.—The first electric locomotive in Sweden has recently been imported from New York by the Wenström and Granström Electric Power Company at Arboga; it is intended for the Boxholm Electric Railway.

TELEGRAPHS IN THE DUTCH WEST INDIES.—The Dutch Government, say *Industries*, has impounded the caution money deposited by the Pedro Segundo Telegraph Cable Company, of New York, which has failed to carry out its contract for the laying of a cable, connecting Paramaribo, the capital of Surinam, with Cuba and Florida *via* Curaçoa. The same contract or a similar one, has now been undertaken by the Compagnie Française des Télégraphes Sousmarins, in Paris, against a Government subsidy of £2,000 per annum.

TELEGRAPH INTERRUPTIONS AT THE ANTIPODES.—One of the interruptions on the telegraph line connecting Port Darwin and Adelaide, Australia, during 1888, was caused by the theft of three poles and twenty miles of wire. On another occasion, a European got lost, so he cut the wire to bring the linemen to his rescue.

THE TUDOR ACCUMULATOR.—According to the *Electrotechnisches Echo*, the Allgemeine Elektricitäts Gesellschaft and Siemens and Halske intend to erect a factory for the manufacture of Tudor accumulators in connection with Müller and Einbeck, the present makers.

ALTERNATING CURRENT MOTOR.—At a recent *soirée* held by the Royal Society, London, a Thomson alternating current motor attracted considerable attention. It was actuated by a current generated by the Ferranti Alternator at the Deptford station.

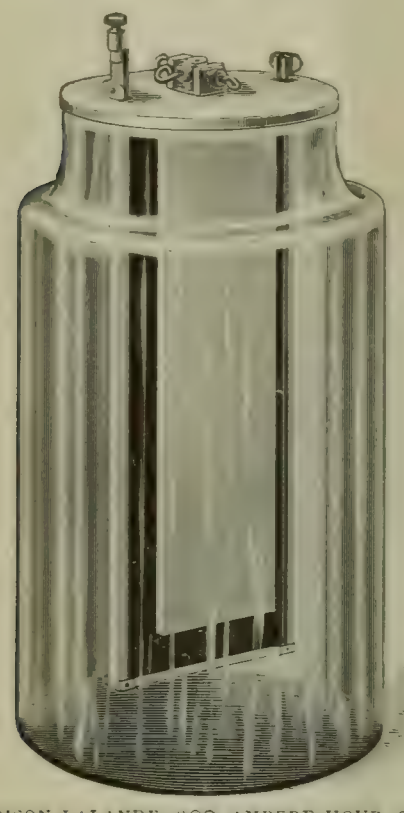
A DESTRUCTIVE FLASH.—During a recent storm at Playford, Suffolk, a poplar tree, about 300 yards away from the church, was struck by lightning, and the bark was completely stripped from top to bottom, the southern half of the body being riven into matchwood. One piece, 5½ lbs. in weight, was picked up 126 yards away from the tree, and the *debris* covered about two acres of land. The discharge left the tree at the foot, following the direction of a fence for about 15 or 20 feet, threw up a sod about a foot square, and went to earth.

TELEPHONIC COMMUNICATION BETWEEN BELGIUM AND GERMANY.—The Telegraph Departments of these two countries have again taken up the question of establishing telephonic communication between Brussels, Verviers, Aix-la-Chapelle and Cologne. In Belgium the wire has already been taken to Welkenraedt on the German frontier, and it only remains for the gap between Welkenraedt and Cologne to be bridged over in order to complete the line right through.

LIGHTNING.—Severe storms occurred in the southern part of Ohio and in West Virginia, June 30th. The lightning is described as being terrific. Three persons were killed by lightning. The head of one of the victims, a German, according to press despatches, was punctured by the lightning.

THE EDISON-LALANDE BATTERY.

The remarkable reputation for efficiency achieved by the Edison-Lalande battery is to be further extended in another direction. It is proposed to adopt the battery to lighting purposes in a small way. At the Edison Laboratory it was said that it was not intended that the battery should be used for general lighting purposes. The idea was simply to supply a small battery plant which would light small lamps, say of 3 candle power, for occasional use. Such a plant would be extremely useful in any house. A three candle power light gives an excellent reading light, and such lamps should find ready use for lighting such places as halls, closets, stables, etc. A small lamp could be placed in the front hall, and on coming home at night, by touching a button at the outside of the door the hall would be all lighted by the time entrance was effected. With such a lamp in the cellar theturning of a



EDISON-LALANDE 900 AMPERE-HOUR CELL.

switch at the head of the stairs would give sufficient light for all purposes. The same thing can be said of a similar light placed in a stable. By turning a button at the back door of the house, the stable would be lighted by the time it was reached. This application of the light commends itself strongly on account of safety and convenience. It is calculated that a plant of six 900 ampère-hour cells will give a years' service. This is an excellent showing, and places the battery next in rank to a dynamo. It is proposed to give these small plants the name of "emergency" light plants in order to distinguish them from the regular, or constant lights, which are maintained by dynamos. As already stated it is not intended to use the battery for large lights.

There exists a great demand for plants of this kind for domestic purposes, and a battery that will give light for a year, more or less, according to the length of time the lamps are kept burning, cannot fail to become popular and successful.

STATISTICS—The annual statistical report of the National Telephone Exchange Association this year will undoubtedly be of extraordinary interest and value. In sending out the blanks to members, containing the usual questions, General Barney, the secretary, calls attention to the addition of several questions relative to underground cables, conduits, etc. These latter statistics will add much to the value of the report.

HONOR CONFERRED.—Dr. J. A. Fleming of London, England, has been given a silver medal by the Society of Arts, for his recent paper on Professor Elihu Thomson's experiments.

SUIT AGAINST A SUBWAY COMPANY.

The North American Underground Telegraph and Electric Company has brought suit in the Supreme Court for $2,500,000 damages against the Consolidated Telegraph and Electrical Subway Company for the failure of the latter company to use a patent system of conduits owned by the plaintiff and to enforce an alleged contract to use them. The complaint alleges that when the wires were ordered underground the defendant corporation was formed and entered into an agreement with the Subway Commission to build the subways. Then, it is alleged, in March, 1888, the defendant entered into a sealed agreement with the plaintiff for the use and operation of the system which the plaintiff controlled, the plaintiff thereupon selling to the defendant the exclusive license to use in New York the plaintiff's patents. It is alleged that the use of the plaintiff's system was agreed on, and that in pursuance of one term of the covenant William H. Johnston, the Vice-President of the plaintiff corporation, was elected a director of the defendant company.

The latter company, it is alleged, built and operated a number of miles of subways on this system, and then, without notice to the plaintiff, suspended this work, though the subways laid were and are still in successful operation. This stoppage and the adoption of another system, the plaintiff alleges, was due to the Western Union Telegraph Company and the American Bell Telephone Company. They owned a controlling interest in the Metropolitan Telephone Company, and that company "is the apparent owner of a large majority of the capital stock of the Subway Company." The complaint alleges that the Western Union and the Bell Company, having vast interests in overhead wires, were opposed to any effective system of subways, and so shut down on the plaintiff's system and began laying worthless and impracticable conduits.

The complaint has been served upon Theodore N. Vail, the President of the Subway Company, and upon D. Morgan Hildreth, Jr., President of the New York Underground Telegraph Company, which is joined as a defendant because, holding certain franchises, it became a party to the alleged agreement with the plaintiff.

Mr. Edward Lauterbach, Counsel for the Western Union, said that he had casually examined the papers, but they hadn't interested him. "We gave up that system of conduits," he said, "because we found a better conduit. We act under the advice of the electrical experts of the city. Our contract with the North American Company permits us to use their system at our pleasure. We were at liberty to stop using it when we saw fit to do so, and we are free to resume it if necessary. As to the idea that the Western Union Company doesn't want the subway system to be successful, that is not worthy of serious consideration. The Western Union Company has most of its wires on the elevated railroad structure, and is not bothered much with the subway question, although I think it approves subways. In truth, the underground system is generally approved now, because after the plant is once established it is cheaper than the overhead method."

VISUAL TELEGRAPHY.—A despatch from London to a New York daily paper tells a rather remarkable story. "The English scientific world is much excited," the despatch reads, "over an invention purporting to be a remarkable instrument solving the problem of visual telegraphy. It is the joint production of Prof. Hughes, F.R.S., and W. H. Preece, F.R.S. On the occasion of the post office jubilee reception at South Kensington Museum, July 2d, the instrument was exhibited before a number of scientists and newspaper men, all of whom are most cordial in its praise. The inventors said they had discovered a machine by which the sender of a message from a distant station could, with the assistance of the telephone, not only speak with the receiver at the other end of the line, but appear in reflection before him, and, in effect, this is exactly what happened on the occasion mentioned. The facts, however, are startling. Electricity has nothing to do with the matter. The picture of the telephoning was not reproduced by means of a telegraph wire; but a series of mirrors had been cunningly arranged on the principle of the old optical illusion business, which reproduces the features of a person standing behind a brick wall, for instance. By means of similar mirrors the sender appeared before the receiver, and newspaper men and scientists were fooled. That such an imposition should have been played upon the scientific world and the British public by the authorities of the South Kensington Museum is a disgrace to British science, and when the fraud is discovered there will be a row. The machine was exhibited to the Duke and Duchess of Edinburgh, the imposture being well maintained. To show how completely the audience were taken in by the fraud, all the unscientific and most of the scientific departed declaring that the electro-phonoscope was the most marvellous discovery of the age.

NON-MAGNETIC WATCHES.

The Paillard Non-Magnetic Watch Company was organized for the purpose of continuing the manufacture and sale of non-magnetic watches, containing Paillard's inventions, which was suspended last February by the dissolution of the Non-Magnetic Watch Company, of America. The Paillard Non-Magnetic Watch Company is in reality the successor to the Non-Magnetic Watch Company. The new company has purchased from the makers the movements in process of manufacture at the time of the suspension of the old company, and has acquired the manufacturing facilities formerly possessed by that company. The movements to be placed on the market by the Paillard Non-Magnetic Watch Company will be manufactured in the same factories and in every respect will be the same as those heretofore sold by the Non-Magnetic Watch Company. The new company promises to add new grades of their goods from time to time. The reputation Paillard's non-magnetic watches have already attained may be taken as a



PAILLARD NON-MAGNETIC WATCH MOVEMENT.

sure indication that the new company has a bright future before it. Electricians, and others in the electrical business, will appreciate the value of these watches, for there is nothing so annoying as to have a magnetized watch, which, of course, keeps very irregular time. Without some protection against the detrimental influence of electric currents on watches, such as this company provides, it is impossible to prevent a watch from becoming magnetized. It would be to the advantage of every one engaged in electrical pursuits to look into the merits of these watches. They cost no more than watches of equal grades of other makes, and can be had of any first-class jeweler. The company warrants every movement.

The Paillard Non-Magnetic Watch Company are the licensees, under the Paillard patents and no other concern has the right to use them. The company's headquarters are in the Corbin's Building, corner Broadway and John street.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, July 12, 1890.

MR. FRANK B. RAE, OF DETROIT, was in the city this week on business connected with his Electric Railway System, and, in company with Mr. Paul W. Bostwick, the Kansas City representative of the Rae System, visited the Chicago Electric Club.

CHICAGO ELECTRIC CLUB. At a meeting of the Board of Managers, this week, Mr. Harry R. Noyes was appointed Manager of the club in the place of Mr. L. W. Collins, resigned. Mr. Noyes is recently of Boston, and is to be congratulated on his choice of the Columbian Exposition City for his future home.

THE WESTERN POWER CONSTRUCTION COMPANY closed contracts for 300 horse power steam plants for the week ending July 5th, and feel confident of continued success. The McIntosh & Seymour engine which they represent in the West, is endorsed by some of the leading lighting companies.

WESTINGHOUSE-PULLMAN COMBINATION. It is rumored from reliable sources that the ground is about to be broken at Pullman, Ill., for the erection of a large factory for the manufacture of electrical equipments for street cars by the Westinghouse company. The location of the great Pullman works at this place and the reported combination of the interests of these companies gives strength to the rumor.

THE HALL SIGNAL COMPANY have elegantly furnished offices at No. 340 Rookery Building, Chicago, where they have installed a complete model plant designed to display to railway superintendents and others interested in the valuable features of their automatic block signal, switch signal, and station signal systems. Mr. Alvah W. Hall, general manager of the company, is at present making his headquarters at the Western office, establishing this system in the West.

Mr. W. R. MOLINARD, of the Baxter Electric Motor Company, is spending some time in this city in the interests of his company. Together with Mr. Cone, western agent for the Baxter company, all motors of this make previously installed in the city have been inspected, and with satisfactory results. A good arc motor is becoming more and more of a demand and under the able direction of Mr. Cone the interests of the Baxter company are not likely to suffer in this section of the country.

MR. L. W. COLLINS has resigned his position as Manager of the Chicago Electric Club to accept a prominent position with the Electrician's Time Company, 416 Stock Exchange Building, a company recently organized in this city with some prominent electrical names at its head. Mr. Collins has been manager of the club for about a year, and prior to that was connected with the *Western Electrician* of this city. In both positions he has made many friends, who wish him success in his new position.

THE WESTINGHOUSE RAILWAY INTERESTS are now represented in this city by Mr. J. L. Barclay, and a corps of assistants, handsome offices having been opened on the ground floor of the Pullman Building. The success attained by the Westinghouse Company in the few months they have been pushing their electric railway interests is remarkable. Mr. Barclay reports contracts closed for twenty roads already, two different roads being equipped in each of three cities. Their first cars were started in Pittsburg on July 4th, and have since been running without a break.

F. M. I.

BOOKS.—All electrical books are for sale by the ELECTRIC AGE PUBLISHING COMPANY, 5 Dey street, New York. Send for catalogue.

NEW YORK NOTES.

Mr. Jas F. Kelly, of the Edison Machine Works, reports large sales of their new solid rubber core wire, which they have recently placed on the market.

The Edison General Electric Company have temporarily moved their office from 65 Fifth avenue to 16 Broad street, until the completion of their new and handsome building, now being erected at 44 Broad street.

The Imperial Hotel, now being erected at 33d street and Broadway, is run with the Interior Conduit and Insulation Company's conduit, and will be, when completed, one of the finest hotels in the city. The wiring of this building is perfect in every respect.

Mr. J. D. Rockefeller's elegant house, barns, grounds, etc., on the banks of the Hudson river, at Tarrytown, are lighted by electricity and the plant, which is probably the most complete and extensive private plant in the world, cost $150,000. The entire estate is covered with a net work of undergrouud wires. Mr. Rockefeller can, by turning a button in his library, illuminate the beautiful grounds, acres in extent. The lights are disposed among the trees and foliage with great artistic taste, and the effect of the unique illumination is indescribable. It must be seen to be appreciated, words can convey no idea of the reality. The entire place, buildings and grounds, is run with the tubing of the Interior Conduit and Insulating Company. The wires being run in these tubes renders accidental fire impossible.

Absolute safety was the main object in view when this plant was installed, and this is secured by the use of these conduits. The only other private plant comparable with this one is that of Blenheim Palace, England, which cost $100,000. Compared with Mr. Rockefeller's wonderful installation however, it becomes somewhat dwarfed.

R. J. G.

A NEW AND VALUABLE BOOK.

THE ELECTRIC RAILWAY OF TO DAY, is the title of a neat little book just published, by H. B. Prindle, of Boston, Mass. It is a popular treatise on the Electric Railway, and is written in a clear and comprehensive manner so that it is easy for any one not familiar with the technicalities of electricity to understand its application to electric railways and their operation. It is very well illustrated, and views are given of cars in operation on electric roads in various cities. The book is the best of the kind ever published. It does not go into details, but describes the operation of electric roads and the apparatus used therefor sufficiently to give a good understanding of the subject. Every one inclined to learn about the operation of electric roads should possess a copy of this excellent little book. The price is but 50 cents, and the information it contains is worth a hundred times that amount to any one who is not familiar with the subject. Copies can be procured at the office of the ELECTRIC AGE, 5 Dey street, New York.

DYNAMOS FOR CHARGING ACCUMULATORS.—The best dynamo for charging storage batteries is the shunt dynamo. Compound or series self exciting dynamos are not so well adapted. The electromotive-force of the dynamo must be higher than the maximum e. m. f. of the battery when being charged. This electromotive force is about 2.5 volts per cell. To charge, for instance, 30 cells connected in series, it would require a dynamo with a maximum electro-motive force of a least 75 volts (30x2.5). The electro-motive force of the cells gradually increases when they are being charged. A rheostat should be connected in the field of the shunt dynamo to regulate the strength of the charging current.

OF INTEREST TO PATENTEES.

Commissioner of Patents Mitchell has decided in the case of the application for patent on an electric heater by Thomas J. Donovan, that an applicant cannot be held to have complied with the requirements of Rule 75, when he merely avers that he conceived the invention and disclosed it to others, without stating by what agency the disclosure was made and the details of which it consisted. The mere statement that he disclosed the invention is of no avail, either to constitute evidence of disclosure or to impart sufficiency to a statement of facts in themselves inadequate.

If sketches or models of the invention were made, applicant should so state, and produce and describe them ; if made and lost and their contents remembered, they should be reproduced and furnished in place of the originals. If neither sketches nor models are relied upon, but it is claimed that verbal disclosures were made, the witness should state as nearly as possible the language used in imparting knowledge of the invention to others.

When claims are rejected upon references and facts are submitted tending to show completed invention by the applicant at an earlier date than the references, the question of novelty is presented. The Office says that a patent should not be granted for want of novelty, and this applicant denies and presents the proof upon which he relies. Upon such a question applicant is entitled to the judgment in turn of the Examiners-in-Chief, the Commissioner, and the Supreme Court of the District of Columbia. No sound principle can justify the practice of deflecting that particular inquiry from the main current of discussion and decision relating to the merits of the application, which lawfully terminates only with the decree of the Supreme Court of the District.

If the Examiner be of opinion that the affidavit is insufficient, he should reject for such reason. No appeal, however, should be taken until final rejection has been had upon all the grounds relied upon by the Examiner for refusing patent.

Rule 75 provides for avoiding a reference to a domestic patent by making oath showing a completion of the invention in this country before the filing of the application upon which the patent is issued.

COUNTER SUIT.—Cassius H. Read and his partner, E. J. Stokes, served on June 28th upon counsel for John W. Mackay, President, and Hector de Castro, Vice-President of the Commercial Cable Company, a summons and complaint in an action to recover $75,000 alleged to be due them on the sale of land and other securities. This is the counter suit which Mr. Stokes brings in response to Mr. Mackay's recent suit to recover $350,000 which he claimed Read and Stokes owed him.

PATENTS.—The test of all patents is their adaptability to general use, and, if they reach into our daily needs, it is easy to see how a small profit on a single article would yield a fortune. Every patent depends as to novelty or utility on the state of the art at the time claim is made.

A PARADOX.—"Why don't the health authorities take the electric wire matter in hand," said Mrs. Knolittle, as she glanced from her paper. "I've just been reading of the companies burying live wires and allowing the dead wires to remain unburied."

ELECTRIC HEATERS.—Tests with an electric heater, says an exchange, show that with a current of nine ampéres, coffee could be boiled or meats roasted as well as on an ordinary stove. After the liquid had come to a boil it could be kept at that point indefinitely, with but half the current first required. Heating by electricity has great advantages over every other form, and when the electric companies are prepared to furnish the current cheaply enough it will come into general use.

FORTY PER CENT. SAVING IN FUEL.

Continued from page 3.

the engine within one per cent. for all changes of load and pressure from zero to full load.

Like the High Pressure Engine, the Compound is of the double crank class with two over hanging wheels, making it entirely self contained. The workmanship and materials used throughout are simply the very best that can be obtained, and each engine is subjected to a most exhaustive test before leaving the shops.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
ROOM 10, COOK BUILDING,
BOSTON, July 12, 1890.

A survey for a new electric line from Waterbury, Conn. to Naugatuck is being made.

A company has been formed in Wakefield for the establishment of an electric street railway to run between there and Stoneham.

The East Hartford and Glastonbury Electric Railroad Company will be petitioned for an extension of its lines to South Glastonbury.

Plans for the Newburyport and Amesbury Railway Company's electric plant have been prepared and contractors are now figuring on the same.

The Newton Aldermen have received petitions from 108 Newton Centre residents, praying for the locations petitioned for to some street railway company between Newton Centre and Newtonville.

The Garden City Electric Street Railway Company have signified their desire to relinquish from their petition for track locations those portions remonstrated against by Newton Highland residents.

The city government of Worcester and the electric light company have agreed upon a three years' contract for street lighting at 40 cents per night per light of 2,000 candle power. The old rate was 55 cents.

S. E. Barton and Captain William Brophy announce that they are prepared to place insurance on all kinds of property. Electric stations eligible to the Electric Mutual Insurance Company will be placed in that company.

The Standard Electric Supply Company has been formed with a capital of $10,000. This company have established spacious headquartes at 180 Summer street, and propose to deal in electric light and railway supplies.

The trustees of the Thomson-Houston pooled stock will very shortly issue a circular to the Thomson-Houston stockholders. Just what it will be is not stated, but it is good opinion that an extension of time will be asked.

An explosion caused by a leak from the gas mains on which men were at work, occurred in one of the man-holes of the New England Telephone and Telegraph Co. on LaGrange Street last Tuesday. One man was injured but not seriously.

The Pulsion Telephone Company are doing a rushing business. Last month they erected and leased forty three lines, at an average yearly rental of twenty dollars each. This company do not sell their lines or instruments, but erect and maintain them for a small yearly rental.

The Malden Electric Light Company held its annual meeting July 2d and voted to increase its capital from $100,000 to $150,000. It re-elected its old board of directors John S. Bartlett, H. A. Royce and J. N. Smith. The usual quarterly dividend of 2 per cent. was declared, payable July 15.

The Brown Electric Protector Company are doing a rushing business and are way behind their orders. This protector is rapidly being adopted by railroads for the protection of their telegraph lines, also by general users of telephone and all electrical instruments that need protection.

The American Wheel Co., of Chicago, has heretofore sold its wheels without tires, but will hereafter tire all wheels before sending them out, using the electric welding process. This will bring the Thomson Electric Welding Company a revenue from royalties on at least 1,000,000 welds annually.

A new electric lighting plant is being erected at River Point, R. I., near Providence, and will soon be completed. The engine which was to run the plant was placed on its foundation Monday, and as soon as it has been set up and cleaned, work will be begun setting the two Edison dynamos, which will furnish the electricity.

The Johnston Train Signal Company will commence operations at their factory in Woburn in a short time. The factory has been thouroughly equipped with the best of tools and the finest machinery and a corps of first-class mechanics will be employed. This company propose to manufacture all kinds of electrical apparatus as well as their own specialty.

At a meeting of the Gloucester board of aldermen held last Tuesday night, a petition from the Gloucester Co. to allow it to erect poles not less than 25 feet above the ground, instead of 45 feet, as provided in a previous order, was referred to the committee on street lights. The corporate bonds of the Gloucester Electric Company, $7,000, and the Gloucester Street Railway Company, $10,000, to hold the city harmless, were referred to the city solicitor.

The largest transfer in money that was ever made in Attleboro was made last week, when $90,000 changed hands. Two heavy owners in the electric street railway wanted the presidency of the company. To get this one man proceeded to get hold of the controlling shares of the stock. The other man heard of the deal and went to work to hold his own in the race. He raised $90,000. This sum saved the day and gave its holder the office.

A meeting of the Rockland Electric Light and Power Company was held last Monday evening in Odd Fellows' Hall. About twenty of the thirty-two subscribers were present. The question of an appeal to the gas commissioners regarding the granting of the franchise to the Abbington and Rockland Company was discussed, and it was voted that an appeal be made from the decision of the Selectmen.

The Pittsfield Electric Light Company was organized Monday, with a capital stock of $100,000, and these officers: President, Alexander Kennedy; Treasurer, W. A. Whittlesey; Clerk, W. L. Adam; Directors, William Stanley Jr., W. R. Plunkett, C. C. E. Merrill and the President and Treasurer. The company has arranged to buy up both existing companies, thus controlling the electric light system, and will furnish light, power and heat. It will erect a fine new building and equip it with improved machinery.

Last Thusday afternoon, Assistant Superintendent Dresser, of the New England Telephone and Telegraph Company, went to Quincy with a gang of men and cut down the feed wire of the Manet Street Railway Company which had been strung on the telephone company's poles. The railway company applied to the city council last Monday evening for the right to string wires, but no privilege has as yet been granted. The statute provides that telephone companies should be given a hearing in such cases where the town or city authorities give a right to other parties to string wires on their poles, and it now looks as though the street railway company will meet with delay in opening their road.

The Belt Line Street Railroad in Lynn was formally opened last Monday, and a large number of prominent men, by invitation of President Quincy A. Towns, made a trial trip. Four cars were brought into use, and, on reaching the power house at the corner of Eastern and Western avenues, a stop was made and the works inspected. The plant is one of the best equipped of any electric railroad in the State, and the cars run through one of the most picturesque districts in the city. After the works had been inspected, refreshments were served at the car house, and President Town made a speech of welcome.

There is a lively fight going on at Augusta, Me., between the managers of the new electric road on one side and the telephone people on the other, which has resulted in a temporary injunction being placed on the new railroad, which will seriously delay them in getting their road in running order. The hearing will not take place until July 18, and until then the cars cannot be started, and perhaps not then. It is now past the time when the road was advertised to be in operation. The telephone people have been planting their posts in the middle of the track and the electric car men have been cutting them down as fast as put up. Neither side proposed to yield a peg until obliged to do so by the strong arm of the law.

W. J. P.

ON A BALLISTIC ELECTROMETER.*

The quadrant electrometer can be used ballistically if the usual damping arrangement is removed, and the needle suspended by a conducting wire. The impulse given to the needle by a moment M acting for a very short time is equal to $\int M\,dt$; and as M may be made proportional either to V or V^2, where V is the potential difference between the quadrants, it thus becomes possible to measure $\int V\,dt$ and $\int V^2\,dt$. Thus if the needle is charged to a high constant potential, the magnitude of the first swing is proportional to $\int V\,dt$; and if the quadrants are connected with the two terminals of a resistance R through which a quantity Q of electricity passes in a very short time it is easy to see that whatever the self-induction of the resistance R

$$\int V\,dt = R\,Q$$

This formula has been practically tested with a Mascart electro-meter, whose needle was suspended with a platinum wire 0.02 mm. in diameter, and charged to a potential of 300 volts. With this instrument a discharge of one microcoulomb through a megohm gave a deflection of 130 mm. on a scale two metres off, the period of the oscillations being 11.6 seconds. It is necessary that the capacity of the condenser used for the discharge should not be too high, or the time taken for the discharge will prevent the electrometer acting ballistically. The action is, however, satisfactory if the product of the capacity in microfarads and the resistance in megohms does not exceed $\frac{1}{5}$th.

In this way large resistances may be conveniently measured, and, as very small quantites of electricity are used, the method is especially suitable for liquid resistances, where difficulties usually arise from polarization. If, instead of Q being known, R is known, the method is one for measuring electrical quantity; and the electrometer thus does the duty of a ballistic galvanometer. The sensibility may, however, be made very great by giving a high value to R. By a suitable modification of the method, condensers of widely different capacities may be compared, and by connecting the needle to one pair of quadrants the electrometer may be used as a ballistic electro-dynamometer.

ANOTHER ELECTRIC RAILWAY OPENED.—The electric railway between Seneca Falls and Waterloo was opened July 11th. The cars ran from the start without stop or hitch. The power is furnished by water at Seneca Falls.

Abstract from a Paper by M. Gouy, *Comptes Rendus*, June 2, 1890.

ELECTRICITY IN THUNDER STORMS.

In a communication to *Science* on the subject of thunder-storms, H. A. Hazen advances a plausible theory regarding their origin.

It has been my purpose for many years, he says, to avoid, as much as possible, all speculations in considering air motions and the causes of atmospheric phenomena. This is especially pertinent when we consider electric action in the atmosphere. It is very difficult to believe that electricity has nothing to do with our thunder-storms, and is merely a result, and never a cause. The fact that physicists have never yet been able to account for more than the smallest fraction of atmospheric electricity should lead us to greater diligence in determining its methods. We know from observation that the electric potential is enormously increased as we ascend in the atmosphere. That little or no connection between atmospheric electricity and storms has been observed by our instruments near the earth is not remarkable, since the earth and air just above it may neutralize all electric action for a hundred feet or more. Our thunder-storms seem to show an enormous storehouse of electricity at five thousand or six thousand feet above the earth; at least, electricity seems to be concentrated there over thousands of square miles during thunder-storm action. We are taught that electricity forms a sort of dual condition, or the electric field is a double one. May not this electric field draw on the sun for its energy? It is believed that light, heat, and electricity are all different manifestations of the same radiant energy. The abundant source of this energy is the sun. Why may not the sun's electricity, oftentimes observed by its direct effect on our magnetic instruments, and more often still indirectly in our auroras, be intercepted by a peculiar condition of the atmosphere or of the earth below, and thus be concentrated in particular localities? Generally this electricity passes through the air to the earth, but must we think that it always does so? May not this electric field or dual condition gradually develop in the atmosphere largely independent of the passage of air-particles through wind or convection currents?

For convenience it has been generally considered that particles have a tendency to leave the positive and pass to the negative pole. For example: in the electric arc light the carbon at the negative pole is built up at the expense of the positive. The velocity of transmission of these carbon particles perhaps cannot be determined, but it must be only a very small fraction of that of electricity, 190,000 miles per second. Is there any inherent improbability in the supposition that in this dual condition in the atmosphere there is a tendency for moisture and possibly dust particles, positively electrified, to pass rather rapidly from the positive pole, or better, positive portion of the electric field, to the negative portion? We know from observation that during the passage of a high area or clear sky the electric potential, with very few exceptions, becomes markedly positive, while during the fall of rain it is negative. While a thunder-storm is passing, there are most violent fluctuations of the electrometer-needle from negative to positive and back again, as each flash of lightning is noticed. These fluctuations of the needle are perhaps 100 times as great as under ordinary conditions of rainfall, and take place when the flash is a mile or two away, showing a most extraordinary inductive action upon the atmosphere, and for enormous distances. We have positive evidence of such transmission of moisture-particles by a force entirely distinct from heat, pressure, or any other commonly recognized meteorologic condition. It is known that the moisture in the air is one of the most constant elements we have to deal with. The temperature may rise and fall thirty or forty degrees during the day, and yet the quantity of vapor is in no wise changed. The wind, either in direction or velocity, does not change this moisture. The hiding of the sun's heat or light in no wise affects it. Changes in air-pressure produce no effect in general. As a storm approaches, however, we find a most marked increase in this moisture over thousands of square miles, and this even in a calm. As a storm passes off, the conditions are sharply reversed. The moisture becomes depleted in a most remarkable manner, as though it were actually drawn out of the atmosphere by an invisible agency.

The most remarkable example of such action was observed on Dec. 22, 1889, from a third story window of a house in Washington. It will be seen that the conditions were not favorable for observing this effect at its best. At 3.11 P. M. there were 4.09 grains per cubic foot, and for more than twenty-four hours previous there had been an abundance of moisture from a storm passing near by. The air was almost a calm, and continued so till nightfall. At 5.02 P. M., or one hundred and eleven minutes later, there was only 1.04 grain per cubic foot, and this continued as long as observed. To any one who has made determinations of the moisture of the air, and noted its great constancy, frequently for several days, this sudden subtraction must be very extraordinary. If such changes are possible near the earth, and in the centre of a large city with houses for more than a mile on all sides, what may we not expect to take place in the free air, where there are no interferences, and where we know that such forces are acting in far greater intensity than near the earth?

NEW BOOKS.

EXPERIMENTAL ELECTRICITY.—By Edward Trevert, Bubier Publishing Company, Lynn, Mass. 164 pages, Illustrated. Price $1.00.

This little book gives, in a simple way, practical directions for performing some easy and interesting experiments in electricity; also for making some electrical apparatus by which considerable practical information may be obtained on the subject. Its contents by chapters are: 1. Some easy Experiments in Electricity and Magnetism; 2. How to Make Electric Batteries; 3. How to Make a Galvanometer; 4. How to Make an Induction Coil; 5. How to Make an Electric Bell; 6. How to Make a Magneto Machine; 7. How to Make a Telegraph Instrument; 8. How to Make an Electric Motor; 9. How to Make a Dynamo; 10. Electric Gas Lighting and Bell Fitting—Some Practical Information for Amateurs; 11. Some Information in Regard to Electric Lamps; 12. Glossary of Electric Terms. The subjects are liberally illustrated, many of the cuts being original, giving the dimensions of parts, etc. The book no doubt will find a large sale among amateurs and students, for whom it was especially gotten up.

ELECTRIC WIRE RAILWAY.—According to the *La Plata Zeitung*, an electric overhead wire railway for the transport of letters between Buenos Ayres and Montevideo is to be put in operation this month. A company has undertaken to erect two overhead wires a distance of 186 miles, so that travelling letter boxes may be despatched every two hours from the capital of Uruguay to that of Argentine. At the La Plata estuary, which is about nineteen miles wide, the wires will be supported on each side of the river by two towers eighty-seven yards high.

OF INTEREST TO WHEELMEN.—The recent acquisition of the stock of the Weed Sewing Machine Company, by Colonel Pope, President of the Pope Manufacturing Co., marks a new era in the bicycle trade. There can be no doubt but that, with increased facilities, this well-known company will surpass all their former record, and wheelmen will look eagerly to learn what they will put out for 1891. In this connection it may be said that the Colonel's liberal policy toward the stockholders of the Weed Company is the same which has always characterized all his dealings, and has won for him hosts of friends.

PHONOGRAPH MUSIC ON TAP.

The Edison Phonograph Works at Orange, N. J., are busy getting out "nickel in the slot" phonographs. This device will do more for the popularity of the phonograph than could be accomplished by any other means. It is proposed to put them in all public places, and in this way thousands of people who never before heard a phonograph will have the opportunity of doing so. The weight of the coin in the slot will operate mechanism which will carry the diaphragm back to the starting point on the cylinder, and will also set the phonograph in motion. When the end of the wax cylinder has been reached the operation of the mechanism will cease until another nickel has been inserted in the slot. Then the same process will be repeated.

TALKING DOLLS.—Great improvements have been made at the Edison Phonograph Works, Orange, N. J., in the internal mechanism of the phonographic talking dolls.

The first dolls turned out were rather frail and had to be delicately handled in order that the reproducing mechanism should not become dislodged. This difficulty has been entirely overcome, and the new dolls will bear the same amount of handling that dolls usually get.

COST OF TRANSMITTING POWER.—The following comparisons of cost of transmission of power by various methods appeared in the *Revue Universelle des Mines*: 1. Comparative cost on 10 horse-power transmitted 1,093 yards: By cables, 1.77 per effective horse-power per hour; by electricity, 2.21; by hydraulics, 2.90; by compressed air, 2.98. 2. Comparative cost on 50 horse-power transmitted 1,093 yards: By cables, 1.35 per effective horse-power per hour; by hydraulics, 1.87; by electricity, 2.07; by compressed air, 2.29. 3. Comparative cost on 10 effective horse-power transmitted 5,465 yards: By electricity, 2.64 per effective horse-power per hour; by compressed air, 4.66; by cables, 4.69; by hydraulics, 5.29. 4. Comparative cost on 50 effective horse power transmitted 5,465 yards: By electricity, 2.37 per effective horse-power per hour; by cables, 2.65; by compressed air, 2.99; by hydraulics, 3.02. Steam was the prime mover used in each of the above instances, and it appears that for long distances, electricity takes the lead in economy over all other systems. It has also a great advantage in the facility with which the power may be subdivided, and there appears to be no doubt that in future coal mining, electricity will be much used for coal cutting, tunnelling, hauling, pumping, etc., as well as for lighting.

WEST END RAILWAY COMPANY'S NEW POWER STATION.—The new central power station of the West End Railway Company, Boston, will consist of a power house and boiler room. The former will be 319x173 feet, built of brick and granite. In this building will be 13 triple expansion engines of 1,000 horse power each, and a 300 horse power compound engine for use in the early morning hours, when the number of cars upon the tracks is limited. The boiler house will be 163x84 feet, and it will contain 24 boilers rated at 500 horse power each, and set in batteries of two boilers each. The massive foundations for the large engines and the chimney are well under way, and it is expected to have the station completed by next fall. Six of the 1,000 horse power engines will be put in as soon as the station is ready for their reception, and one half of the boilers will be placed at once.

TELEGRAPHIC INSTRUCTION IN THE BRITISH NAVY.—At the close of the summer manœuvres of the English navy, the torpedo depot ship *Hecla* will be converted into a telegraph instruction vessel, and a school for naval signalmen established on board. When serving with the Mediterranean squadron some time since, the *Hecla* was made use of as a school for telegraphy, and over fifty men passed in this important subject.

ANSWERS TO INQUIRIES.

Editor of THE ELECTRIC AGE: Will you please inform me through the columns of your valuable paper, what would be the maximum current I could with safety use on No. 14, B. W. G. wire? I am wiring my house with wire of that gauge, and would like to know what quantity of current it will stand.

Haverhill, Mass. "ELECTRIC."

Answer.—No. 14 wire will carry with safety 24 ampères of current. Copper is assumed to be the material of your wire.—Ed. ELECTRIC AGE.

"A student" asks what is a "dead beat" galvanometer.

Answer—It is a galvanometer provided with certain devices to bring the needle quickly to rest, instead of swinging to and fro. This method of stopping the oscillations of the needle is sometimes called "damping."—Ed. ELECTRIC AGE.

Editor of THE ELECTRIC AGE: I have read about dead wire on dynamo armatures. What does this mean?

Baton Rouge, La. RALPH MITCHELL.

Answer—Dead wire means that portion of the wire on the armature which produces no useful current when passing through the magnetic field.

"Sagamore"—We think that Atkinson's "Elements of Electric Lighting" will answer your purpose. It is the best low-priced book on that subject. We can send you a copy by mail. Price, $1.50.—ED. ELECTRIC AGE.

Editor ELECTRIC AGE: What is the electrical resistance of the human body?

Buffalo. M. D.

Answer—That is a difficult question to answer. There are really no accurate data as to the resistance of the human body. Experiments have, however, been made in this direction with varying results. Wolfenden found the resistance in fifty healthy persons, measured under exactly similar conditions, to vary from 4,000 to 5,0 ohms. A good deal depends on the pathologic or other condition of the parts acted upon. Th skin offers the chief resistance In some cas of diseased persons the resistance goes as high 8,000 ohms, while in one case as low as 350 ohm was noted.—ED. ELECTRIC AGE.

"Cape May" is informed that Professor Hen produced induced currents of the seventh orde that is, the primary current was made to indu a secondary, the second a tertiary, the third fourth, and so on up to the seventh.—ED. ELE TRIC AGE.

"Franklin"—Edison is the inventor of th three wire system of electric lighting. The sy tem effects a great saving in copper wire.—E ELECTRIC AGE.

HONORS TO M. GRAMME.—The Société d'E couragement has awarded the Ampére medal t M. Gramme.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED JULY 8, 1890.

431,551. Electric Ceiling Block. Waldo C. Bryant, Bridgeport, Conn. Filed May 15, 1890.

431,559. Magneto-Electric Machine. Arthur E. Colgate, New York, N. Y., assignor to F. G. Otto & Sons, same place. Filed Mar. 27, 1890.

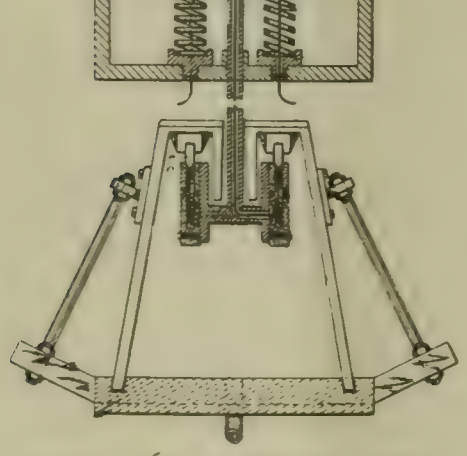
431,564. Apparatus for Cutting Electrical Conduit Pipes. Sylvester P. Denison, Brooklyn, N. Y., assignor to George R. Thompson, Philadelphia, Pa. Filed Aug. 10, 1889.

431,565. System of Defending Harbors by Submarine Torpedoes. Alexander G. Donnelly, New York, N. Y., assignor of one-half to Alden Solmans, South Norwalk, Conn. Filed Mar. 26, 1889.

431,597. Electric Signaling Apparatus. Geoffrey B. Lehy, Medford, Mass. Filed May 21, 1889.

431,598. Signaling Apparatus. Geoffrey B. Lehy, Medford, Mass. Filed Dec. 24, 1889.

431,617. Apparatus for Preparing Electric Accumulator Plates. Charles F. Pollak, Paris, France. Filed Nov. 14, 1889. Patented in France May 9, 1888; in Germany Dec. 28, 1888, and in England May 3, 1889.



NO. 431,634.—ELECTRIC RAILWAY.

431,618. Regulator for Dynamo-Electric Machines. Gustavus A. Polson, New York, N. Y. assignor of one-half to Samuel Carey, same place. Filed Dec. 4, 1889.

431,630. Conduit. Thomas Wallace, New York, N. Y. Filed June 27, 1889.

431,633. Conduit for Electric Railways. Joseph H. Wehrle, Newark. N. J. Filed Sep. 28, 1889.

431,634. Electric Railway. Joseph H. Wehrle, Newark, N. J. Filed Oct. 9, 1889.

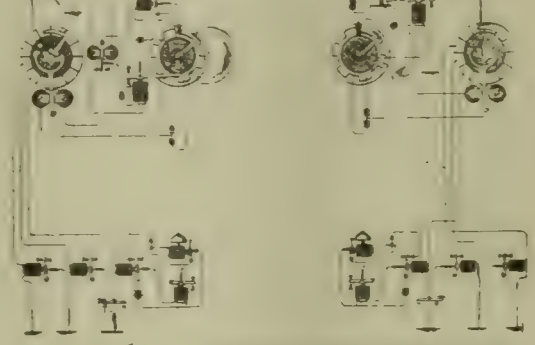
431,649. Electric Motor Apparatus. Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Gas Improvement Co., same place. Filed Apr. 11, 1890.

431,651. Private Line Telegraphy. Patrick B. Delany, South Orange, N. J. Filed Feb. 21, 1890

431,671. Signaling Apparatus. James H. McCartney, Rochester, N. Y. Filed Aug. 31, 1889

431,681. Incandescent Lamp Socket. James J. Wood, Brooklyn, N. Y. Filed Dec. 14, 1887.

431,684. Trolley Pole Supporting System. Johan M. Andersen, Boston. Mass. Filed Apr. 11, 1890.



NO. 431,651.—PRIVATE LINE TELEGRAPHY.

431,711. Electric Railway. Sidney H. Short, Cleveland, Ohio. Filed Oct. 29, 1889.

431,718. Thermal Cut-Out. Lorenzo B. Favor, Bridgeport, Conn., assignor to the Thermal Electric Company, of Maine. Filed Apr. 14, 1890

431,720. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Filed Jan. 26, 1887.

431,721. Means for Attaching and Detaching Electric Lamp Bulbs. Solomon J. Jacobs, New York, N. Y. Filed Feb. 24, 1890.

431,742. Galvanic Battery. Charles R. Goodwin, Paris, France, assignor to the Electric Gas Lighting Co., Boston, Mass. Filed May 14, 1889. Patented in France Sept. 9, 1885; in Belgium Feb. 20, 1886, and in England Feb. 25, 1886.

431,776. Incandescent Lamp. George R. Lean, Boston, Mass., assignor to the Bernstein Electric Company, Portland, Maine. Filed Apr. 4, 1890.

431,777. Electric Device for Slaughtering Animals. Jacob D. Miller and James A. Dofflemyer, Gunnison, Colo. Filed Apr. 7, 1890.

431,780. Subway for Electric Cables. Walter L. Parsley, Wilmington, N. C. Filed Feb. 18, 1890.

431,784. Printing Telegraph. George B. Scott, Lakewood, N. J. Filed May 18, 1889.

431,792. Apparatus for Preparing and Translating Secret Messages. Frank Anderson, Peekskill, N. Y. Filed Dec. 3, 1888.

431,793. Automatic Telegraphy. Frank Anderson, Peekskill, N. Y. Filed Mar. 8, 1890.

431,794. Automatic Telegraph. Frank Anderson, Peekskill, N. Y. Filed Mar. 8, 1890.

431,810. Aural Attachment for Telephone Receivers. Edwin C. Hess, Montreal, Canada, assignor of two-thirds to Frank Caverhill, sam place, and Frank S. Harrison, Newark, N. J Filed Apr. 16, 1890.

431,811. Power-Transmitting Device. Edward H. Johnson, New York, N. Y. Filed Nov 18, 1889.

431,812. Dynamo. Edward H. Johnson New York, N. Y. Filed Dec. 27, 1889

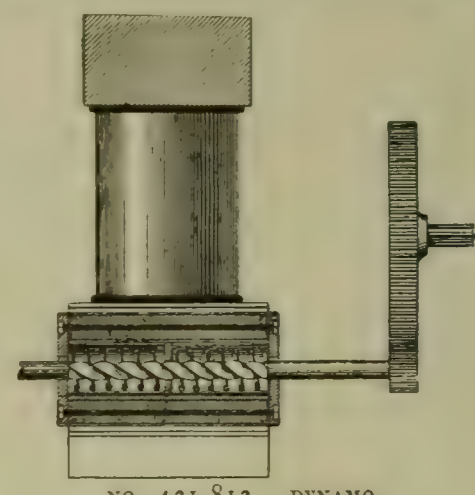
431,823. Electric Railway Motor. Frank J Sprague, New York, N. Y., assignor to th Sprague Electric Railway and Motor Company same place. Filed June 11, 1889.

431,883. Automatic Coin-Controlled Phonograph. Leon F. Douglass, Grand Island, Neb Filed Apr. 16, 1890.

431,885. Boiler-Alarm. Daniel Focer, Cap May, N. J., assignor of one-half to Thomas Lovegrove, Philadelphia, Pa. Filed Sept. 1889.

431,955. Metallic Pole for Electric Wires, etc Joseph F. Schneider and David K. Carson, St Louis, Mo.; said Carson assignor to William H Myers. same place. Filed Mar. 22, 1890.

431,968. Process of Forming Porous Pots fo Voltaic Batteries. Charles R. Goodwin, Paris France, assignor to the Electric Gas Lightin Company, of Maine. Filed May 28, 1886. Pa ented in France, Sept. 9, 1885, in Belgium, Feb 20, 1886, and in England, Feb. 25, 1886.



NO. 431,812.—DYNAMO.

431,973 Hangers for Trolley Wires. Joh T. Herty, Boston, Mass. Filed April 28, 189

431,977, Electric Railway. Rudolph M Hunter, Philadelphia, Pa., assignor to the Thom son-Houston Electric Company, of Connecticu Original application filed Feb. 23, 1887. Divi ed and application filed Oct. 18, 1889. Agai divided and this application filed Apr. 23, 189

431,978. Electro-Therapeutic Appliances Abram W. Jackson, New York, N. Y., assigno to the De Groot Electric Company, of New York Filed Feb. 20, 1890.

431,979. Automatic Fire-Alarm. Henry E Jacobs, Milwaukee, Wis. Filed Aug. 2, 188 Renewed June 17, 1890.

431,987. Printing-Telegraph. Andrew T McCoy, Boston, Mass., assignor to John Ande son, New York, N. Y. Filed Oct. 17, 1887.

UNDERGROUND WIRES.—Negotiations have for me time been pending between the Stockholm rporation, the State telegraphs, and the Tele- one Company about carrying underground ephone cables through the streets. Co-opera- n will also be arranged between the State tele- aphs and the two telephone companies; but the estion has been a difficult one to settle on ac- unt of various conflicting interests.

THE INTERNATIONAL TELEGRAPH CONFERENCE.—The Seventh International Telegraph Conference, which was held at Paris, closed on June 21st, last. It opened on May 16th, and it was in session thirty-seven days. Very little was done which will affect those in this country who use the cables.

THE ELECTRIC LIGHT IN SWEDEN.—In Sweden a large number of electric installations in industrial establishments have been completed of late, prominent among which are a good many saw-mills. Whenever new industrial works are erected, or extensions of old ones made, it is almost a matter of course that electric light is adopted.

ZÜRICH.—An electric tramway on the overhead wire system, 2.5 kilometres long, is to be built at Zürich. Water power is available.

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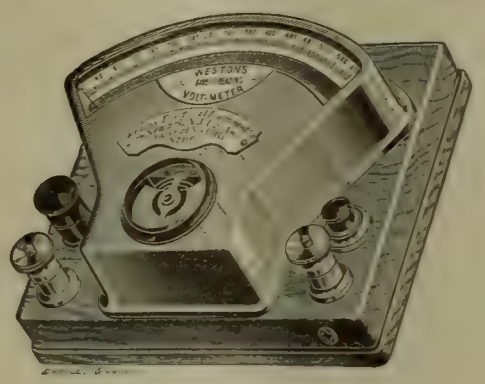
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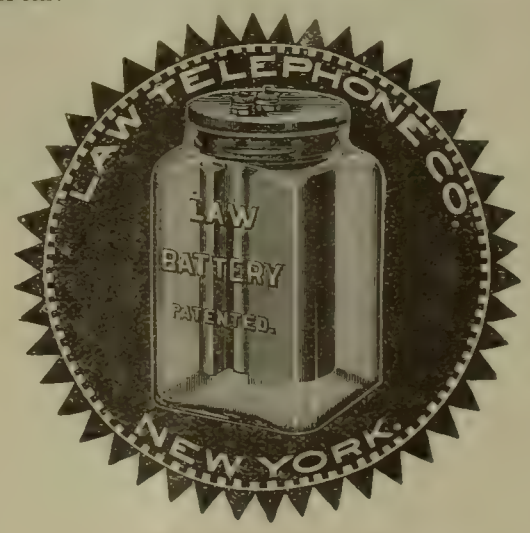
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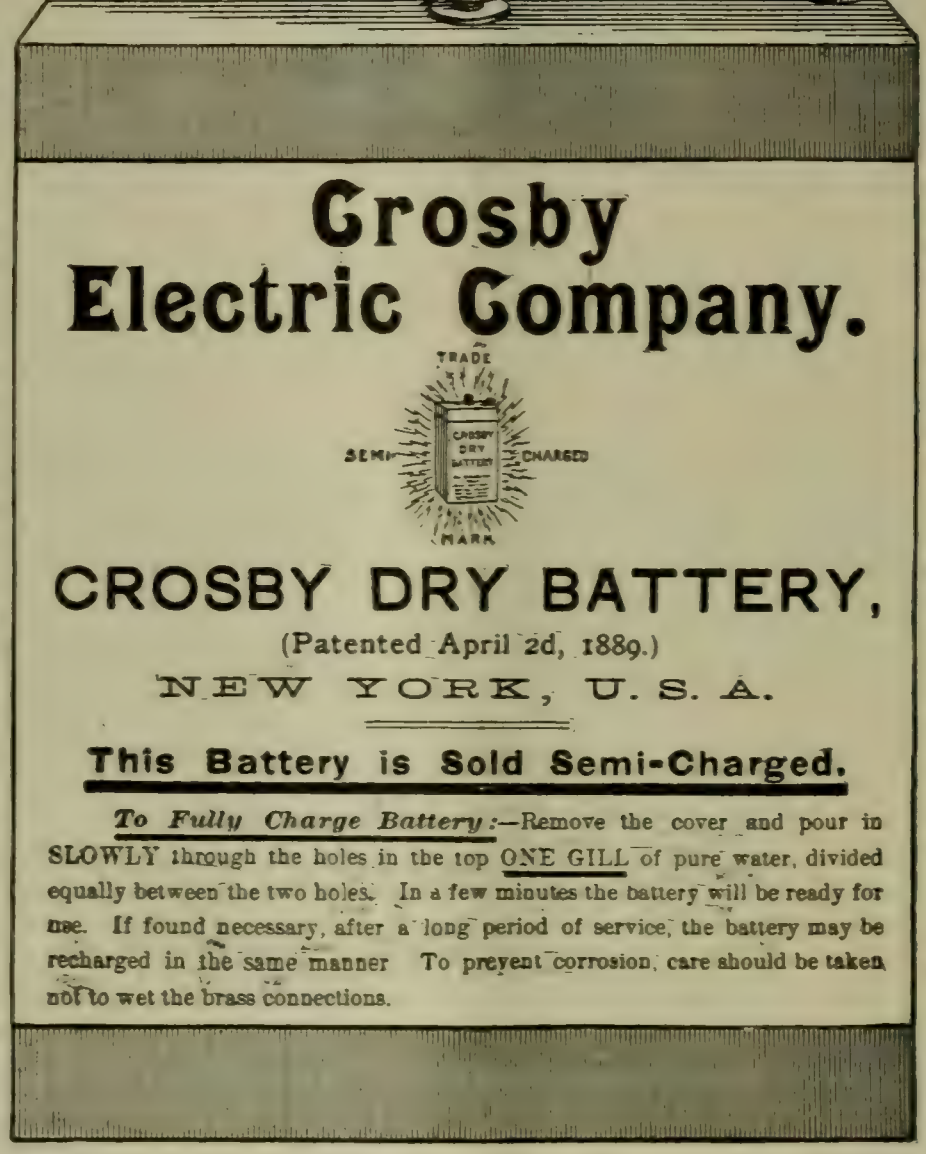
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NEW YORK, JULY 26, 1890.

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THE WESTERN UNION FIRE.

"It has come at last," is the remark said to ve been made by a Western Union official nen he saw what destruction fire had wrought the Western Union building in this city on ly 18th. This expression puzzled a good many ople until it was afterwards explained by other that the gentleman who made the statement meant that he regarded the building as a e trap, and that such a disaster as that of the th was only a question of time. It may be ated in this connection that he was not alone this opinion. Everyone who was at all miliar with the actual condition of things ithin the building shared the same opinion. he fire proof qualities of the building itself uld not reasonably be questioned—there was doubt on that point as the experience of the th has uncontrovertibly proved. Then what as the reason for these misgivings on the part so many? It was well known that what fires ave occurred within the building took place the portion of the structure where the batries were, and where the numberless wires ere distributed to the operating desks, in her words the battery room and the operating om were the dangerous spots. The wires both of these departments were numbered by the thousands, and as each one was sulated, in the main, with material of an inammable nature, the danger is at once apparent. Short circuiting of wires was the constantly impending danger of this vast institution, and every recaution had been taken and provided to revent damage in such an event.

There is no reasonable doubt as to the origin the last fire—short circuiting—but how the ort circuit was caused will probably never be nown. Everything that might have been used give a clue has been destroyed; hence the question of the actual beginning of the fire will always be a matter of conjecture.

The battery room being the focusing point of all of this imflammable material, naturally the greatest danger existed there, and there it was that this last fire started.

After the fire an investigation was instituted to determine if possible, the cause of the disaster. It was found—and we got this story from high authority—that the first inkling of anything irregular was noticed by an attendant in the battery room. He noticed smoke issuing from one wire of a bunch and noticed that the insulation was swelling, indicating abnormal heat in the conductor. As soon as the heat destroyed the insulation, water or some other liquid was thrown on the wires, causing a short circuiting of the entire lot. Then the flames burst out with a vigor and fierceness beyond the power of those present to control.

The destruction of the battery room and the thousands of wires alone would have been disastrous enough, and ordinarily the destruction of the contents of one floor of a fire proof building need not necessarily endanger the floors above and below. But here a very weak point was developed. As is well known, there were hundreds of openings in the operating room floor communicating with the battery room. These were used for carrying the wires from the battery room to the various operating desks. These openings were scattered all over the floor, there being one under each desk. Each of these holes acted as a flue for the flames in the battery room beneath and the result was, in an incredibly short space of time, every desk in the operating room was afire. The desks had evidently taken fire simultaneously as eye witnesses state that from every window of the operating room, from the front of the building to the back, great volumes of flame and smoke issued at once, and that the whole floor was a sheet of flame.

Those who saw the spectacle say it was a grand and unusual sight—it was spread over so great an area. The narrow stairways and the flues within the walls of the building carried the fierce flames and heat up to the eighth floor, on which was situated the Associated Press office, the Western Union lunch room, and bookkeeping department. The flames played some queer pranks on this floor, and confined themselves to the front part, destroying completely the bookkeeping department and the executive office of the Associated Press. The other sections of this floor were comparatively untouched by the fire, but were badly water soaked.

Another weak point in the building, and by far the most important one, was made apparent, and that was the wholly inadequate means of escape. On the operating room floor during the daytime there are employed in the neighborhood of 800 persons, and the only means of egress from this floor were two stairways, each about four feet wide, one at each end of the building. If the fire had broken out two hours later than it did the loss of life must indeed have been awful. It would have been simply impossible for such a vast number of people to pass down these stairways under such exciting circumstances without frightful results. A panic and a crush on the stairs could not have in any way been averted. At the time the fire occurred there are fewer persons in the upper part of the building than at any time during the twenty-four hours, and this fact considered in connection with the fire is something for serious reflection. The Telegraph Company certainly will, after this experience, provide ample means of escape from the building in case of danger. The inadequacy of means of exit has often been commented on, but so much confidence was placed in the fire proof qualities of the building, that the matter was never given serious thought.

The building was erected expressly for telegraphic purposes, but strange to say it was never suited for this work. When it was put up it was done in the best manner possible in those days, but the constantly increasing telegraph business and the necessary alterations to accommodate it have and are yet constantly crowding the quarters more and more, until now it has become a serious question as to how future enlargements to facilitate the handling of business can be made.

Many important and valuable lessons are to be learned from this fire. The first thing of prime importance is to provide abundant means of escape from the building in time of danger. The stairways should be widened, and if possible more put in, and fire escapes should be placed on the outside of the building at every floor.

Some other method of conveying the wires to the operating desks should be thought out and adopted, instead of running them through holes in the floor which act as flues in case of fire. This one thing alone vitiates the fire proof quality of the building, and the latter might just as well be built of wood. Had it not been for these flues in the operating room floor, it is reasonable to suppose that the damage would have been confined to the battery room where the fire started.

The company should have a duplicate plant. Many large establishments have a duplicate plant for use in case of emergence, and the Western Union Company would act wisely to do the same. Their vast operating plant has been wiped out, and it will take months at least to replace it as a great deal of the machinery must be manufactured. The company at New York, no doubt, will be crippled for a long while to come, although every man in the service is doing his utmost to help place the company in a position to handle the public business with as little delay as possible.

There was a plentiful supply of fire extinguishing apparatus in the building, but in the confusion and panic they availed little, although some were brought into use by a few level headed employés. Some of the latter stood before the fierce flames unflinchingly with the red hot tar, paraffine, etc., dropping on their heads and faces from the burning wires, and while their sufferings were intense they stood at their posts bravely until it was evident they must flee to save their lives.

Too much praise cannot be given these men, and it would be a fitting recognition of their fidelity to the company if the latter would remember them with something more substantial than praise.

Effective electrical safety devices should be used on all main conductors, to effect a break in the circuit in case of the overloading of a wire. There are reliable methods of averting the dangers incident to overcharged wires, and the company cannot afford to be without the protection such devices afford.

One of the most remarkable features of the fire was the rapidity with which it spread and the intense heat. Evidence of the latter is seen in the granite trimmings of the operating room floor. These were actually melted, and great pieces were flaked and broken off, completely ruining that part of the ornamentation of the building.

It will require extraordinary tact and management to restore order out of the chaos that now exists, but that there is an abundance of these qualities in the make-up of the Western Union management is evident from the fact that hardly had the fire been extinguished before men were put to work to clear away the debris and get things in shape for restoration. The plan of operations was soon organized, and everything under the new conditions is now moving with clock-work regularity.

The business community and the press suffered for the first day, but the recuperative power of the Western Union soon asserted itself, and now business is being transacted with a great degree of promptness considering the exceeding difficulties under which the company is laboring.

PERRET AUTOMATIC ELECTRIC MOTORS.

We take pleasure in illustrating and describing a line of low speed automatic electric motors designed by Mr. Frank A. Perret, electrician of The Elektron Mfg. Co of Brooklyn, N. Y. These machines were brought out last year and have been giving great satisfaction wherever introduced, but a detailed description has never before been published, as it was desired first to thoroughly test them in actual work and to secure patents, which have now been done.

They differ from the well known two pole Perret motors in that they are of the multipolar type. This form has now been adopted for all sizes above 2 H. P. and the company are carrying in stock machines of 4, 6, 8, 10, 15 and 20 H. P. wound for 200 volts, and they are wound to order for any E. M. F. between 100 and 500 volts

It seems to us that they mark a noteworthy advance in motor and dynamo construction, as they combine in one machine the important features of high efficiency, extremely low speed and close regulation without excessive weight and bulk It is found in the electric motor field as elsewhere, that each make has its peculiarities: one excelling in this feature, another in that, and we doubt if any one machine has ever before been put on the market which excelled in *all* of the three features mentioned. It is well known that most motors and dynamos are run at a high rate of speed, because the efficiency, regulation and output now demanded cannot be obtained at a low speed with the construction used. In the opinion of many of the best electrical and mechanical engineers of the country this high speed is very objectionable on various grounds and many of them have during the past year recorded their belief that the next great advance would be in the line of a large reduction in speed. This belief has long been held by Mr. Perret, who is one of the most level-headed men in the profession, and while others have been talking about this improvement, he has, in his quiet way, accomplished it. That the improvement made by him is a radical one is apparent from the simple statement that the revolutions of armature per minute, in the ordinary shunt-wound Perret motors of the new type, is between 600 and 1500 in the sizes ranging from 4 to 20 H. P., which is less than half the speed of others, and for special work they may be wound to run 300 revolutions or even less.

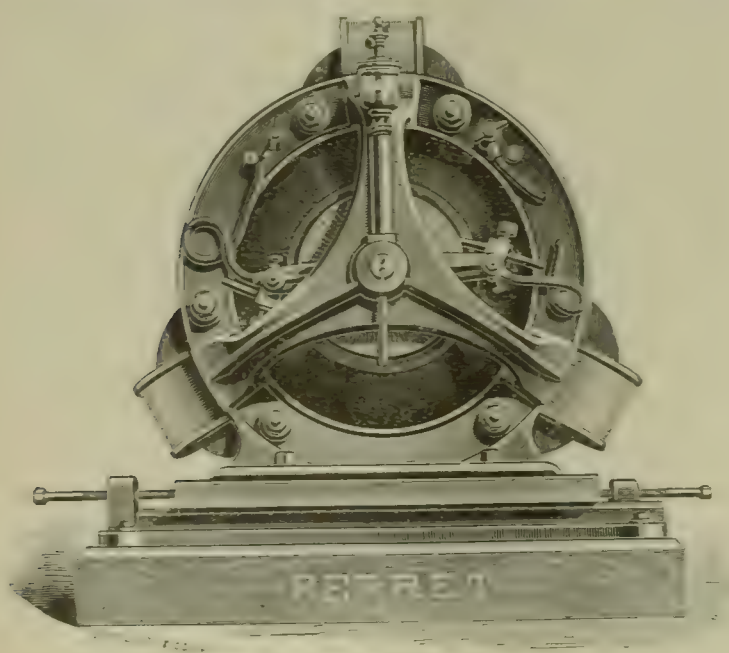


FIG. 2.—END VIEW OF MOTOR.

It is of course understood that motors have been built that ran nearly as slow, but they were made expressly for some special work and were very heavy and bulky and cost high considering their power. It is a very different matter to put the low speed machines on the market at the same price as ordinary high speed as The Elektron Mfg. Co. are doing. We hope the business will be as profitable and satisfactory to themselves as the machines are satisfactory to their customers. At all events buyers of Perret motors are to be congratulated on getting big value for their money.

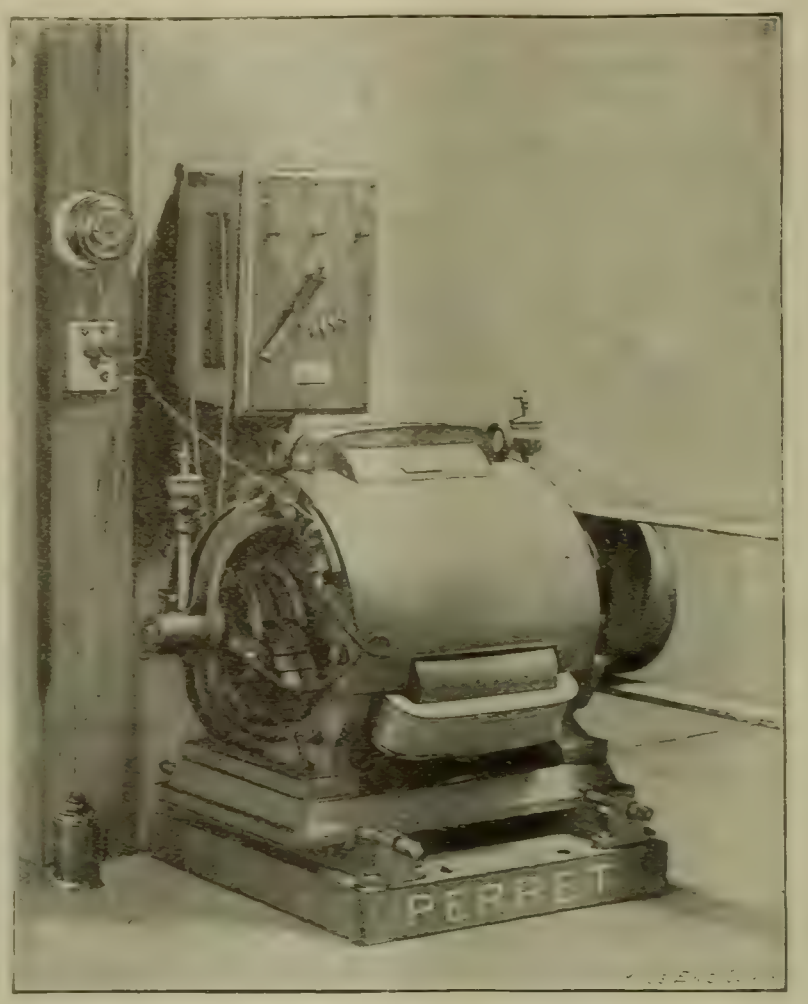


FIG. 1.—PERRET 20 H. P. MOTOR.

It is not as fully understood by the general public as by builders and electricians that reducing the speed of a dynamo electric machine reduces the power or output correspondingly, and increasing the speed increases it. For example a certain Perret motor, running at 600 revolutions per minute, develops 4 H. P. If it were wound suitably and run 1200 revolutions per minute (which is lower than many others), it would be 6 H. P. and the price for a 6 H. P. machine could be obtained. In order to furnish a motor to develop 4 H. P. with the same speed as the Perret (600 revolutions), other manufacturers would have to use a machine which theynow rate at 8 or 10 H. P., and would either get the price of an 8 or 10 H. P. machine or lose money. The Elektron Mfg. Co., therefore, claims that in comparing prices buyers should compare speeds also. The practical advantages of low speed machines are many. For instance, in ordinary machine shops, wood-working shops, printing offices, etc., the shafting is commonly run 200 to 300 revolutions per minute, and it is a simple matter to belt direct to it from a motor running 500 to 600 revolutions, thus saving the first cost of a counter-shaft and one belt, and saving considerable power which would be lost in transmitting through the counter-shaft and additional belt used necessarily with a motor running 1,000 to 1,500 revolutions. The same applies in the case of an elevator operated by belt, and in elevator work, indeed, it is possible to gear direct from the motor. The Perret machines have recently been applied by direct gearing to pumps and coal cutting machines in mines, also to the operation of coal cutting machines by means of rope belt transmission from the motor to the cutter, and the company now have some very large orders for this class of work, which would have been very difficult with motors of high-speed.

The motors are particularly adapted to the direct driving of large exhaust fans and blowers, and to operating hoists and traveling cranes and it is to be hoped that they may be applied soon to street railway work where they would doubtless effect a considerable saving of the power now wasted in the gearing, which is a very large item.

In addition to the advantages of low speed in the special cases mentioned, there is, of course, in all cases a *general* advantage in the avoidance of the rapid wear and deterioration usually connected with high speed. The machines are built with a 6-pole field and with armatures of large diameter, thus securing a powerful torque and great momentum of armature which is a decided advantage when a heavy load is thrown suddenly on, as is often the case in elevator work and all sorts of hoisting.

It is quite remarkable that Mr. Perret, has been able to retain in those larger machines the distinctive feature of laminated field magnetsfor which his smaller machines are noted, and indeed the results secured would be well nigh impossible with any other construction.

In the illustrations, figure 1 is a side view of a 20 H. P. motor complete with sliding base and starting box. Figure 2 is an end view of the same, and figure 3 is a diagram showing a cross section of the magnetic circuit.

It will be seen that the armature is a ring of comparatively large diameter with longitudinal channels on its periphery, in which the conductors are wound and thus embedded in the iron which is, in such close proximity to the iron pole pieces that there is practically no gap in the magnetic circuit.

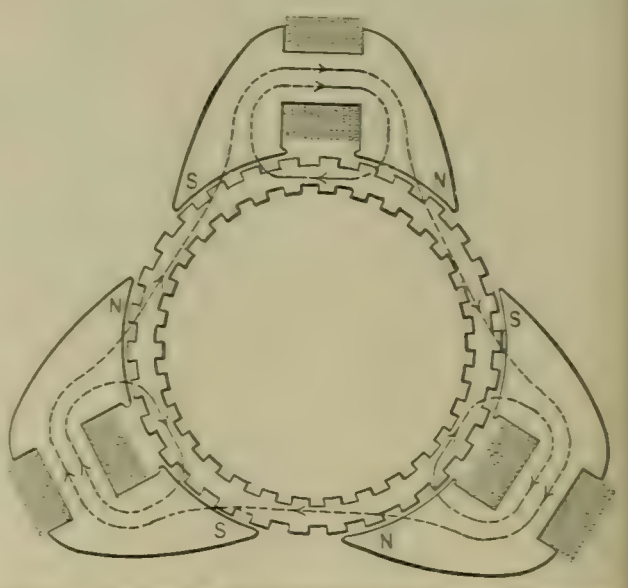


FIG 3.—DIAGRAM OF SECTION OF MAGNETIC CIRCUIT.

The field consists of three separate magnets arranged at equal distances around the armature, each magnet having two pole pieces. The winding is such as to produce alternate north and south poles. The magnets are built up of plates of soft charcoal iron, which are shaped as shown in the diagram, and the magnet thus

produced is of such form that it may be readily wound in a lathe. A non-magnetic bolt passes through a hole in each pole piece, and the plates are clamped together between washer's and nuts. These bolts also serve to attach the magnets to the two iron end frames which are of ring shape and are bolted to the plates of the machine.

The magnetic circuit is of unusually low resistance by reason of its shape, its shortness, which is shown by the diagram, and the superior quality of iron used. There is no magnetism whatever in the frame bed or shaft of the machines as the magnets are supported at some distance from the frame by means of the non-magnetic bolts and the armature is mounted on the shaft by spiders of non-magnetic metal. There is therefore no opportunity for magnetic leakage, and furthermore, the whole is enclosed by a shield or case of sheet metal as shown in fig. 1. With such a construction it is not strange that the motors have already secured a great reputation for high efficiency and close regulation as well as for low speed.

The machines are calculated to be equally as efficient and desirable as dynamos and are coming into use rapidly in small isolated incandescent light plants For this purpose they are compound wound and the regulation is so perfect that all but one lamp may be suddenly turned off without moving the rheostat or brushes, and without noticeable change in the brilliancy of the remaining lamp. This severe test has been made repeatedly in the presence of electrical experts.

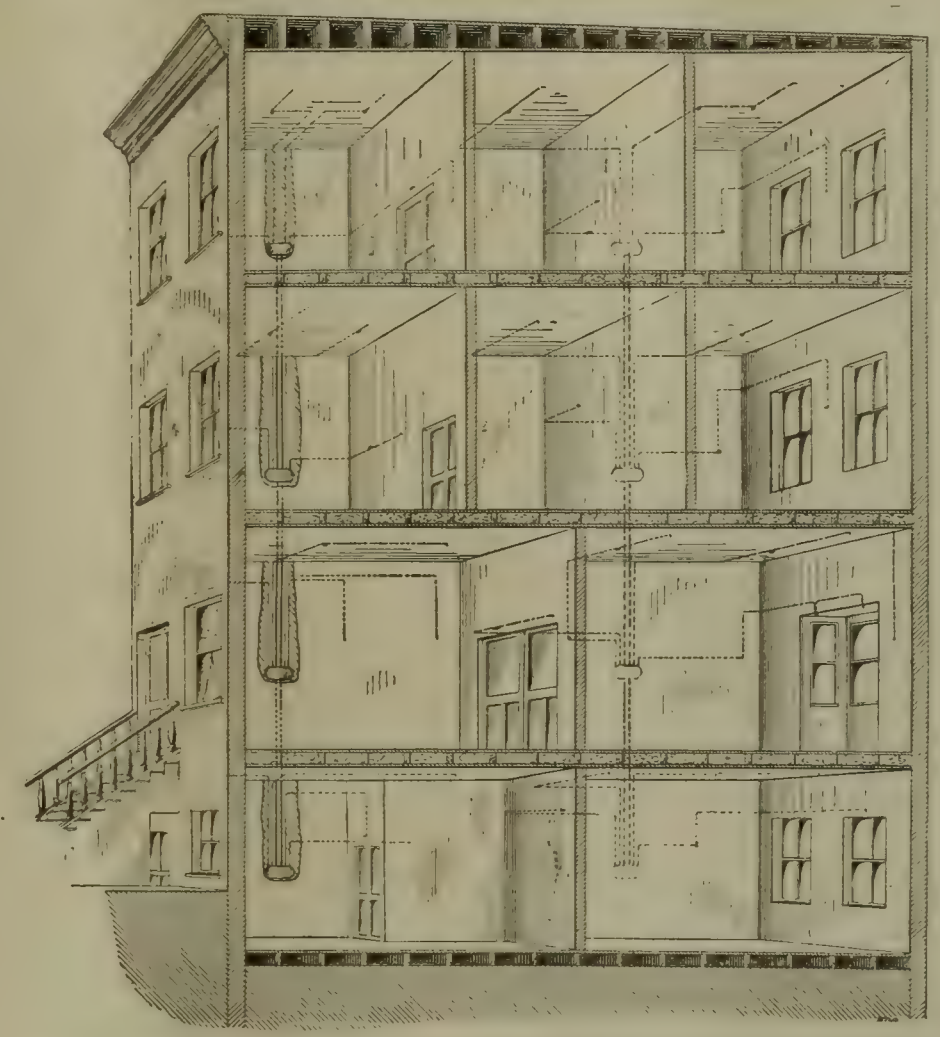
Their low speed makes them well suited for direct connection with steam or gas engines and they are the ideal dynamo for lighting railway trains, yachts, steamboats, etc.

The Elektron Mfg. Co have recently added largely to their cash capital to enable them to handle properly their large and constantly increasing business, and have doubled their manufacturing facilities twice during the last six months. They now occupy nearly all of the large new factory building 79 & 81 Washington St., Brooklyn, N. Y., one block from the bridge entrance. Their works are notable for fine machinery whereby all parts are made accurately and interchangeably to standard gauges, and for the methodical and careful arrangement of their business.

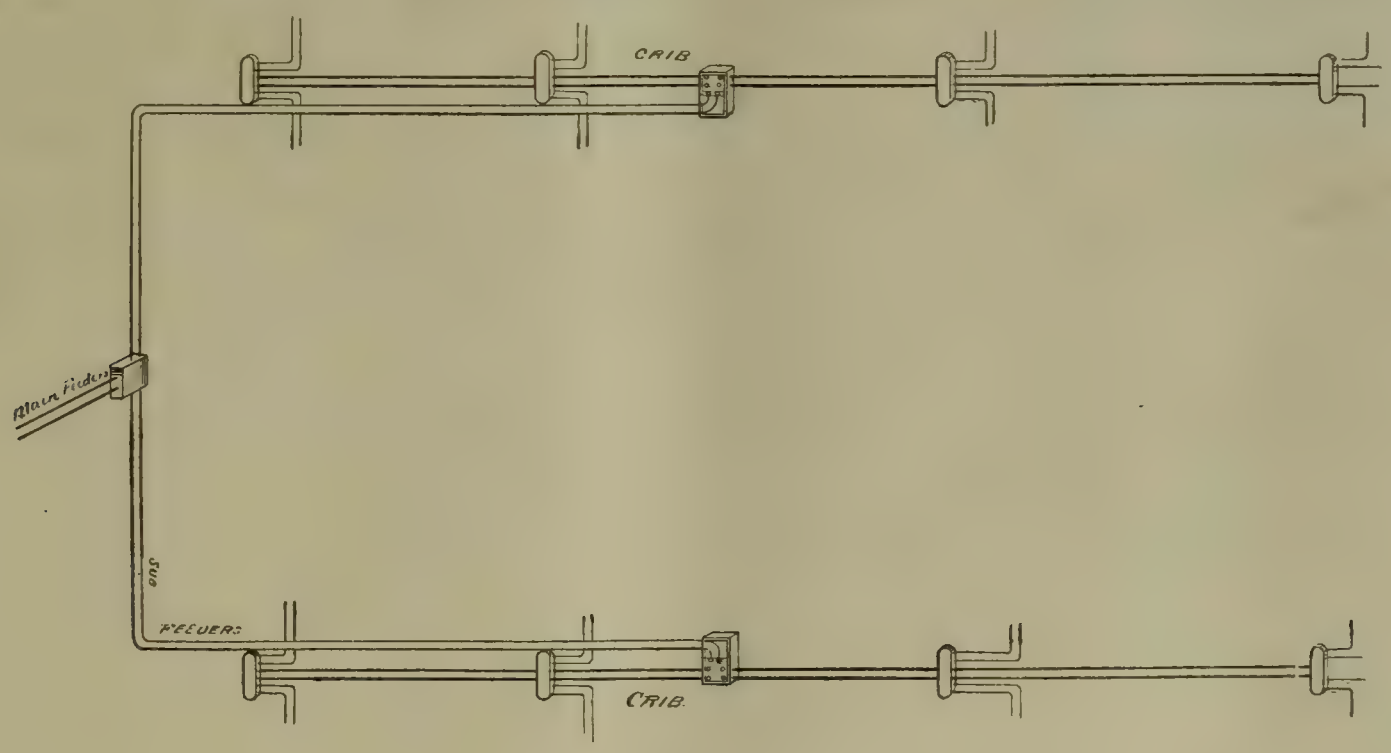
THE INTERIOR CONDUIT AND INSULATION COMPANY.

This company is about to issue a new catalogue and price list, and from an advance copy we obtain the accompanying cuts, the first showing the method of distribution employed and the second the "crib" used in connection with the first. The Interior Conduit and Insulation Company demonstrated by experence, that electric light wiring can only be done economically and effectively by the establishment of centres of distribution wherefrom to radiate all minor circuits, and this system has been modeled in its entirety upon this plan and really good work can be had by installing the system thereon. For mains and feeders the company advises a separate tube for each conductor in which a rigid wire with either underwriters or weather proof insulation may be employed, but for branches the special flexible twin conductor, with both conductors in one tube, should always be used. It is easily seen from the cut of the house that by employing as many risers as possible that long lateral runs, which are objectionable, are thereby avoided.

We are gratified to notice the invention of many new and useful appliances which greatly facilitate and reduce the expense of the installation of this admirable system of electric wiring.



THE INTERIOR CONDUIT AND INSULATION COMPANY'S METHOD OF DISTRIBUTION.



THE "CRIB."

ELECTRIC HAIR CLIPPERS.—Animal shears, driven by electricity, are among the latest electrical novelties. A small motor is attached to the handle, and by a small crank the movable knife of the clippers is connected with the motor armature.

TELEPHONIC EXTENSION.—A telephone trunk line was opened three weeks ago, connecting Weston-super-Mare and Bristol, England. The trunk wire between Dundee and Aberdeen, a distance of 200 miles has been completed.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part II—Field Magnets and Pole Pieces.

34—What are the field magnets of a dynamo?

The field magnets are those parts of a dynamo which are employed to produce the magnetic field in which the armature revolves. In the accompanying figure the parts Y, and MM combined, constitute the field magnets.

35—What are the main parts of field magnets?

The main parts of field magnets are the cores, the yoke and the wire with which the cores are wound. (see figure.)

36—What are the magnet cores?

The magnet cores are those parts on which the wire is wound.

37—Of what material are magnet cores made?

Magnet cores are made of solid iron, either wrought or cast.

38—Why are magnet cores made solid?

It is desirable to have plenty of iron in magnet cores in order to avoid too ready a magnetic saturation.

39—What is magnetic saturation?

Magnetic saturation means that the core has acquired its greatest posssible magnetism, and any increase of the magnetizing current (in the case of an electro magnet) has no perceptible effect on the magnetic strength of the core.

40—What quality of iron is used for magnet cores? The best soft iron.

41—Why is soft iron necessary?

Because it acquires and parts with its magnetism more readily than any other kind.

42—What is an electro magnet?

An electro magnet is one which becomes magnetic only while a current is flowing through the wire with which the core is wound.

43—What is a permanent magnet?

A permanent magnet is one made of hardened steel, which is capable of retaining its magnetism for a long time after being once magnetized.

44—Why are permanent magnets not used for dynamos?

Because of their low energy as compared with electro magnets.

45—What is the yoke?

The yoke is the cross piece of iron that joins the ends of the field magnet cores opposite the ends at which the pole pieces and armature are situated. (see Y in figure.)

46—What are the pole pieces?

The pole pieces are the masses of soft iron placed at the end of the magnet cores (see P. P. in accompanying illustration).

47—What is the function of the pole pieces?

To concentrate and direct the magnetic field.

48—Of what shape are the pole pieces usually made?

The pole pieces are made in a variety of forms, but in all cases they are shaped to conform to the outline of the space in which the armature revolves. They are brought as near as possible to the circumference of the armature.

49—Why is it necessary to place the pole pieces close to the armature?

The pole pieces are placed as close to the armature as possible, in order to increase the intensity of the magnetic induction.

50—Are pole pieces always made of solid metal?

No; not always. They are sometimes laminated.

51—What is the object of laminating pole pieces?

To avoid eddy or Foucault currents.

52—Should the pole pieces completely surround the armature?

No. There must be a break—the pole pieces must not entirely encircle the armature (see P. P. of accompanying figure).

53—Why is it necessary to have this separation of pole pieces?

To prevent loss of lines of magnetic force which would occur if the pole pieces were brought very close to each other or were actually in contact.

54—In what way would they be lost?

Their usefulness in producing currents in the armature would be lost by passing across from the projections of one pole piece to those of the other if the space between them were too small.

55—How far should the edges of the pole pieces be separated?

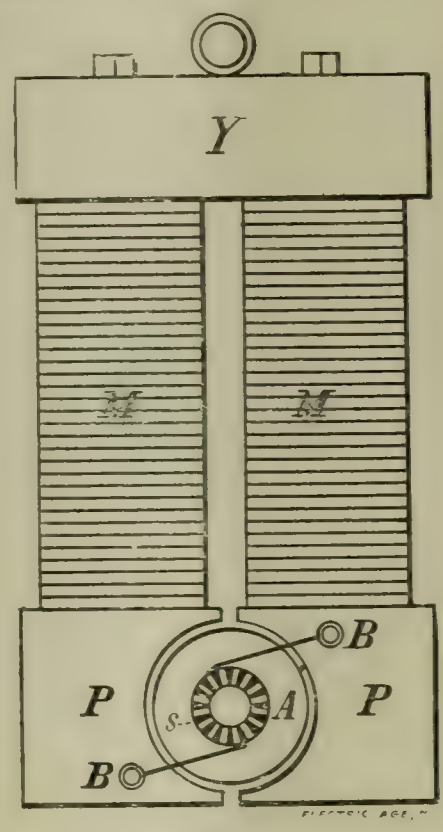
Far enough to insure the line of force passing through the armature in preference to passing through the air space. The proper space between the edges of pole pieces can only be determined by calculation based on the elements entering into the mechanical construction of the machine.

56—What is meant by the magnetic field?

The magnetic field is the space between the faces of the pole pieces, in which the armature is situated.

57—Why is the armature placed in the magnetic field between the pole pieces?

In order that the armature coils may cut as many lines of force as possible in the densest part of the magnetic field, which is between the pole pieces.



TYPICAL DYNAMO.

Y.—Yoke. M. M.—Magnet Cores, the parallel lines representing the convolutions of wire. P. P.—Pole Pieces. A.—Armature. B. B.—Brushes. S.—Armature Segments, representing terminals of armature coils.

58—Do the magnetic lines of force pass through the mass of the armature in preference to going around it in the air spaces; if so, why?

Yes, because the metal of the armature offers much less magnetic resistance than the air, that is, the magnetic lines of force encounter less resistance by passing from pole to pole through the mass of the armature, than they would through the same space of air; they therefore take the shortest cut across, which is through the armature.

59—Do the pole pieces represent the north and south poles? Yes.

60—Is there any particular method of finishing the contiguous edges of the pole pieces in preference to any other?

Yes. It is preferable to round them off.

61—Why?

Because there is less magnetic leakage from round surfaces than there is from angles. Points dissipate magnetism.

62—Are the pole pieces of all machines alike in shape?

No. The shape of the pole pieces differs with the make of machines. Each maker of dynamos has his own method of shaping the pole pieces. The object of them all is the same however, i. e. to concentrate the magnetic lines of force.

(To be Continued).

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ACCURATE MEASUREMENT OF LOW RESISTANCE.

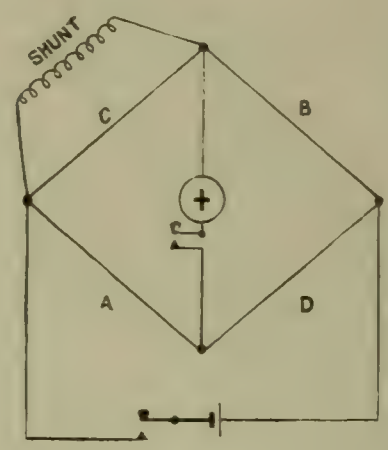
Everyone who has had occasion to use the Wheatstone bridge, with the mirror galvanometer, for the purpose of measuring small resistances has suffered from the inconvenience and difficulty consequent on inexact balance, even when unequal arms are used.

In the London *Electrical Review* a correspondent says: Recently finding it necessary to obtain a very accurate adjustment with the bridge, with arms of equal resistance and not exceeding 100 ohms each, the minute difference of resistance existing between the arms, although nominally equal, rendered an accurate balance impossible.

The use of fine wires, sliding contacts and various other devices were tried, without any satisfactory result.

It then occurred to me to shunt one of the higher resistance arms with an adjustable resistance very much greater than itself, and this was found to be perfectly successful; alterations of the shunt, enabling a perfect balance to be obtained, although the conditions were such that a difference of $\frac{1}{100000}$th in the joint resistance of the shunted arm produced a deflection of one division.

This mode of attaining the condition of perfect balance has no doubt suggested itself to



others, but does not appear to have been published before and it may be of service to draw attention to it now.

It is clear that it is not only useful in attaining a perfect balance with some predetermined fixed resistance, but may be employed in the exact determination of small fractions of an ohm which are now less accurately estimated by using arms of unequal resistance.

If determinations to $\frac{1}{1000}$, $\frac{1}{10000}$ or $\frac{1}{100000}$ are required, the shunt should be respectively 1,000, 10,000, or 100,000 times the arm resistance, and it may be used to determine a resistance which by that amount is in excess of, or is less than, the resistance unplugged in the measuring arm.

For *plus* results in D the shunt should be placed across the arm A, and for *minus* results across the arm C; and it will be found in practice that this method admits of very exact measurements with great ease of manipulation.

THE ROTATION OF THE PLANE OF POLARIZATION AS A MEASURE OF CURRENT.—In 1851 Wiedemann discovered that if a tube containing bisulphide of carbon is surrounded with a wire carrying a current, the rotation of the plane of polarization is exactly proportional to the strength of the current. Starting from this point M. d'Arsonval has devised a very simple arrangement for measuring currents and testing the accuracy of ammeters. In the apparatus recently shown to the Société de Physique, a coil of wire was wrapped round an ordinary saccharimeter tube containing pure water or bisulphide of carbon. The E. M. F. of a single Leclanché cell will cause a rotation of 1 deg. The apparatus can be made as sensitive as one pleases, since for a given current the sensibility depends simply upon the number of convolutions of the end.

WESTERN UNION BURNED OUT.

A GREAT FIRE, THE EFFECT OF WHICH WILL BE WIDESPREAD.

Fire broke out in the battery room of the Western Union Telegraph Company's main building, Dey street and Broadway, about seven o'clock A. M. July 18th, and soon the greater part of the upper portion of the building was enveloped in flames. The fire spread with great rapidity. The first alarm was immediately followed by a second and third. There was some delay in sending out the first alarm, the police officer with the box key being at the other end of his post. An officer further up on Broadway, seeing the flames and no engine, turned in an alarm from the corner of Warren street. The remaining alarms were struck at Fulton street and Broadway. About sixteen engines responded. The police, to guard the streets, were also soon on the scene, and the streets for blocks around were cleared.

At the time of the outbreak there were only about forty operators at their tables in the operating room. This is on the seventh floor of the building, directly above the battery room, and the occupants were made aware of the danger they were in by smoke issuing from the apertures connecting the battery room with the operating room. It was a dense, stifling smoke, and the operators with one accord left their instruments and beat a hasty departure, some not waiting to collect all their wearing apparel. On reaching the landing outside the room they found a safe means of leaving the building for the stairway, made of iron, running in a zig zag fashion to the floor below was free of smoke or any indication of fire. The battery room is situated on the sixth floor of the building. This did not reassure them, however, and they scampered down stairs pell mell. A few of the more cool-headed waited for the elevator, and this was kept running until the drum operating it above began to smoke and sparks fell.

All in the lower portion of the building had got out by this time. The last to leave the operating-room were the night manager, Mr. Tobin, and the chief operator, James Robinson. They looked for the flames as soon as the force took flight in alarm, and in the centre of where is located the distributing ring, which contains the numerous Associated Press tubes and the distributing tubes of the Western Union Company, they saw a tongue of flame shoot up from the room below. It was a fierce flame, and soon shot up several feet. Tobin caught up some hand grenades and threw them into the flames, while Robinson seized a Babcock fire-extinguisher and turned it on. These methods proved futile, and the men as a last effort seized the fire-hose and connected it with the nozzle which enters the operating room near by. This was put in operation and the stream directed against the flames. But their efforts in this direction were as unsuccessful as the others had been, and they abandoned the work.

The firemen found considerable difficulty in fighting the fire. The chiefs put men in all the adjacent buildings, whence they directed streams of water into the fiery furnace. But these buildings were low, and the outside streams did very little good apparently. The water tower, extended to its full height, was put on the Broadway side of the building, a stream shooting from the top being just sufficient to reach the lower windows where the fire was burning most fiercely. But it was evident to observers that the flames could best be reached from within. The fire-chiefs also seemed of this opinion, and dozens of lines of hose were speedily run through windows and doors to the interior. Soon great dashes of water would burst through the sashless windows and the cracked slate roof, showing the splendid fight that was going on within.

Apparently the fire was somewhat under control about nine o'clock, after two hours of fierce burning. At that time the entire upper portion of the building was destroyed. This embraced the battery room, the operating room, the gallery, the dressing room, the main office of the Associated Press on the top floor of the building, and the restaurant adjoining it.

The operating room was completely gutted. The exterior of the building, from below, looked as if a deluge were rushing out of it. Sheets of water often fell downward from doors and windows for minutes at a time, and Broadway was ankle deep in some places. When the woodwork of the tower caught fire at 9.30 o'clock everybody was watching it with fascination. No great attempt was made to check the progress of the flames in this direction, for the woodwork only covered an iron frame, and there was no danger of the fire spreading any farther as this was at the extreme height of the building, except for the pole on which the time ball falls at noon every day. The stone work on the upper portion of the building was chipped and cracked by the heat and slivers of stone and coping fell continuously to the sidewalk. Smoke and sparks burst from the windows from the sixth story up, and at times the top of the tower was completely enveloped by smoke

The cars were stopped from running on Broadway below Vesey street from a few minutes after seven o'clock until after ten o'clock.

Mr. R. H. Rochester, the Treasurer of the Western Union Company said that the loss by the fire would be over $1,000,000, and that the company did not place any insurance outside, doing its own underwriting.

At noon the fire was totally extinguished. The burned building looked as though it has been through a hard time—as it had. Its upper stories were wrecked and blackened. Water dripped from the window cornices on every floor. Crowds of people lined Broadway and gazed at the upper stories with great interest. Many of the telegraph operators, especially the women, made their way into the building to see if any of their effects were saved, but they were all disappointed.

Superintendent Humstone called on Mayor Grant and secured permission from him, as Presiednt of the Board of Electrical Control, to string wires to be run into the old Baltimore and Ohio Telegraph Company's building, No. 415 Broadway, which will be the temporary quarters of the Western Union Company. On this permit a large force of linemen were at once put to work.

The office of the Associated Press has been temporarily established in the building of the Pennsylvania Railroad Company in Jersey City, near the Jersey City office of the Western Union Telegraph Company. It thus is enabled to use the wires of the Western Union terminating in Jersey City.

When the fire reached the Associated Press rooms, on the eighth floor, it had fresh fuel to feed upon in the immense stacks of papers, newspaper files, and the desks and wooden partitions. Everything was destroyed, and nothing left of value. Not a single cent of insurance was on the property, and, although the loss on the replaceable property was $15,000, many times that amount would not represent the value of the manuscripts, the papers, etc. Packed away on the shelves were letter-books containing the history of the Associated Press since 1845. This was an interesting and valuable collection, and without a duplicate.

As the fire broke out in the lull between the night and day work, there were few employés in the building. In the Associated Press rooms two operators and the night editor were present, and they got down stairs safely with but little difficulty.

The building in which the office of the ELECTRIC AGE is located, is directly opposite the Western Union building. The heat from the fire was so intense that American District, Telephone and other wires running into the ELECTRIC AGE were burned off, and it was only by constant drenching that the building was saved. Some idea of the intensity of the heat may be had from the fact that the massive granite window trimmings and pilasters around the W. U. building on the 6th and 7th floors were melted and flaked off in great pieces as though the material had actually taken fire and burned. Pieces of granite were found on the window sills of the ELECTRIC AGE office.

PATENT LAW.—It is the object of the patent law to give the inventor recompense for his work. Under the length of life granted a patent by our laws, however, there are a great many of unoperated patents which only serve to hinder other workers in the same field and give the inventor no benefit. To meet the difficulty it is proposed that the English system be adopted so that the normal life of a patent shall be five years, which term might be extended on payment of additional fees. It is the principal of the patent law to remunerate the inventor for his addition to the sum of national industry and resources, hence if he does not avail himself of the exclusive privilege offered to him to manufacture the patented article and to put it upon the market, it should be forfeited to the public by limitation.

THE MECHANICAL EQUIVALENT OF LIGHT.—According to Dr. O. Tumlirz a surface of one square centimetre placed vertically at a distance of 1 metre from an amyl-acetate lamp, so that it is normal to the rays, receives in each second a quantity of light, the energy of which is equivalent to a heat energy of

$$361 \times 10^{-9} \text{ calories,}$$

or to an electrical energy of

$$(1.226 \text{ milliampéres})^2 \times 1\ \Omega.$$

Taking this in conjuction with the statement of S P. Langley that 1 square cm. of the earths surface, under vertical incidence of the sun's rays, receives in a minute 2.84 calories, it will be seen that the sun's light can be replaced by 1,020 quadrillion units of light, or 820 quadrillion normal German candles.

ACCUMULATORS WITH POROUS PARTITIONS.—In connection with M. Regnier's latest form of storage cell, M. Chatiliez, manager of the Verdun water power electrical station, writes to *L'Electricien* to say that he has met with considerable success by employing ordinary porous partitions between the battery plates. These partitions are fluted to admit of the introduction of the electrolyte and pierced with holes to allow the liquid to circulate, and to diminish the internal resistance. The end plates rest against India rubber washers. M. Chatiliez states that a series of experiments with these plates have shown that the grids may be made lighter and the perforations larger than usual without detriment. The internal resistance of the cells may be kept within moderate limits by slightly increasing the density of the solution.

ELECTRIC LIGHT BIDS.—The new bids for street lighting from the electric lighting companies of this city were opened July 14th, by the Gas Commission. The companies' bids had twice been rejected as too high and calculated to make the cost of street lighting exceed the amount appropriated for this year. The new bids were: United States Company, 236 lamps at 35 cents a night each until Jan. 1 and 43 cents thereafter; the Brush Company, 165 lamps at 35 cents and 65 at 45 cents until Jan. 1, and afterward 165 at 43½ cents and 60 at 45 cents; the East River Company, 189 lamps at 35 cents to Jan. 1 and 43 cents thereafter; the Mount Morris Company, 165 lamps at 35 cents to Jan. 1 and then 43 cents; the Harlem Lighting Company, 104 lamps at 35 cents to Jan. 1 and 43 cents afterward. The bids were referred to the secretary of the commission for tabulation and report. If they do not come within the appropriation Commissioner Gilroy says he is prepared to resume gas lighting.

DEATH OF THE SWISS DIRECTOR OF TELEGRAPHS.—The death is announced of Herr Frey, Director of the Swiss International Telegraph Bureau, who was only recently appointed.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
ROOM 17, COOK BUILDING.
BOSTON, July 19, 1890.

Prof. Thomson's laboratory will be moved from its present location to the basement of Factory D.

President H. A. Pevear, of the Thomson Houston Co., with Mrs. Pevear, his son, H. T. Pevear, and wife, have gone on a trip to Alaska.

General Warner, of Ohio, and Professor Gray, of the Rose Polytechnic Institute of Terre Haute, Ind., inspected the factories of the Thomson-Houston Electric Co., in Lynn, last Thursday.

The Manet Street Railway Co., have strung their feed wires on the poles of the Quincy and Boston Railroad. The road was opened to the public on Tuesday and the trial trips were very successful.

Electricity plays a very prominent part in the production of the "Fall of Babylon" now being produced in this city. Without its aid it would be almost impossible to have a successful performance.

The Washburn and Moen Co., of Worcester, Mass., have purchased 60 acres of ground in Chicago for a site for a branch factory. The plant will cost $1,000,000 and 1000 men will probably be employed.

The station which the new electric company is to build at Pittsfield will cost about $25,000 and be built of brick 62 × 115 feet. The boiler rooms will be in the rear and the stack will be 75 feet high. The station will be ready about October 1.

The Brown Electric Protector Co., of New England, are still behind on their orders although they are having the protectors turned out as fast as possible. The orders are still coming in and the company are arranging for a grand public exhibition.

The Newton Street Railway Company will start their line from Waltham to Newton, August 1. New boilers are being placed in the Waltham Electric Light Company with which to furnish the necessary power to the Street Railroad Company.

The Boston Electric Light Company intend building a station at the corner of Vernon and Hampshire streets, in the Highland district. The city fathers visited the locality one day this week, in order to get an idea of the location before going ahead with the movement.

Another man has been killed in this city by the electric cars, but the fault was entirely his own, and eye witnesses declare that the motor man did every thing in his power to avert it. In his efforts to stop the car he bent the brake handle all out of shape but to no purpose.

The Thomson-Houston Co., has organized a department for testing raw materials at their Lynn factories. It will be located in the basement of the new office building on Centre street. Felix Cleeverg of the Sheffield Scientific School, of Yale College, will perform chemical work in this department.

It is said upon good authority that no more electric street car lines will be equipped by the West End Company until the completion of the new power station, as all available power is now in daily use. The poles on Tremont street are being fitted with temporary lights to facilitate work at night. Jamaica Plain will doubtless be the next outlying portion of the city provided for.

At a meeting of the directors of the Pittsfield Street Railway Co , last Wednesday, it was voted to sell the road to a new company for $17,000. A new company is to be organized with a capital of $35,000; shareholders in the old company to have the privilege of taking stock in the new in proportion to the old stock held. The new company will be organized immediately and will take steps at once towards equipping the road with electricity.

The New England Telephone and Telegraph Company are erecting poles in most of the streets of Marlboro. These are almost the first poles this company have set in the town since the exchange was started some years ago. Almost anything that would hold a wire has been made to do duty.

The trolley and underground wire for the new electric street railway in Concord, N. H., are nearly all in position and there are only a few more poles to be set. The engine is in position and the generator and trucks for the cars will be delivered next week. The road will be opened some time in August.

The Electric Light Company at Lowell has received the new 500-horse power engine made by the Harris-Corliss Co., at Providence, and the foundation for it and the boilers will be completed at the new plant next week. The new plant will be ready for operations next month. Four new boilers will be put in.

The Abington and Rockland Electric Light and Power Company have applied to the Selectmen of Abington for a permit to erect poles on the principal streets. Similar requests will be made to the Rockland and Whitman Selectmen, as it proposed to consolidate the new company and the one recently formed in Whitman.

A committee from Woodville, N. H., have been looking over the various systems of electric lighting and have decided on the Brush. Work will begin at once. The contract for a one story brick building 38 × 40 feet, a 100 horse power engine, 125 horse power boiler, the foundation for the dynamo, and all machinery except the dynamo itself has been awarded.

An order was introduced in the Quincy board of aldermen last Monday evening to the effect that the commissioners of public works present to the council a plan which shall re-locate the poles and wires of the New England Telephone and Telegraph Company by placing the wires in underground conduits along thoroughfares and highways where the exigencies of the case demand and where they conflict with other wires used for electrical purposes.

The scheme to organize another street railway at Holyoke, with electricity as the motive power, which was agitated several months ago, has been revived and it is understood that an application has been made to the State authorities for a charter. In case the latter is granted and the new company can secure a franchise from the city government, it is proposed to put $75,000 into the venture and equip the road at once. The names of the men who are interested in the scheme are being kept quiet, but are supposed to have money to back their faith. It is alleged that the scheme is to get a franchise and then make the present street car company buy off the new comer.

A handsome style of arc lights has recently been designed at the Thomson-Houston works. It has practically the old mechanism, but the frame of the lamp and its fixtures are different. It has a very handsome iron frame, designed to go on an iron post. The frame is ornate in design, and beneath the lamp, in a fine piece of scroll work, is the monogram, "T.-H." This is in reality a gate, which opens to let down the carbons. This lamp is designed largely for the European market, as American tastes have not become sufficiently luxurious, or exacting, or to speak plainly, cultivated. Our municipal buyers usually think the beauty of the lamp is sufficient to offset the ugliness of a wooden or plain iron post. Undoubtedly the company would willingly furnish a more graceful outfit were it asked.

The first annual meeting of the Massachusetts Electric Lighting Association was held Wednesday afternoon at the Point of Pines. The association is composed of thirty of the leading electric lighting companies of the State, representing a capital of $5,000,000 At the business meeting the treasurer's and attorney's reports were read and the following officers were elected for the ensuing year: President, Frederick A. Gilbert, of the Boston Electric Light Co.; first Vice President, Hon. Theodore C. Bates, of the Worcester Electric Light Co.; second Vice-President, George W. Field, of the Lowell Electric Light Co. Executive Committee: Frederick A. Gilbert, Hon. Theodore C. Bates, Geo. W. Field, C. L. Edgar, C. A. Nichols. The meeting adjourned to the dining-hall where a substantial repast was enjoyed.

A clever joke was played upon Electrician Rohrer of the T. H. party of campers at the White Mountains. Four years ago while up there he blew off a piece of ledge from the top of Whiteface with dynamite. On this excursion while at Plymouth, the party was waited upon by the sheriff of the county, who, after singling out Mr. Rohrer proceeded to read a warrant for his arrest on the grounds of carrying dynamite over the public ways. At first the matter was thought to be a joke, but the sheriff refused to show his warrant and maintained so serious an air, that Mr. Rohrer became convinced that he must get bail or spend the night in durance. While he was endeavoring to see what help he could get from his comrades who were as surprised as he at the affair, he managed to get behind the sheriff and glanced at his document. At the same moment Woodward of the Boston office crawled under the table. The joke was out. The warrant was in Woodward's handwriting.

W. J. P.

ELECTRIC LIGHT AFFAIRS IN DENVER.

A suit has been instituted by certain tax payers of Denver, Col., against the City of Denver and the Western Electrical Construction Company. The complaint alleges that under the charter of the city neither the city council nor any officer thereof has authority to make any contract upon the city or imposing upon it any liability to pay money until a definite amount of money shall have been appropriated for the liquidation of all pecuniary liability under such contract.

It is then alleged that the Western Electrical Company was a mere prospective company, but bid for the lighting of the city against the established company; that its bid was higher than that of the old company, and that the contract was awarded to the new company. The complainants allege that this contract is not lawful and pray that it be declared null and void. Fraud is alleged in connection with the deal.

THE PARIS CENTRAL STATIONS.—The *Bulletin International de l'Electricité* estimates that three quarters of the total available engine power at the Paris Central Stations lies idle for twelve hours out of the 24. It suggests as a means of employing these engines that industries requiring power should be established adjoining the central stations, and the spare power utilized in this way during the hours of light load. The Conseil d'Hygiène et de Salubrité de la Seine has decided to place electric lighting stations employing more than 100 indicated horse-power in the class of "dangerous establishments." In the report of M. Michel Lévy upon this subject, it is stated that the horse-power of the 20 central stations in Paris now amounts to 10,000, or one-sixth of the total motive power used in this department of the Seine.

A NEW PERIODICAL.—The first number of the *Electric Railway News and Stock Exchange* was issued July 19th. It is a neat four-page paper and will be published every Saturday by the Electric Railway Publishing Company, 79 Milk street, Boston, Mass. This new addition to periodical electrical literature is to be a medium far reaching electric railway managers and promoters, and its columns are open to inventors, scientists, railway managers and others connected with railroad propulsion. A feature of the paper will be the reports of electric stock sales.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, July 19, 1890.

THE WESTERN POWER CONSTRUCTION COMPANY report sales aggregating 800 horse power in engines and boilers in the past two weeks.

THE DOMESTIC SEWING MACHINE COMPANY are wiring their building in this city for an isolated incandescent plant of 300 lights, the work being done under the supervision of the National Engineering Bureau.

Mr. G. A. EDWARD KOHLER, of the Eddy Motor Co., mentions the sale of a 3 H.P., motor to R. J. Ederer & Company, 151 Wabash Avenue, Chicago, for running machinery for manufacturing fish nets, and hammocks.

MR. G. K. CUMMINGS AND MR. D. G. McDOUGALL now have charge of the Western Office of the C. & C. Electric Motor Company, in the Phenix Building, Chicago, they succeeding Mr. F. H. Lewis, who has accepted a position with the Edison Company. Both gentlemen have been connected, prior to coming to this city, with the Eastern Office of the C. & C. Company.

FOREE BAIN, 76 Market street, Chicago, is making a motor of special design which he calls a double or composite motor, for use in street or traction work, to be driven by primary batteries. The motor has two armatures, one of which geared 16 to 1 is used to start the car and on heavy grades, and the other geared 4 to 1 is used for keeping the car in motion after starting and on level road.

THE WASHBURN AND MOEN MANUFACTURING COMPANY have purchased a large tract of land in this city, and expect to erect works thereon where they will manufacture wire to supply their great trade in the West. Such a factory would save the company $4 a ton freightage. The intention of the company is to commence on a limited scale, manufacturing only certain lines of their goods and increasing from time to time.

WESTINGHOUSE WORKS. The announcement comes this week from Chicago real estate circles of the purchase by the Westinghouse Company, of 480 acres of land, situated just south of the city and lying between 119th and 127th streets, and Halstead street and Wabash avenue. It is understood that the Westinghouse Company will erect works for the manufacture of street car equipments. The land is near the Pullman tract, and it is reported that Mr. Pullman is interested in the deal.

Mr. S. D. GREEN, who has the management of the Western Office of the United Edison Manufacturing Company, in this city, for the past few months, will return to New York August 1st, as assistant to Mr. Insull, general manager of the Edison General Company. At this time the arrangement will go into effect by which the Edison and Sprague interests are consolidated under the name of the Edison General Company. It is understood that Mr. John I. Beggs, vice-president of the New York Illuminating Company, will come West and assume the management of the Edison office here.

Mr. FOREE BAIN is much pleased with the letter which has come into his possession written by J. J. Welch, president of the Shawnee Coal & Iron Company, to an intending purchaser of coal mining machinery who had written him for information. The letter indicates the satisfaction their electric plant has given the Shawnee people and also contains a fine testimonial to Mr. Bain personally, in which the writer expresses the belief that Mr. Bain is the "best posted and most practical man in electricity as applied to mining in the country". Mr. Bain values this letter all the more as being unsolicited on his part.

THE WESTINGHOUSE ENGINE REPRESENTATIVES report sales of engines during the first six months of 1890 aggregating 22,180 H. P., the number sold being 471. Among power plants furnished for use with electric machines may be mentioned four engines of 15 H. P. each furnished the Chicago, Milwaukee & St. Paul Railroad for their train lighting system. These engines are placed in the baggage car and drive Edison dynamos. Four 65 H. P., engines have also been furnished the Michigan Calumet & Hickly Mining Company. The Detroit Electrical Works are installing 200 H. P., and the Excelsior Electric Light Company of Port Huron, Mich., 350 H.P.

ELECTRICITY AT THE WORLD'S FAIR.—The interest electrical people are taking in the Columbian Exposition of 1893, is shown by the effort already in progress to secure the appointment of a good man for the head of the electrical department. The friends of Prof. J. P. Barrett, Chicago's city electrician are circulating a petition, asking for his appointment, which contains the endorsement of most representatives of the electrical industry in this city. That Professor Barrett will make an excellent head for this section, his success in organizing the Chicago City telegraph department and his success in carrying through and putting into successful operation our fine system of municipal lighting, shows. As an executive officer his abilities and experience would go far toward making a success of the electrical department of the fair. In this connection there are also mentioned the names of several prominent scientific men as desirable for having charge of the theoretical part of the work, among whom is Prof. Elisha Gray, of this city. It seems to be desired that some eminent scientific man of world-wide reputation should be connected with this branch of the World's Fair work, and Professor Gray's friends unite in recommending him.

F. M. I.

MOLECULAR THEORY OF INDUCED MAGNETISM.

At the meeting of the Royal Society in London, June 19th, a paper by J. A. Ewing, F. R. S., Professor of Engineering in University College, Dundee, entitled "Contributions to the Molecular Theory of Induced Magnetism," was read.

After referring to the discussion by Maxwell of Weber's theory, which ascribes the magnetization of iron and other magnetic metals to the turning towards one direction of molecules which are already permanent magnets, and to suggestions by Profs. Wiedemann and Hughes, the writer describes experiments which he has made bearing directly on the molecular theory. The experiments have been made by grouping near to one another a large number of small pivoted magnets each free to turn about a fixed centre, and studying the configuration which the group assumes and the manner in which it yields when an external magnetic force is imposed. The results do not support the idea that the molecular magnets form closed chains in unmagnetized iron. They lead, however, to the important conclusion that no arbitrary conditions of directional constraint need be postulated to make the behavior of the molecular magnets agree with what is known about magnetic quality.

In the writer's view the molecular magnets are perfectly free to turn in response to external magnetic forces, except in so far as they are constrained by the magnetic forces which they mutually exert on one another. This theory is briefly discussed in the paper in relation to the form of the magnetization curve, to the character of cyclical processes, and to known effects of temperature, vibration, stress and so forth, and the following conclusions are stated:

1. That in considering that magnetization of iron and other magnetic metals to be caused by the turning of permanent molecular magnets, we may look simply to the magnetic forces which the molecular magnets exert on one another as the cause of their directional stability. There is no need to suppose the existence of any quasi-elastic directing force or of any quasi-frictional resistance to rotation.

2. That the intermolecular magnetic forces are sufficient to account for all the general characteristics of the process of magnetization, including the variations of susceptibility which occur as the magnetization force is increased.

3. That the intermolecular magnetic forces are equally competent to account for the known facts of retentiveness and coercive force, and the characteristics of cyclic magnetic process.

4. That magnetic hysteresis and the dissipation of energy which hysteresis involves are due to molecular instability resulting from intermolecular magnetic actions, and are not due to anything in the nature of frictional resistance to the rotation of the molecular magnets.

5. That this theory is wide enough to admit explanation of the differences in magnetic quality which are shown by different substances, or by the same substance in different states.

6. That it accounts in a general way for the known effects of vibration, of temperature and of stress, upon magnetic quality.

7. That, in particular, it accounts for the known fact that there is hysteresis in the relation of magnetism to stress.

8. That it further explains why there is, in magnetic metals, hysteresis in physical quality generally with respect to stress, apart from the existence of magnetization.

9. That, in consequence, any not very small cycle of stress occurring in a magnetic metal involves dissipation of energy.

NEW YORK NOTE.

The Gas Commission still regard it as doubtful if the bids for lighting the city by electricity will be awarded at the figures of the electric light companies. The commissioners assert that it looks like a combination between the electric lighting companies, inasmuch as there is no infringing upon one another's territory, and the figures are made to bear out the suspicion of mutual understanding.

ELECTROLYSIS OF THE MUSCLES.—In a recent number of the *Bulletin de la Société Belge d'Electriciens*, Dr. G. Weiss contributes a brief account of some interesting electro-medical investigations undertaken by him. That electrolytic effects take place at the electrodes where an electric current enters and leaves the human body is, says Dr. Weiss, universally admitted; but is the electrolytic action confined to these points? Dr. Weiss then points out how, when intermittent currents of the same size are sent along the gastronemian muscles of a frog's leg, the contractions rapidly cease, and no amount of rest restores the muscles to their primitive condition. On the other hand, the duration of an alternating current does not perceptibly effect the contractions. This phenomenon points, therefore, to electrolysis of the muscle along the entire path of the current. Dr. Weiss then tested this theory as follows: He took two vessels containing a one per cent. solution of chloride of sodium, connected them by a syphon filled with the same liquid, and passed a given current from vessel to vessel, using platinum electrodes. The experiment was then repeated with the two hind legs of a frog as connecting piece. The E.M.F. of polarization was considerably greater in the latter case than in the former. Dr. Weiss is of opinion that an electric current traversing a muscle gives rise along the whole length of its path to chemical decompositions, and that the products of these give rise in their turn to powerful secondary actions upon the substance of the muscles, which are rapidly attacked and destroyed. Microscopic examinations showed that the entire structure of a muscle was gradually altered by the passage of a current. Dr. Weiss then poured a strong saline solution of gelatine, colored with well neutralized-turnsol, into a U tube, and when the gelatine had solidified he poured in water colored in a similar manner. The turnsol not only changed color at the platinum electrodes but also at surface, separating the gelatine and the water. With albuminous water the albumen was coagulated at the positive and completely dissolved at the negative surface of separation.

ELECTRIC LIGHTING IN FRANKFORT. *

The following is an abstract of an interesting report of a committee appointed by the town council of Frankfort on-Main, to deal with various matters in connection with the question of electric lighting.

In order that the lighting effect of arc lights fed by the alternate and direct current system might be tested, the corporation built two exactly similar rooms, provided with windows on the north side only. In one room was a Schuckert direct current lamp, and in the other a Ganz alternating current arc lamp. Both lamps were placed at the same height and consumed equal amounts of energy. The five members of the Committee each observed, from outside, the illumination produced on the three sides, ceilings, and the floors of the two rooms. In the result, it appeared that the illuminating effects of the alternating current lamp and the direct current lamp were as 1 : 1.23. For outdoor illumination, all the observers agreed in putting down the illuminating power of the alternating current as less than that of the direct current, in the proportion of 4 to 5. It was proved that the alternate current lamp required more ampéres than the other; but it also appeared that if that total radiation was taken into account, and not only that portion of it that was directed towards the earth, the ratio of the lights was as 4 : 3. It appeared that the maximum illuminating effect of the alternate current lamp was not, as frequently stated, in a horizontal direction; but that two cones of maximum illumination existed one above the other below the horizontal. The Committee reported, therefore, that equal amounts of energy gave 20 per cent. less useful lighting effect with the alternating current both for outdoor and indoor lighting. On the other hand, the alternating current lamp required a lower tension, and a smaller resistance for regulation, and could consequently be run with 20 per cent. to 30 per cent. lower voltage; so that three of them could be run in series off a 105 volt circuit, instead of only two in the case of the direct current lamp. The Committee reported that the buzzing noise observable with alternating currents was quite unimportant, as there was always a slight hissing even with direct current lamps. The consumption of carbons was found with equal energy to be 20 per cent. higher in the alternating current lamps; but as the cost of the carbon in 6 to 12-ampére lamps is only 10 per cent. of the total, this only means an increase of 2 per cent. on the whole cost. It was found that the cost of an 8-ampére alternating current lamp was from 2.8 pence to 3.5 pence per hour, this size giving the same amount of light as a 6-ampére direct current lamp costing 2.25 to 2.8 pence per hour; the larger sizes, taking 16 and 12 ampéres respectively, cost from 5.2 to 6.5 pence in the case of the alternating current lamp, and 4.1 to 5.1 pence in the case of the direct current lamp. It was remarked that the alternations of current gave a multiple impression of objects in rapid motion, though on fixed objects the alternating current light seemed perfectly steady.

Alternate Current Meters.— Tests made with the Bláthy alternate current meter showed that the instrument was correct within 3 per cent. for currents within the limits for which it was designed. In point of simplicity, size, cost, and sensibility it fulfilled all reasonable demands.

Alternate Current Transformers.— The Committee reported that some tests undertaken by them showed that the efficience of the Ganz medium sized transformer was at full load 95 to 96 per cent., at half load 93 to 94 per cent., at quarter load 90 per cent., at one-eighth load about 80 per cent.

Direct Current Transformers.—The Committee reported that they were not acquainted with any direct current transformer that would answer the requirements of a central station. They could not recommend that which had been first proposed by Schuckert, and afterwards by Lahmeyer, in which both windings were on the same ring. They regretted that they had had no opportunity of testing such a transformer. The question of cost was not gone into, as none of the systems proposed for Frankfort involved the use of a direct current transformer in the same way as the alternating current schemes. The Committee called attention to the fact that the direct current transformer, unlike that for alternating currents, contained moving parts, and therefore required constant attention. The efficiency of the direct current transformer when working with full load was found to reach the 82 per cent. claimed for it by Messrs. Schuckert and Co. For less than full load the efficiency was not a matter of importance, as it was intended to use the transformer always at full load to charge accumulators. The loss on alternate current transformers was only 5 or 6 per cent. as compared with this 18 per cent.

Accumulators.—With reference to accumulators, the Committee were asked whether any cell could be recommended for use on a large scale. Although on other questions they had been unanimous in their decision, on this point there were differences of opinion. Prof Ferraris remarked that with regard to accumulators he had always been a pessimist. There have been numerous attempts at improving secondary cells, which proved the importance of the question; but up to the present all expectations have been falsified. The Tudor accumulator gave good results on account of the method of making the plates, but this very process made it probable that they would completely break down after a time; and he considered that a longer experience was necessary before deciding on its degree of merit. He did not consider that any system embracing so doubtful an element was to be recommended. Prof. Weber said that from the experience of the last few years he considered the lead accumulator had not improved much in efficiency. As regarded the life of the new Tudor cell, he thought an improvement had been effected in this direction, but it was impossible to say to what extent, as only two years' experience was obtainable, and from this no deductions could be made as to their probable state after ten years, the time for which the Company gave guarantees. He considered it a step in the right direction that Müller and Einbeck, of Hagen, undertook the maintenance of the cells. He would be pleased to see an accumulator plant installed at Frankfort, as it would afford an opportunity for watching the behaviour of accumulators employed on a large scale. Director Uppenborn did not see that the town would incur much risk, as the surplus of the subscribed fund could be applied to maintenance. He considered that all that was known of the action of the lead plates proved that their life would be sufficiently long. Prof. Kittler agreed with Director Uppenborn, but said he should have reported against the adoption of accumulators until the production of the Tudor type, which he was convinced showed great progress. He had proposed the use of accumulators for running machinery to the authorities at Darmstadt, where they had been working satisfactorily. He thought the substitution of wood for glass cells was an improvement, doing away with many chances of accident. He considered, therefore, that a town in using accumulators ran no risk either from a technical or a financial point of view.

The Five-Wire System —As to the applicability of the five-wire system, the Committee reported that the first scheme of Siemens and Halske was not satisfactory, but that the second was more likely to satisfy requirements. As to the proposed tension of 440 volts, the Committee reported that the use of so high a voltage would necessitate great care on the part of the attendants. A disadvantage of the system was that the five distributing mains would each have to be laid separately, as under no circumstances would it be advisable to make up all the leads into one cable. Moreover, to ensure good regulation, it would be necessary in most cases to connect all five cables with customers' house, which would be expensive. The Committee, however, stated that all these disadvantages were not so vital as to exclude the five-wire system where other circumstances rendered its adoption advisable.

Electric Traction.—With regard to traction, the Committee regarded a direct current supply with overhead wire as out of the question for Frankfort; an underground channel would therefore have to be used. If the traction current was supplied from the same circuits as the lighting current, the result would be a very bad effect for traction purposes at different times of the day and seasons of the year. This would be greatest on the winter evenings, just when the light was required For financial and practical reasons, it would, therefore, be well to separate the lighting and traction mains. It would, however, be advisable to adopt in each case the same class of current and the same voltage, so that in cases of accident interruption might be guarded against. For this reason both curcuits should be worked from the same central stations. If the five-wire direct current system were adopted, the pressure would suit traction work. If transformers (direct current) were used, a subsidiary station could be employed. If the alternating current was used, the traction systems might be supplied either from the exciting dynamos, or by means of transformers, using alternate current motors. If, however, improvements in accumulators should warrant it, they would afford the surest and most satisfactory solution of the difficulty. It was concluded, therefore, that either system would serve equally well for the traction service.

Current for Electro-Chemical Purposes.—On the subject of distribution for electro-chemical purposes, the Committee reported that the demand for this was comparatively small, and that, the voltage required being very low, even with the direct current system, a transformation would be necessary, so that the alternate current and direct current systems were in this respect on an equality.

On the whole question as to which of the two systems was to be adopted at Frankfort, the Committee found it difficult to arrive at a definite conclusion, owing chiefly to the fact that the suitability of this or that system depended largely on where the central station was to be, and whether water-power would be available; and neither of these matters were then settled.

* London *Electrician*.

An Improved Connection for Carbon Battery Plates.—A useful little improvement in the way of connecting the carbon plates of batteries has been devised by Mr. Dopping-Hepenstal, R.E. A small hole is drilled through the carbon plate about ¼ inch from the upper edge. A piece of platinum wire, twenty-four or twenty-two S.W.G., is next snipped off obliquely, so as to form a chamfered end, and the last quarter of an inch or so of the piece is bent back upon itself, and pinched tight. The piece is then passed through the hole in the carbon plate, and pressed in hand tight, until arrested by the swell of the loop. A length of two to three inches will usually be found convenient. The plate may be partially or totally submerged in the exciting fluid. It does not matter whether the actual junction between carbon and platinum is above the level of the exciting liquid in the cell or below it, the platinum being, for all practical purposes, incorrodible. Thus a Leclanché cell can be sealed up, the carbon plate being entirely within the cell, and connected to the outside by a single platinum wire passing through the seal.

Dynamo Brush.—A patent has just been issued to Mr. James F. McLaughlin, of Philadelphia, on an improvement in commutator brushes for dynamos. The brush consists of alternate strips or plates of copper and carbon placed in series

THE ELECTRIC LIGHT IN CANADA.

In a paper read by A. J. Lawson, M. Can. Soc. C. E., etc., on May 8th, last, before the Canadian Society of Civil Engineers, much interesting information is given. According to the paper, there are at the present time 13,530 arc lights and about 70,765 incandescent lamps in use throughout the Dominion. There is hardly a village in Ontario, having a population of over 3,000 inhabitants, which has not an electric light station of some kind in operation, and few of the important towns of the other provinces are without electric lighting. Most of these, it is true, are arc lighting stations, but about a dozen supply the incandescent light only, chiefly to stores and public buildings, the lighting of residences being yet scarcely entered upon. Several of the local companies which have hitherto supplied the arc light alone, or with a few incandescent lamps in series with their arcs, or in series multiple with them, have recently purchased and put into operation incandescence A. C. plants; and the various lighting companies formed for the supply of incandescent lights only, have also found it necessary in most cases to add arc lighting to their business, it having been sufficiently demonstrated that the incandescent light is unsuitable for street lighting, the public demanding from electric lighting, whether arc or incandescent, a much better illumination than is usually obtained from gas lighting, and in this respect the incandescent light has failed to meet the expectations of its advocates. The Edison municipal system was used for street lighting on the Lachine Canal, and at Vancouver, B. C., Valleyfield, Quebec, and Chatham, N. B, but has been replaced by arc lights in the two first-named places.

The following is a summary of the number of lights of the various systems now in operation in the Dominion:

System.	Arc Lights.	Incandescent Lights.
Thomson-Houston	6,105	14,600
Edison	.....	23,500
Ball	3,529	1,660
Brush	615	3,300
Hochhausen (Wright's improved)	750	.....
Reliance	1,780	.....
Westinghouse	.....	6,850
Slattery	.....	5,850
Craig	.....	4,515
Mather	.....	3,125
Weston	180	5,365
Fuller-Wood	425	.....
Other systems	150	1,500

In regard to engines Mr. Lawson says: Unfortunately in a great many cases where steam-power is used, it was assumed in the early stages of electric station construction that any kind of steam plant would answer, and very good reason existed for the complaints made of the unsteadiness and unsatisfactory character of the lights supplied.

High speed engines belted direct to the dynamos were next tried, but from lack of experience on the part of the manufacturer of this class of machinery, the product was a mechanical curiosity and a failure. A reaction soon afterwards set in in favor of slow speed engines, especially for arc lighting, and at the present time, with few exceptions, engines of the Brown and Wheelock types are used in all arc light stations in Canada operated by steam power. For the running of incandescence plants, however, high speed engines, mostly of American manufacture, have obtained the preference to which their excellent qualities and performance entitle them.

14,750 horse-power generated by steam engines is used for electric lighting and electric railway working in Canada.

On the subject of water power Mr. Lawson says: At Quebec, power is obtained at the Falls of Montmorency, nine miles distant, to drive the Thomson-Houston arc dynamos and Thomson-Houston A. C. incandescence machines.

At Peterboro, water-power is used to drive Thomson-Houston arc dynamos, from which 137 arc lamps and a number of Bernstein incandescent lamps in series are supplied. At Barrie, Ont., a stream five miles distant from the town furnishes the power for both the arc and Brush A. C. incandescence plants.

Also in Ottawa, Cornwall, Smith's Falls, St. Catharines, Welland, Dunville, Thorold, Sault Ste. Marie, Sherbrooke, Joliette, Valleyfield, Almonte, and some other places, for both factory and central station lighting, water furnishes the motive power, the total horse power from turbines used for electric lighting and power transmission in the Dominion being 4,520, or more than one-fifth of the whole power utilized for this purpose.

The dynamos are not coupled direct to engines in any of the Canadian stations. Ordinary double leather belting, made without seams or rivets, is generally used. In a few cases link leather belting has been tried, but the results have so far justified the opinion that this belting has been invented chiefly to find a market for scrap leather. Belting should not be overtaxed. One inch width of double leather belting running at a speed of 750 feet per minute will easily transmit one horse power, and at this tension will last a long time. Some dynamo manufacturers, in order to impose the belief that their machines use but little power, are in the habit of providing a much smaller margin than this per horse power. The only advantage, of which the contractor receives nearly the whole benefit, is that the first cost is decreased. The disadvantages, which affect the purchaser, are the necessary excessive tightness of the belt, and the consequent heating of journals, rapid wear of the belt, and large oil consumption. Rope driving may eventually be used, as it has many advantages, but so far, with one exception in an isolated plant, the method has hitherto not been tried in Canada.

The arc light systems in use in Canada are the Thomson-Houston, Ball, Brush, Reliance, American, or Fuller Wood, Hochhausen (Wright's improved), and Weston. The large majority of machines and lamps is of the Thomson-Houston and Ball systems.

In the Thomson-Houston, in the Brush and in the Fuller Wood or American systems a current of 9.6 ampères is used, with a pressure varying according to the number of lamps in circuit. In the Ball system a current of 8 to 8½ ampères has been the standard, but lately that company have supplied several plants having a current of only 4 ampères the lamps for which are nominally of 1,000 candle-power each. In the Hochhausen-Wright system, a current of 10 ampères is used. In the Weston system the current is about 18 ampères, and the P.D. between the terminals of each lamp 25 volts. On account of the short arc and the consequent hissing, the Weston lamp has not found general favor in this country. The regulation of the Thomson-Houston machine is excellent. It is not, however, quite so steady as some clock-work arc lamps, and requires the feed rod to be kept very clean in order to secure the proper working of the clutch. With the rack and pinion lamps this point is not of such importance, and the difference in the running of the two kinds of lamps sometimes observed, may, to some extent, be due to the cleaning of the clutched lamp rod having been neglected.

In regard to the rating of arc lamps, some change seems to be desirable. At present lamps taking 48 volts and 9.6 ampères, lamps of the same voltage taking 10 ampères, and lamps of 50 volts and 8 ampères, are all compared the one with the other, and each is called 2 000 candle-power, which is manifestly absurd. The current and pressure, or watts per lamp, should be given in all specifications, tenders, and contracts.

For lamps of 2,000 nominal candle-power No. 6 wire, American gauge, and for lamps of 1,200 nominal candle-power No. 8 American gauge wire is used for the leads. Up to within the past two years the insulation known as "Underwriters' wire" was used, but lately this has given place to much superior quality. Unfortunately, there is still room for improvement even on the best which has yet been supplied in Canada.

A very short experience of distribution, on the multiple arc system demonstrated that lights singly controlled could not be furnished economically by it at a greater distance from the central station than a quarter of a mile radius. The three-wire system, invented by Dr. John Hopkinson, and elaborated by Mr. Edison, was a temporary and partially successful solution of the difficulty, but the system, although it greatly reduced the quantity of copper necessary, only increased the radius of distribution on a paying basis by another quarter of a mile, and, while satisfactory for thickly populated towns, still left the distribution of light in suburban districts or openly built country towns as far from attainment as ever. The adoption of the alternating current system of distribution solved the difficulty.

The method of regulation first employed for the maintenance of equal pressure at the ends of the feeders in the three-wire system consisted of placing adjustable resistances or feeder equalizers in each circuit, more or less resistance being inserted by hand, according to the indications of the pressure indicators. Where the frames of such equalizers were made absolutely fire-proof, such a system of regulations in small stations having only three or four sets of feeders radiating from it was in a measure unobjectionable, but when it came to the distribution of several hundreds, perhaps thousands, of ampéres of current, through dozens of sets of feeders, the loss in these equalizers became a serious matter, and perfect regulation was difficult of attainment. In several cases also the heating of the equalizers was the origin of fires which resulted in the burning down of the stations, the destruction of the Edison stations in Boston and New York being cases in point. In recent practice these equalizers have not been used, but a method of interlacing the feeders as well as the distributing mains has been adopted, necessitating a somewhat larger outlay in conductors, but not involving, as in the other case, a loss of energy by the heating of useless resistance. With this interlacing the pressure at the lamps is much more nearly constant than under the old method.

At the price of labor and fuel and the selling prices current in this country, it may safely be said that the economical distribution of light or power, on the three-wire system, is limited to half a mile radius from the station in our most thickly-populated towns. In both the United States and Canada, distribution by this system has been carried out on a much wider area for a limited number of lights and under special circumstances; but it is doubtful if there is a single city in Canada which will return any dividend on the necessary investment to a company placing low tension wires carrying a pressure of even 300 volts underground, and there are not more than six cities in the whole Dominion which will yield any return on this system with over-head wires, unless the charges for electric lights be at least 50 per cent. more than the current prices for gas.

In the method of distribution by high tension alternating currents, the converters are placed in parallel circuit. As shown, the high tension current from the dynamo does not enter the premises of the consumer, but merely passes through the fine wire in alternately opposite directions, and generates, by induction, a low tension current in the secondary or thick wire of the converter or transformer, which induced current is carried into the houses and through the lamps.

There are at present no alternating current motors in use developing large powers, but probably before many months have elapsed machines will be supplied which will convert the electrical energy of alternating current into

power with high efficiency. Ganz & Co, of Buda Pesth, have, indeed, nearly completed a station from which to distribute power by A. C. motors, and the Westinghouse Company are just completing a contract for A. C. motors for mine working. It is also the case that the A. C. system will not easily lend itself to the charging of storage batteries, without a complication of commutators and other apparatus. But there does not appear to be any demand for the charging of storage batteries except what can be supplied from continuous current stations or isolated plants now in operation, or for which special dynamos would not be best used separate and distinct from any other circuit.

ANSWERS TO INQUIRIES.

Editor ELECTRIC AGE: Please give a simple rule for computing electrical horse power. What power can I get from a wire carrying a current of 100 volts and fifty ampères?

Westmoreland, Pa. J. C. K.

Answer—A simple rule, employing the factors you have given, is to multiply the voltage by the amperage, and dividing the result by 746, which in this case would be $\frac{100 \times 50}{746} = 6.70$, which is the horse power. Consult any of the recent books on electric lighting and electric power for these formulas.—Ed. ELECTRIC AGE.

Editor of the ELECTRIC AGE: I notice that on all of the electric cars in operation here the motion of the armature is transmitted to the car axles by cog gearing. Is the worm not good for such purposes?

Richmond, Va. WELSH.

Answer—Worm gearing has been used to some extent, and with satisfactory results, but cog gearing is held to be better.—ED. ELECTRIC AGE.

Elmore, Lake City—There are several dry batteries, of more or less merit, on the market. One of the most efficient that we know is Himmer & Anderson's, which can be restored after it has been worked out, by pouring in a small quantity of liquid which is absorbed by the carbon element. The Burnley battery is another good one.—Ed. ELECTRIC AGE.

Editor of ELECTRIC AGE: I am much interested in the articles you publish from time to time about the Edison-Lalande battery. I would like to ask if there is any local action in the cell, and if its value has ever been determined?

Troy, N. Y. A STUDENT.

Answer—The local action of the Edison Lalande cell is less than one half of one per cent. In other words, this means that more than ninety-eight per cent. of the theoretical amount of power contained in the zinc is obtained in practice.—Ed. ELECTRIC AGE.

F. A. M—A transformer is a device used on electric light circuits for transforming alternating currents of high pressure to lower pressure. This is the use to which they are put in practice. An induction coil is a transformer, but the results are the reverse: that is, a current of small pressure is transformed into one of high pressure.—Ed. ELECTRIC AGE.

R. J. Williams, Chicopee Falls.—An alternating current, sent through a self-exciting dynamo, will drive it continuously as a motor. The sudden reversals of magnetization, however, are liable to cause injurious heat unless the cores are thoroughly laminated.—Ed. ELECTRIC AGE.

THE PASSIVE STATE OF IRON AND STEEL.—In a paper on this subject recently read before the Royal Society, Mr. Thomas Andrews gives the results of his latest investigations in this direction. The results afford an indication that magnetization of comparatively low intensity, acting during considerable periods of time, exerts only a limited modifying influence on the passivity of iron or steel in the cold, though the influence is discernible when employing a delicate galvanometer. Magnetization, with the nitric acid at a higher temperature, produces a quicker effect. In a recent research by the author, on "Electro-Chemical Effects on Magnetizing Iron," it was noticed that local currents were set up between the polar terminals and central portions of steel magnets exposed as electrodes; and this class of local action, together with the slight alteration of the physical structure of the magnet bars consequent on their magnetization, may possibly be involved in producing the effects due to magnetism on passive steel or iron in concentrated nitric acid.

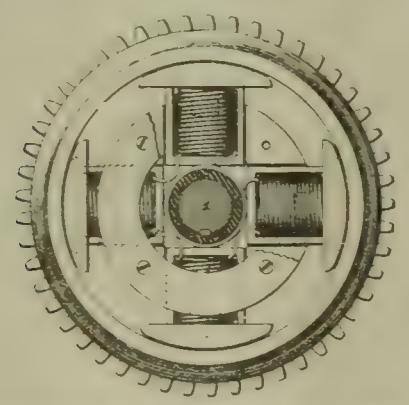
THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED JULY 15, 1890.

432,040. Electric Stop-Motion for Warping Machines. John P. Haslam, Wilmington, Del., assignor of seven-tenths to Francis E. Gallagher, Samuel L. Foster, and John T. Ahrens, all of same place. Filed Sept 28, 1889.

432,049. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed June 29, 1887. Divided and this application filed April 26, 1890.

432,050. Induction Coil or Transformer. Carl E. Kammeyer, Eau Claire, Wis. Filed April 1, 1890.



NO. 432,209.—ELECTRIC CLUTCH.

432,053. Electric Meter. Philip H. Korst, Racine, Wis. Filed May 27, 1889.

432,063. Trolley. William C. Miller, Albany, N. Y. Filed April 8, 1890.

432,095. Electric Railway Switch. William D. Swart, Boston, Mass. Filed Nov. 13, 1889.

432,098. Telegraphic Relay. John M. Treber, Louisville, Ky. Filed April 7, 1890.

432,131. Current Regulator or Rheostat. Otto Fleming, Philadelphia, Pa. Filed March 27, 1890.

432,136. Electrically-Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa. Original application filed Mar. 18, 1886. Divided and application filed Feb. 8, 1889. Again divided and this application filed Mar. 27, 1890.

432,142 Electric Locomotive. Walter H. Knight, New York, N. Y. Filed Feb. 24, 1885.

432,169. Dynamo Electric Machine. Frank A. Perret, Brooklyn, N. Y. Filed Feb. 24, 1890.

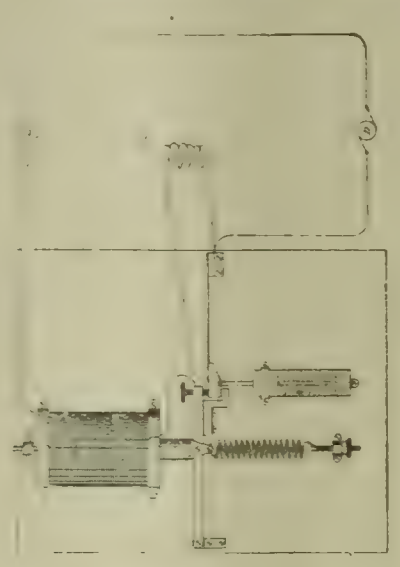
432 197. Electric Cigar-Lighter. Robert Graham, Reading, Mass. Filed April 7, 1890.

432,202. Electrode for Secondary Batteries. James F. McLaughlin, Philadelphia, Pa. Filed Dec. 19, 1889.

432,204. Means for Electric Locomotion. James F. McLaughlin, Philadelphia, Pa. Filed Jan. 30, 1890.

432,205. Electric Heater. James F. McLaughlin, Philadelphia, Pa. Filed Feb. 1, 1890.

432,206. Commutator Brush. James F. McLaughlin, Philadelphia, Pa. Filed Mar. 19 1890.



NO. 432,310.—REGULATION OF ARC LIGHT CIRCUITS

432,207. Electric Switch. James F. McLaughlin, Philadelphia, Pa. Filed April 17, 1890

432,208. Electric Motor Car. James F. McLaughlin, Philadelphia, Pa. Filed Apr. 19, 1890.

432,209. Electric Clutch. James F. McLaughlin, Philadelphia, Pa. Filed Apr. 26. 1890.

432,215. Apparatus for Detecting Short Circuits. Harvey Redding, Everett, Mass. Filed Apr. 14, 1890.

432,234. Electric Switch. Arnold C. Frey, Wilkinsburg, Pa. Filed Jan. 16, 1890.

432,237. Electrically Propelled Vehicle. John W. Henderson, Philadelphia, Pa. assignor to the Electric Car Company of America, of Pennsylvania. Filed Mar. 26, 1890.

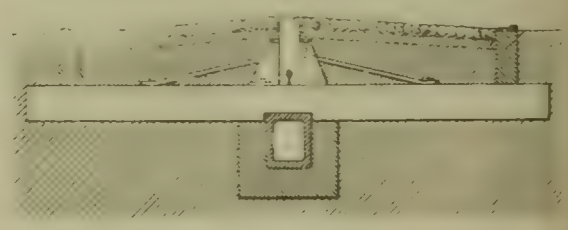
432,279. Current Regulator or Rheostat. George B. Massey, Philadelphia, Pa., assignor to Otto Fleming, same place. Filed Apr. 2, 1890.

432,284. Electric Arc Lamp. Edwin C. Russell, Boston, Mass. Filed Mar. 5, 1890.

432,310. Regulation of Arc Light Circuits. Daniel Higham, Boston, Mass, assignor to the Higham Patent Right Company, Rockland, Me. Filed Nov. 23, 1889.

432,345. Multiplex Electric Locomotive. Charles J. Van Depoele, Lynn, Mass. Filed Mar. 11, 1889.

432,387. Armature of Dynamo Electric Machines. Oscar A Enholm, New York, N. Y. assignor, by direct and mesne assignments of one-half to Julius M. Heyman, same place, and Emmanuel Duret de Brie, Cognac, France. Filed Nov. 23, 1889.



NO. 432,416.—CONDUIT FOR ELECTRIC OR CABLE RAILROADS.

432,416. Conduit for Electric or Cable Railroads John Lynch, Washington, D. C. Filed May 11, 1889.

432,453. Printing Telegraph. William W. Taylor, Mansfield, Mass., assignor of one-half to Ellen Maria Leavens, Providence, R. I. Filed Nov 23, 1889.

432,462. Graphophone. John H. White, Washington, D. C. Filed Dec. 23, 1889

432,500. Armature. Edmund Wagemann, Little Rock Ark., assignor of six-sevenths to John D. Adams, Dean Adams, Oscar Davis, John W. Davis, Horace G. Allis, and John B. Jones, all of the same place. Filed Sept. 24, 1889.

432,501. Electric Car. Edmund Wagemann, Little Rock, Ark., assignor of six-sevenths to John D. Adams, Dean Adams, Oscar Davis, John W. Davis, Horace G. Allis, and John B. Jones, all of the same place. Filed Oct. 17 1889.

ACCUMULATORS AT THE BERLIN TELEGRAPH OFFICE.—In a paper recently read before the Elektrotechnischer Verein, Herr Strecker, chief engineer to the German Imperial Telegraph Department, gave a brief account of the accumulators, which have been installed in Berlin in connection with the telegraph service. In October last a battery of 25 Tudor accumulators, having a capacity of 25 ampére hours, was installed at the Berlin telegraph offices. The cells are charged with a current of 7 ampéres by a shunt-wound Siemens machine, driven by a 5 horse-power Otto engine. The current is conveyed to the central office, distant 1.7 kilometre, by means of a seven wire cable, each wire having 5 ohms resistance. Only three wires at present used, and they convey the current in the following manner: The first, starting from the eighteenth cell of the battery, supplies 36 circuits at 34 volts; the second, starting from the twentieth cell, supplies 12 circuits at 40 volts; the third starts from the last cell of the battery, and supplies 13 circuits at 50 volts, six circuits at 60 volts, and one circuit at 80 volts. In the two last circuits 10 and 30 primary cells respectively are added to the secondary cells. These 68 lines comprise 41 Morse and 27 Hughes circuits The negative pole of the battery is connected to earth. The average discharge is at the rate of 60 milli-amperes, so that the accumulators can supply this from 30 to 40 days, although, as a matter of fact, they are charged every ten days. The charging is effected in the following manner:—The dynamo is switched on to the accumulators through very high resistance, so that the charging current is at first very small indeed. A wire is taken from the centre of the battery to earth through a voltmeter, and when the E. M. F. rises by about 2 volts, the engineer in charge, by means of a switch switches out a cell from the telegraph circuits, still leaving it in the charging circuits. The charging current is then increased, and as the E M.F. rises still further more cells are switched out. The reverse process is gone through on stopping. The difference of potential on the telegraphic circuit during the charging operations is kept so uniform that no complaints have ever been received from the central office. Since the cells were first employed in the beginning of October, 1889, they have worked in an irreproachable manner, and the authorities are so satisfied with them that they now propose to adopt them on a far larger scale.

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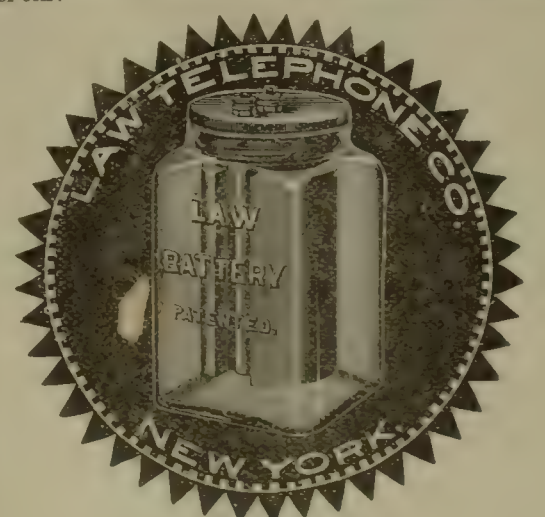
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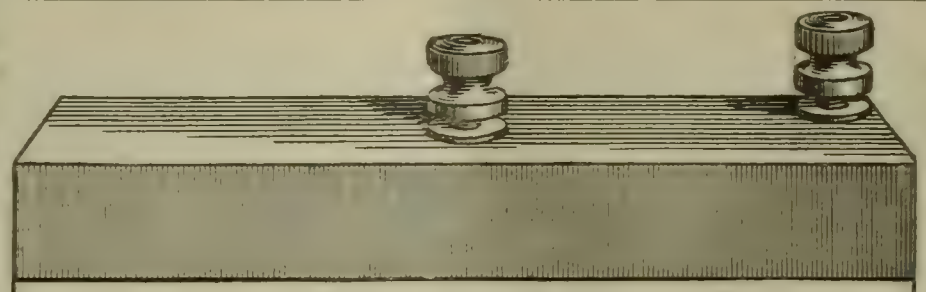
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The Crosby Battery is not affected by temperature; whether hot or cold, it is equally capable of performing the work for which it is intended.

The Crosby Dry Battery is only intended for **Open Circuit Work.** If, however, through an accident, it becomes **Short Circuited, it recoups itself.** This cannot be said with equal truth of any other Dry Battery known.



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NEW YORK, U. S. A.

This Battery is Sold Semi-Charged.

To Fully Charge Battery: Remove the cover and pour in SLOWLY through the holes in the top ONE GILL of pure water, divided equally between the two holes. In a few minutes the battery will be ready for use. If found necessary, after a long period of service, the battery may be recharged in the same manner. To prevent corrosion, care should be taken not to wet the brass connections.

The Crosby Dry Batteries are manufactured in different sizes and forms, to suit the needs of different purchasers. The quantity of current required for any given work can be secured by a change in the form and size of the battery.

In instances where very low internal resistances is desired, as in telephone work and for medical electrical purposes, the rectangular form is the better.

The quantity of current in the **Crosby Dry Batteries varies from one to ten amperes,** according to the size and shape, while the electromotive force remains constant at 1.55 volts.

To use the Crosby Dry Battery is to approve and indorse it. It will give perfect satisfaction. Comparison with other batteries shows its superior qualities.

Dr. Schuyler S. Wheeler, in writing of the **Crosby Dry Battery,** says: "I have examined the Batteries sent to me from your office, and take pleasure in assuring you that you are manufacturing a first-class Battery for Open Circuit Work which, for convenience and portability, has no equal. Its qualities of simplicity of construction, cleanliness, finish and general adaptability to the work which such batteries have to perform are at the same time equal to those of any batter yet brought to my notice."

OFFICE OF FLEMMING'S ELECTRO-MEDICAL INSTRUMENT MANUFACTORY, No. 1009 ARCH STREET, PHILADELPHIA, MARCH 8, 1890.

CROSBY ELECTRIC COMPANY, NEW YORK:

GENTLEMEN: The opportunity of expressing to you my views in reference to the Dry Cells made by your firm gives me great pleasure, and I do not hesitate in describing my experience with some of them. I charged and connected one of your No. 2 square cells with one of my rapidly interrupted 4-ohm resistance primary coils, starting it January 28, 1890, at 4 P. M., kept running all night and following day, January 29, when at 4 P. M. it became accidently short-circuited, and remaining so until 6 P. M. The cell was then released and allowed to recuperate till January 30: 7.30 A. M., started again, and left running until February 13, stopping during night time. Thus, in defiance of a two-hour short circuit, the cell functionated = 371 consecutive hours, a result never before attained in all my experience with open circuit battery cells. The same cell, being recharged afterwards, still retains its working capacity, apparently as good as previous to its testing. Very respectfully,

COPY. (Signed) OTTO FLEMMING.

CYLINDRICAL.
SIZE IN INCHES.

	Height	Diam	Price.
No. 3	7½ x	2½ inches.	$1.20

RECTANGULAR.
SIZES IN INCHES.

	Height.	Width.	Length.	Price.
No. 2	5 x	1½ x	4½	$1.20
" 3	9 x	1½ x	8	2.25

TELEPHONE.
SIZES IN INCHES.

	Height.	Width.	Length.	Price.
Long Distance	7½ x	2½ x	4¾	$2.00
Telephone	7½ x	2 x	4¾	1.50

THE CROSBY ELECTRIC COMPANY,

JUDGE BUILDING, FIFTH AVENUE AND SIXTEENTH STREET, NEW YORK.

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NEW YORK, AUGUST 2, 1890.

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EXTRAORDINARY.

Our illustrated articles this week are of unusual value and interest. The illustrations of the Western Uuion Building and the operating room after the fire will excite at once great attention and interest. They are reproduced from photographs taken especially for the ELECTRIC AGE; hence they represent accurately the actual appearance of the exterior of the seventh floor of the building and the operating room after the fire finished its work. They were the only photographs taken, and are therefore the only authentic and reliable records in existence.

The article on the systems of laying wires undergound in Paris is timely, and will be read with profit by those interested.

In the description of the Verity Safety Cut-out a very valuable fact is made prominent. Mr. J. G. S. Cunnington, the inventor of the cut-out, has discovered that when fuses are coated with grease, rosin or a similar compound, the fuse will melt at its normal point, whereas fuses not so coated become oxidized and in this condition will carry 50 per cent. greater current than that required to melt it when coated. In other words, this means that a fuse calculated to melt at a certain temperature will, in reality, not yield until a 50 per cent. greater current flows. This margin might in many cases result in disastrous consequences. This is a very important point to be settled and should receive the careful attention from experimenters that it deserves.

THE NEW WESTERN UNION OFFICE.—It has been decided to rebuild the stories above the fifth of the Western Union building and remodel that part of the structure. The mansard roof and the tower are to be abandoned, and instead, the new walls will be carried up straight and the roof flat. The portion to be rebuilt will be four stories high, making nine stories in all above ground. The property on Dey street, abutting the main structure will be carried up to the full height of the latter and made a part of the same. These improvements will give a great deal of additional space, and two of the new stories are to be used as operating rooms. The battery room is to be located in the cellar. In this latter connection the thought forces itself upon us that the danger that was always present in the old building need not be allowed to exist in the new. In the remodelled building it will be necessary to re-run all of the wires. If they run the same way as the old, that is not confined to fireproof channels, the danger of communicating fire to the building in case the wires catch fire will still exist. The use of fireproof conduits such as manufactured by the Interior Conduit and Insulation Company for the purpose of containing and enveloping the wires would render a fire from the cause named an absolute impossibility. It is reasonable to say that if these conduits had been used in the old building the heart of the telegraph system of the Western Union would not have been so completely paralyzed as it was on the 18th instant.

FIREPROOF BUILDINGS,—It is really amusing to read the comments on the fire resisting qualities of the Western Union building indulged in by the general press. Even some of the technical papers have taken up the cry from hearsay and proceed to discourse on a subject they evidently know nothing about, excepting what they have read emanating from the brain of some imaginative reporter who writes on "space." A technical journal introduces an article on the subject with the heading: "The Problem of Fireproof Bui dings still Unsolved." The fact is the fire in the Western Union building has not in any degree unsettled the problem; and nobody's faith in absolutely fire proof buildings need be shaken in the least. If the building were not fireproof how does it happen that it still stands? There is a vast difference between the furniture contained in a building and the building itself. Had it been that the building was not fireproof then in place of the immense pile that yet stands there would be nothing on the corner but a lot of rubbish. Architects ought to turn their attention now to rendering these fire proof buildings waterproof too. It may not always be desirable to have waterproof buildings, especially when occupied by concerns with large capitalization, but it would be a great satisfaction to many people to know that buildings could be made waterproof as well as fireproof.

ELECTRIC LIGHT AT ALL HAZARDS—The great question "Shall New York hereafter be lighted by electricity or gas?" has at last been settled—for a time at least. We pointed out some time ago that the people of New York would not consent to the return to the gas lamp in place of the electric light, and we are glad to see that the sentiment of the people is so fully represented in the Gas Commission. The appropriation for street lighting was not sufficient to meet the expense of using all of the electric lights, so, in order to keep within the limit and at the same time have the electric light, the number of lights to be used was reduced. The first city of the continent should set the example in all things, including electric lighting. Instead of that there are scores of small towns throughout the country who show greater enterprise and liberality in the matter of electric lighting than does the metropolis.

STRANGE COINCIDENCE.—It is a coincidence worthy of special remark that fire should have visited the present and former headquarters of the Western Union Telegraph Company within one week. Before the telegraph company moved into its present building it occupied the structure at 145 Broadway, corner of Liberty street. In the latter building fire occurred on July 25th, just one week after fire at 195 Broadway. The successive occurrence of events in one way or another connected are mysteries entirely beyond the power of the human mind to fathom.

THE ELECTRIC LIGHT IN GERMANY.—A Dresden syndicate has obtained a concession under which it will supply 168 towns in Saxony with electric light.

THE ELECTRICAL DIRECTOR OF THE WORLD'S FAIR.

It is very gratifying to note the keen interest taken in every branch of electrical industry in the movement to secure the selection of Mr. J. P. Barrett as the head of the electrical department of the World's Fair. As is well known, Mr. Barrett is the electrician for the city of Chicago, and a more efficient and energetic officer does not live. The enthusiasm with which his name has been received in connection with the proposed responsible position, is unmistakable evidence of the faith entertained in Mr. Barrett's ability to fill the position efficiently. Another fact in this connection is worth special mention. There is entire unanimity in the electrical field on the question of the fitness of the appointment. Corporations and individuals, prominent in electrical affairs, with one accord endorse him as the proper person to head the great department. There is no opposition whatever, and the petition in favor of his appointment is receiving the names of persons prominent in the electrical field in all parts of the country. The great electrical corporations are in favor of his appointment, and we notice on the petition the names of many persons of prominence who would not affix their names to such a document unless they knew that the person directly concerned was thoroughly efficient. With such a galaxy of names in his favor it hardly seems possible that Mr. Barrett's appointment can be otherwise than assured. The eastern interests are as hearty in their indorsement of Mr. Barrett as are those nearer and at his home.

In this connection we have just received the following letter from Mr. F. W. Jones, Assistant General Manager and Electrician of the Postal Telegraph-Cable Company:

NEW YORK, July 28, 1890.

T. R. TALTAVALL, ESQ.,
Editor ELECTRIC AGE.

Dear Sir: The nomination of Mr. J. P. Barrett, Electrician of the City of Chicago, for the position of Manager of the Electrical Department of the Columbian Exposition, is, in my opinion, eminently wise and fitting, and from a long acquaintance with Mr. Barrett I am thoroughly convinced that his selection would secure a man who would deal out even-handed justice to all parties interested, coupled with a patient ear for all complaints, and a courteous attention to the wants of the largest and smallest exhibitors alike. His executive ability is vouched for by his present responsible position, and is too well known to require any comment at my hands.

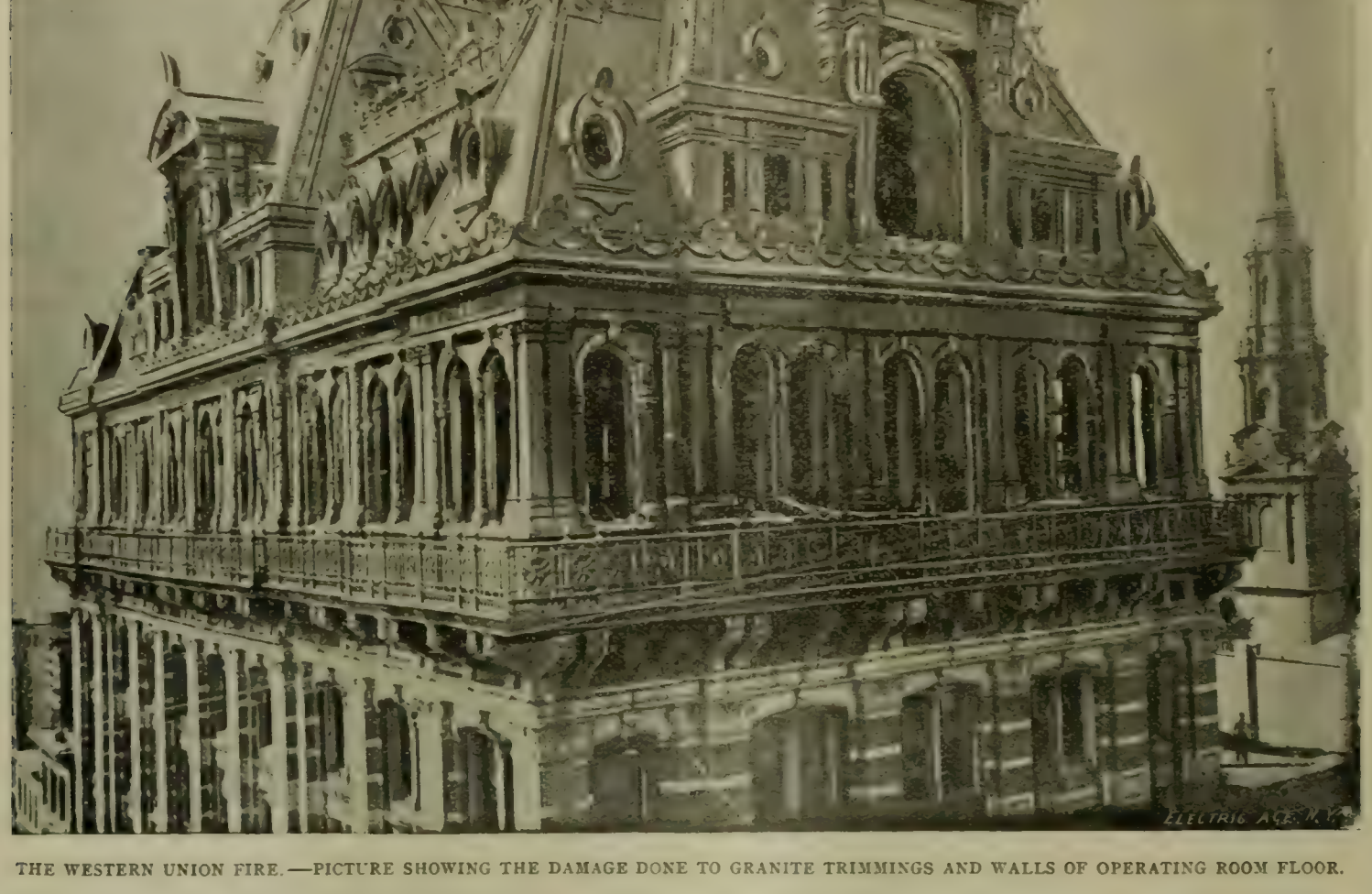
Yours very truly,
F. W. JONES.

A LECTURE FROM THE MAYOR.—Mayor Grant wrote a letter a few days ago to the Fire Commissioners lecturing them for their inaction in the matter of getting the fire department wires underground. He closes his letter by saying that he hopes that he will not be again obliged to call their attention to the matter, and that the wires will be removed from the poles at a very early date. Judging from the tone of his language Mayor Grant may be compelled to do something unpleasant if the Fire Commissioners do not stir. The language he uses reminds one very much of a mother administering a caution to her child.

ELECTRIC LIGHTING FOR BEGINNERS.—We present on another page the third of our series of articles on "Electric Lighting for Beginners." From many sources we have received expressions of commendation and approval, at having begun the publication of these articles, as there was a great necessity for information of this character. The interest that has already been manifested in these articles has inspired greater zeal in their preparation, and no effort will be spared to make them valuable to the thousands who are anxious to learn something about the method of lighting by electricity.

THE WESTERN UNION FIRE.

The illustrations given below of the upper portion of the Western Union building and of the ruins of the operating room are reproduced from photographs taken by Mr. Thomas R. Taltavall, editor of this paper, after the destructive fire. The exterior view was taken before the fire was completely extinguished, the black smoke from the fire engines in the street below rendering it necessary to watch for an opportunity between times to make the exposure. The picture shows very distinctly the damage to the granite trimmings on the exterior of the operating room floor. These were actually melted and broken off in large masses, completely ruining the ornamentation.



THE WESTERN UNION FIRE.—PICTURE SHOWING THE DAMAGE DONE TO GRANITE TRIMMINGS AND WALLS OF OPERATING ROOM FLOOR.

The operating room picture is most interesting. It was taken from a position near the Broadway and Dey street corner of the room, and the camera stood on a large pile of débris—the ruins of former operating desks, typewriters, instruments, etc The windows in the background look over the North river and New Jersey. The intense heat of the fire badly warped the four massive pillars at the Broadway end of room, one of which—out of plumb—is seen in the picture at the right. Immediately behind this pillar and above the head of the man in foreground is seen the ruins of the once magnificent switch board. Nothing of this was left but the heavy iron beams forming the frame work.

The great holes noticed in the ceiling and the walls, give further evidence of the great heat and resulting ruin. The ceiling was constructed of heavy iron beams filled in with bricks and plaster. After the fire, masses of this material were continually dropping from above, rendering it dangerous to life to move about the room. It was under these circumstances that these pictures were taken. When it is remembered that in this room before the fire were over 500 operating tables, each holding four sets of instruments, the devastation may be appreciated.

Everything inside the room that would burn was burned, and everything that would melt was melted—with the single exception of the heavy iron frame of the switch board and the news gallery.

Even these were twisted into all sorts of fantastic shapes. The large tubes which described graceful curves reaching more than half way to the ceiling, were melted down to the floor, and the frame work of the message carrier system went down with the rest in the general destruction

Another picture of the operating room was taken from the rear, looking towards the Broadway end. In this picture is seen the ruins of the gallery used by the Commerical News Department, which consist of a few twisted and tumbled down iron beams. Nothing in this magnificent room was left but the ruins of what it once was. The frame work of typewriters lay scattered in every direction in utter confusion.

Copies of the two photographs from which the accompanying illustrations were made, and that giving the front view of the room can be had at this office at 50 cents each. These three photographs comprise an interesting and valuable memento of this great fire. They were the only photographs taken, hence they are the only authentic records in existence and should be in the possession of every one interested.



THE WESTERN UNION FIRE.—VIEW OF OPERATING ROOM AFTER THE FIRE, LOOKING TOWARDS THE REAR—RUINS OF SWITCH BOARD SHOWN AT RIGHT. DIMENSIONS OF ROOM 150X65 FEET, 21 FEET HIGH.

The place where the fire first made its appearance in the operating room was a little to the right of the second man nearest the foreground

THE FRAGER CURRENT METER *

The following is a brief description of the latest form of the Frager meter, an instrument which is largely used by the Paris electrical supply companies. The Frager meter consists of an electro dynamometer, whose deflections afford a measure of the energy consumed, a clockwork arrangement which registers at stated intervals the energy consumed, and a train of wheels which show on a dial the product energy × time.

The electro dynamometer consists of a fine wire coil A (Fig. 1) divided into two halves. This coil

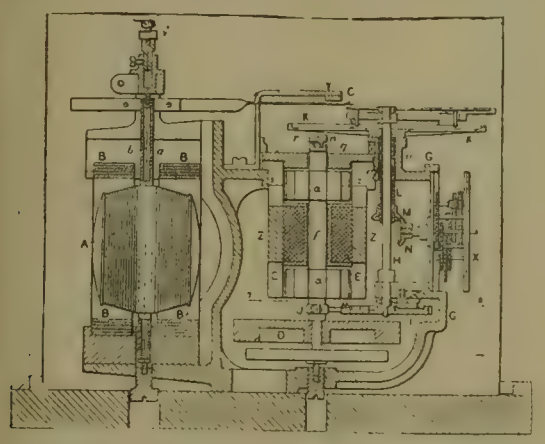
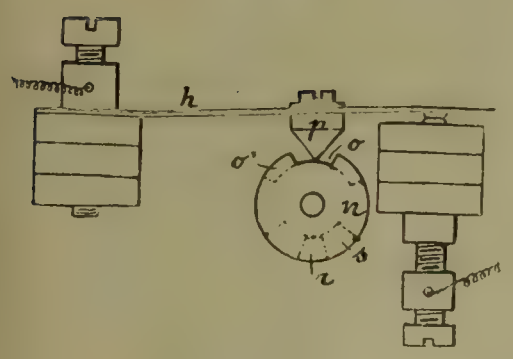


FIG. 1.—FRAGER CURRENT METER.

is suspended from a torsion wire *b*, and is enveloped by the thick wire coil B B, which is wound in the reverse way to A. The torsion wire *b* is kept taut by the adjustable screw *v*, and it is connected to the coil A through the tube *a*, which is rigidly attached to the frame of the coil and to the index needle C. The thick wire coil is in series, and the fine wire coil is in shunt with the lamp circuit. The action of the fixed coil B upon the movable coil A reduces itself to a





FIGS. 2 AND 3.

couple the moment of which may be expressed in terms of current intensity and a function of the angle between the axis of the two coils, as the moment of the opposing couple is proportional to the angle of torsion, the position of the index needle is a measure of the energy in the lamp circuit.

The clockwork mechanism is governed by a spiral spring seconds' pendulum, D, whose motion is maintained by electricity. To effect this the arbor *f* of the pendulum is provided with six projections (*see* Fig. 2), and moves freely within the hollow iron core Z of the coil E, which, together, constitute an electro magnet with poles at *a a*. The coil E is connected at one end direct to the coil A, but the other end is connected to the other end of A through the spring *h* (Fig. 3). The arbor of the oscillating pendulum terminates in a cap, *n* (Figs. 3 and 4). When *n* is in the position shown in Fig. 3, the pin *p* falls within the notch *o*, and the circuit is completed through the contact *t*. Underneath *n* we have the loose

* From *La Lumiere Electrique*.

disc *q*. This disc has a notch, *o'*, which is larger than *o*, and a cavity, *s*, in which oscillates the projection *r* (Fig. 4). When the pendulum D is in the middle of an oscillation, the teeth on the arbor, *f*, are in the position shown in Fig. 2, and the pin *p* falls within the notch *o*. As soon as the current passes the arbor rotates say to the right, the pin *p* is lifted out of the notch and the circuit is broken. When the pendulum is swung back by the spring, the circuit is again closed, and the electro magnet E gives it another impulse. This goes on until the amplitude of the oscillations is such that the pin *p* strikes against the other end of the notch. The average amplitude of the oscillations is therefore at least equal to the angle subtended by the notch *o*, and as the pin *p* falls within this notch at every half oscillation, the pendulum D receives an impulse every half oscillation. The object of the disc *q* is to prevent the oscillations from becoming too great. In fact, whenever the amplitude is greater than the play of *r* in the notch *s*, the cap *n* carries the disc *q* round with it, and if the amplitude of the oscillations becomes greater than *o'* × *s*, the ends of the notch *o'* lift the pin *p* and keep the current cut off until the diminution of the amplitude restores the notches to their proper relative positions.

The registering mechanism G (Fig. 1) is governed by the movements of the vertical arbor H, to which is attached the ratchet wheel I. The

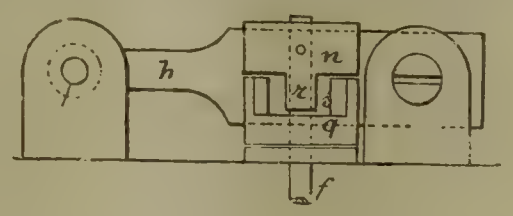
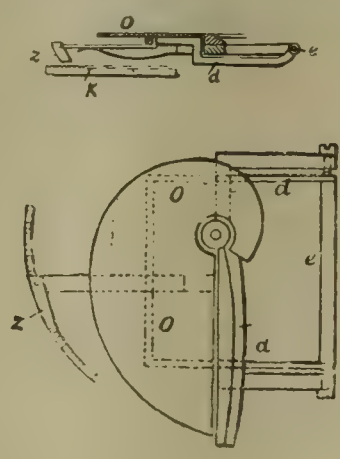


FIG. 4.

wheel I is provided with 100 teeth, and is actuated by the pawl J *u*, which causes it to turn through the distance of one tooth at every oscillation of the pendulum. The arbor H makes, therefore, one complete revolution in 100 seconds. At the top of the arbor H, there is a projecting piece which, at every revolution lifts the end of the electro-dynamometer needle C against the circular piece *y* (Fig. 1). When the projecting piece passes from under C the needle falls upon the cam O (Figs. 1, 5, and 6) and depresses it, causing its support *d* to turn round *e*, so that the catch *z* being pressed into the notched edge of the wheel K brings it round with the cam O. The rotation of K is transmitted by *v* L M N (Fig. 1) to the counting apparatus X, and as the rotation of K is maintained during the whole period that the end of C rests upon the cam O, this rotation is proportional to the energy consumed. Hence the dial pointers revolve every hundred seconds by an amount propor-



FIGS. 5 AND 6.

tional to the energy which is being consumed in the house circuit.

When at rest the axis of the coil A makes an angle of 45 deg. with that of the coil B B. The scale is, therefore, very open near the position of rest, and the meter is, consequently, very sensitive for a small consumption. By altering the relative position of the two coils, the meter can be adapted to heavy circuits. When the relative exactness of the indications of the meter between the limits which it is proposed to use it have been ascertained, the calibration is completed by increasing or diminishing the number of teeth on the wheel I, according as the meter registers too high or too low, or by changing the wheel N (Fig. 1) the instrument can be converted into an ordinary current meter by merely replacing the coil A by a bar of soft iron.

UNDERGROUND MAINS IN PARIS.*

The accompanying figures illustrate the methods adopted by two other companies engaged in the electric lighting of Paris. The Société de

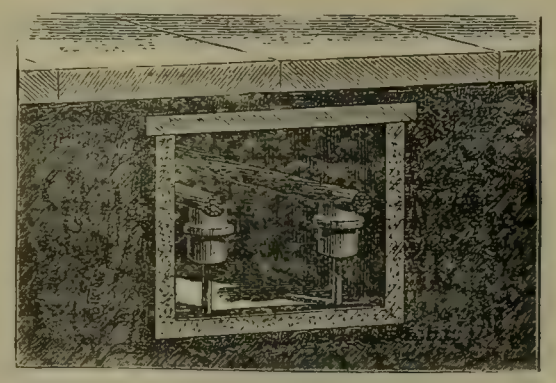


FIG. 1.—UNDERGROUND MAINS IN PARIS.

la Transmission de la Force par l'Électricité have at present three central stations, but these will shortly be converted into distributing centres fed from the main station at St. Ouen. A high-tension continuous current from St. Ouen will drive motors in the sub stations, the motors in their turn driving low tension dynamos. The mains of this company are of bare copper wire, and are supported on porcelain insulators situated in cement conduits as shown (Fig. 1). The conductors are kept on the insulators by galvanized iron cross-pieces. The Compagnie Popp employ iron pipes 20 cm. in diameter (Fig. 2). These pipes are provided with flanges, and the lengths are bolted together, a ring of india-rubber being

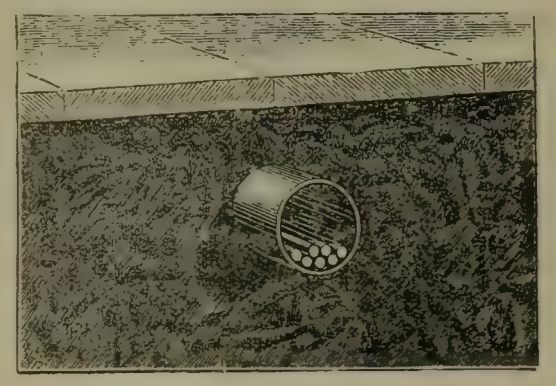


FIG. 2.—THE PAPP COMPANY'S SYSTEM.

placed between the two flanges as they are screwed up. The cables, which are insulated, are drawn in in the ordinary way.

SUBMARINE CABLE MANUFACTURE IN FRANCE.—The submarine cable between Demerara and Cayenne, a distance of 230 miles, has just been laid. This is the first submarine cable constructed by the Société Générale des Téléphones since it took up this branch of cable manufacture. The same firm have in hand 3,000 miles of cable for the Société Française des Antilles. The Société Générale is erecting large submarine cable works at Calais, and has given an order for the construction of a cable ship.

SPRAGUE MOTORS IN CLEVELAND.—The Sprague Railway and Motor Company, have just delivered to the East Cleveland Railroad Company, Cleveland, Ohio, thirty car equipments and six 80,000 watt generators. Some of the motors are for use on the Garden street line.

* *L'Electricien*.

THE VERITY PATENT SAFETY CUT-OUT.

In this cut-out contacts are placed at a given distance apart for a given quantity of current. The mounted fuse is also of a given length to exactly fit the contacts of the fuse blocks, making it impossible to fix a large fuse into a block where the length between the contacts is intended for a smaller size. A small fuse can be put into a large block if required, but on being overloaded would at once melt, and, as each block is stamped with a number of ampéres, the contact pieces are arranged for; when once the proper size of cut-out is fixed, a fuse of larger size can by no inadvertency be inserted. The safety blocks are made interchangeable as far as possible, so that the same fixing screws and holes will do for any size block. This is found con-

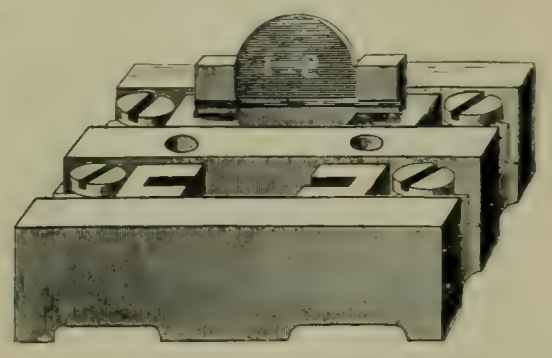


FIG. 1.—THE VERITY SAFETY CUT-OUT.

venient, as alterations are often made in house wiring, and lights added on to branch circuits where the carrying capacity of the branch conductors admits. Mr. J. G. S Cunnington, the inventor of the cut-out, has made a series of careful tests on fuses, and has found that if a lead or composition fuse be not coated with grease, rosin, or a similiar compound, it becomes oxidized when heated, going to a white heat, and carrying 50 per cent. more than the current required to melt it when not so coated. As an additional security, therefore, all the fuses supplied with these blocks are treated with a compound of rosin, which insures the fuse melting at its normal melting point—612°F. The parts are very well made, and have sufficient metal to

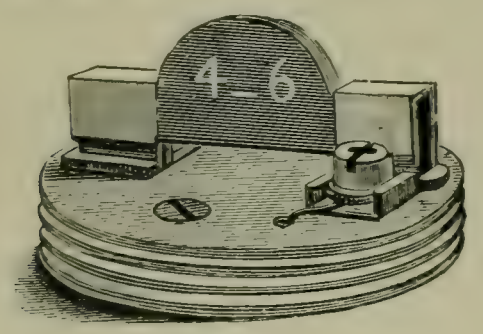


FIG. 2.

insure contact and to avoid the points heating, while the screw connections are of ample size for the cables.

The above particulars and illustrations are from the London *Electrician*.

AMSTERDAM.—The Town Council has passed the bill fixing the rules and conditions under which the electric lighting of Amsterdam shall be entrusted to those tendering in open competition for the contracts prior to September. The contractors will have to pay the Corporation 5 per cent. per annum on all receipts; of the balance, 6 per cent. will go to the contractors, who will also receive one moiety of the surplus, the other moiety going to the consumers. The Town Council is to have the right to readjust the charges for electric lighting every five years, and may lower them if found unreasonable or excessive.

ELECTRIC TRACTION IN ROME.—The tram line erected by the Series and General Electric Traction Company, in Rome, on the Series system, was opened by the King of Italy, July 6th.

A METHOD OF LOCALIZING PARTIAL OR DEAD-EARTH FAULTS IN INSULATED CONDUCTORS.*

This method is applicable to the elimination of faults from leads which have not been laid in pipes, or otherwise rendered inaccessible for manipulation.

The mode of procedure is as follows: The cable in which the fault occurs is wound on an

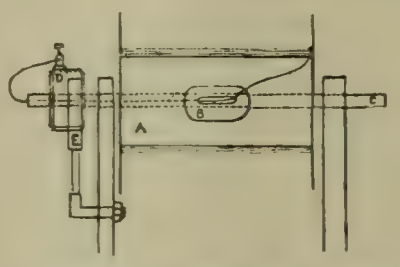


FIG. 1.—DIAGRAM OF DRUM AND CONNECTIONS.

iron drum of special construction, as shown in the diagram below (No. 1). A is the barrel of the drum, B an aperture cut in the barrel large enough to admit a man's hand, C a hollow tube which acts as the spindle of the drum. In C a slot about 10 in., in length is cut, and to one end of C an insulated collector, D, is fixed. A brush E, also insulated, and fixed to the stand which supports the drum, makes contact with the collector D. One end of the cable to be tested is passed through the aperture B, threaded through the slot in C, and attached to a terminal on D. The other end of the cable is led through a vessel containing water and insulated from the ground, the cable being then wound on an iron drum, mounted on an iron stand. In diagram No. 2, Z represents the water vessel, X,X,X,X, the insulating supports, and Y a pulley fixed under the water, and under which the cable passes. The end of the cable on A is connected to one pole of battery by a lead, one end of which is attached to a terminal fixed to the brush, E. The other pole of this battery is put to earth. In the insulated water vessel, Z, a metal plate dips, to which is attached, by a terminal above the surface of the water, a lead connected to a Thomson galvanometer. The other side of the galvanometer is put to earth. While the fault or weak place remains on the drum, A, no deflection is obtained on the galvanometer; but as soon as the fault leaves the drum the galvanometer is deflected, this deflection being greatest at the moment when the fault enters the water. Thus a fault or weak place can be localized with great accuracy, even to a few inches.

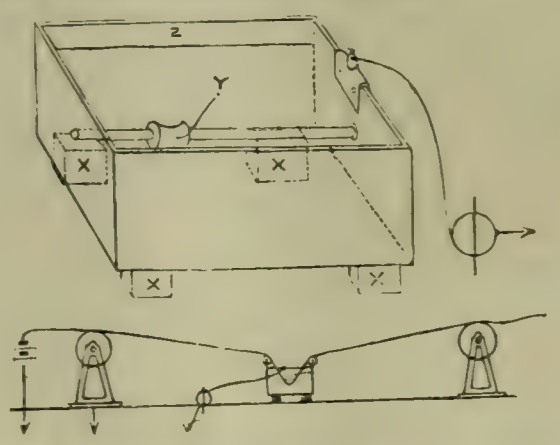


FIG. 2.—THE WATER VESSEL. FIG. 3.—GENERAL ARRANGEMENT.

The advantages claimed for this method are, that all cutting of the outside sheath of the cable is avoided; a great number of weak places in a cable can be localized in a very short time, and the time occupied in detecting the faults being dependent only on the speed with which the cable is wound from one drum to the other; faults of very high resistance can be localized with accuracy, any variation in the insulation resistance of different parts of the lead being at once apparent on the galvanometer. The test is not applicable to armoured cable, but has been used by the author with complete success with tape-covered, felted, and braided lead or cable. In the case of braided lead, this method of localizing faults is of exceptional value, as the expense of repairing faulty braided lead is very much augmented by the fact that any cuts in the braiding have to be repaired by hand.

A distance of several yards between the first drum and the tank is advantageous, as the absence of deflection on the galvanometer, while the fault remains upon the drum, is dependent upon the resistance of the sheath of the conductor between the drum and the tank. Also it is desirable, for this reason, to have the cable as dry as possible before beginning to test. Neither of the above precautions is, however, essential to the test; but the best conditions for making the test are not obtained if these points are neglected.

In diagram No. 3 a general arrangement of the test is shown, which will make the above description more easily understood.

* H. Cuthbert Hall in London *Electrical Review*.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part III—Commutators.

63—What is the commutator of a dynamo?

The commutator is that part of a dynamo designed for the purpose of causing the currents produced in the armature coils to flow in one direction in the external circuit.

64—As the currents are generated in the armature coils, are they not of one direction?

No; the currents generated in the armatures of all dynamos are alternating.

65—The commutator, then, is for the purpose of converting these alternating currents into direct currents?

Yes.

66—Are all classes of dynamos made with commutators?

No; only direct current dynamos—that is, only those which are designed to give currents of unchanging polarity.

67—Then alternating current dynamos have no commutators?

No; but in the place of commutators they have what are called collecting rings.

68—What are the collecting rings for?

Collecting rings on alternating current dynamos are for the purpose of affording a contact between the armature coils and the external circuit, so that the currents generated in the armature coils may be collected and led to the external circuit.

69—How many collecting rings are there on alternating current dynamos?

Two.

70—What do they represent?

They represent the two terminals of the armature coils.

71—Describe a commutator of a direct current dynamo.

A commutator usually consists of a number of segments of a circle, made of metal of good electrical conductivity, and placed on the armature shaft longitudinally, but insulated therefrom. Each segment is insulated from its neighbors, and the segments and insulating material between them form a circle around the armature shaft composed of alternate sections of metal and insulating material. In the illustration given in the preceding article, "s" shows the general appearance of the end of a commutator.

72—Describe the collecting rings of alternating current dynamos.

The collecting rings are unbroken metallic rings attached to the armature shaft crosswise, but insulated therefrom.

73—What do the segments of a commutator represent?

*Copyrighted.

The segments represent the terminals of armature coils.

74—What is the function of the segments?

To afford means of contact between the armature coils and the external circuit.

75—Why is a contact between the armature coils and the external circuit necessary?

In order that the electrical currents generated in the armature coils may pass into the external circuit.

76—Are all commutators made up of the same number of segments?

No, the number of segments varies according to the number of armature coils, and the manner in which the coils are connected with the commutator.

77—What metals are used for the segments of commutators?

Brass, copper, bronze, gun-metal, etc.

78—How many times during one revolution of the armature does the commutator change the direction of the current?

Twice.

79—In selecting the metal for commutator segments what qualities are essential?

Metal that is not liable to heat or corrosion should be selected.

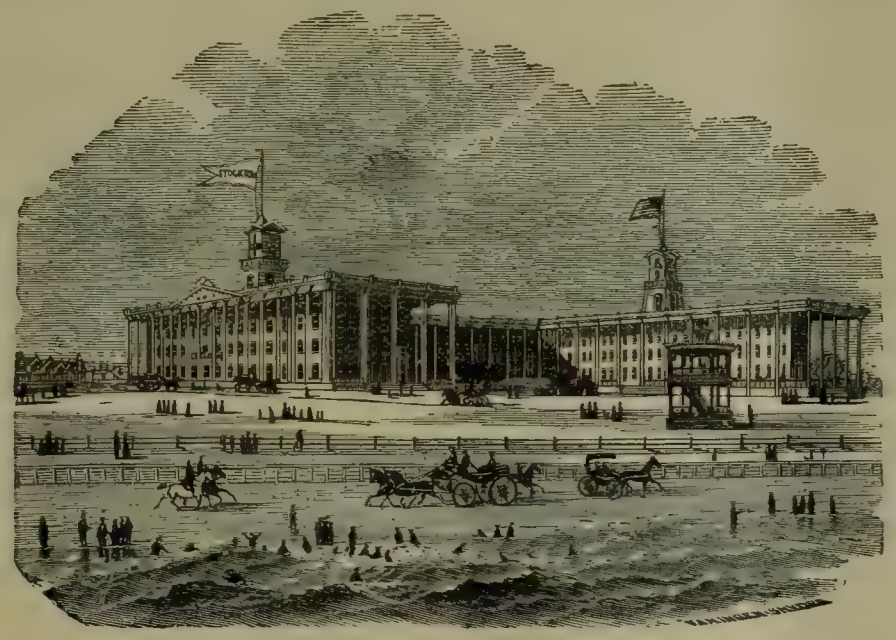
80—What is a two part commutator?

A two-part commutator is one with two segments. There being but two, each segment is made semi-circular.

(To be continued.)

THE ELECTRIC LIGHT CONVENTION.

We are in receipt from Mr. Allen R. Foote, Secretary and Treasurer of the National Electric Light Association, of some interesting facts in connection with Cape May where the next convention of that association will meet on August 19th next. Mr. Foote, gives an interesting account of the place, going back as far as its history will permit, which is the year 1609 when Henry Hudson landed there.



STOCKTON HOTEL, CAPE MAY, N. J.

He then tells how to get there to attend the convention. Mr. Foote also gives reasons for going there and advises any one having any interest in a Central Station Company, either as a stockholder, officer, manager or superintendent, to be there to engage in the discussions and learn of others' experiences, all of which will be profitable. Among the reasons for going there he mentions yachting, sea bathing, driving, pure spring drinking water, change and rest, etc., etc., as good ones.

The Heraldry of the Convention will be a feature of the meeting. The president's crest will be an owl; the vice-president will be known by the representation of a spring chicken [the spring of what year not stated]; the secretary and treasurer will be adorned with two saw-bucks pendant from a white, yellow and green ribbon. For the benefit of those who fail to see the significance we will state that two X's represent the saw bucks, also $20, which is the cost of becoming a member of this worthy association. The reception committee will wear a commutator brush pendant from a white ribbon.

Cape May is an excellent spot at which to hold a convention in the hot season, and we predict a thoroughly enjoyable time for all those who have the good fortune to be present.

The accompanying illustration is that of the Stockton Hotel at Cape May, N. J., at which the Convention of the National Electric Light Association is to be held.

ELECTRIC BLOWERS IN STEAMER FIRE HOLES.

One of the most humane uses to which electricity can be put is the ventilation of the fire room of ocean steamers. Reform in this direction is greatly needed, and we notice that in some of the latest fast trans-Atlantic steamers some attention has been given to this matter. In the stokeholes of fast steamers the temperature ranges from 125 to 140 degrees during the run. This may seem incredible to many but it is the fact, and its wearing effect on the coal heavers and firemen is extreme. The only relief afforded up to a recent date was short hours of work and long hours of intermission. No human being can stand such extreme heat long at a time, and yet, strange to say almost everything else about a steamship has received the attention of the managers. We are glad, however, for the sake of these poor fellows who are compelled to do this extremely heavy work in high temperature in the bowels of great ocean steamers that their turn for consideration is at hand.

On most of the large steamers can be found electric light plants. With comparatively little additional expense such vessels can be equipped with electric blowers which would keep the fire holes of these marine monsters comparatively cool and endurable. It would be economy to put these blowers in, inasmuch as the men would thereby be enabled to work longer hours and with less fatigue. Fewer men would therefore be necessary.

Electric Stations and the Public Health.—The Sanitary Council, Paris (Seine Department), has been requested to report upon the advisability of including electric stations in the list of *établissements insalubres*, by reason of the noise, trepidations, and smoke caused by them, and which have been bitterly complained of. In the last three years about thirty important electric stations have been erected in central positions.

Personal.—Col. C. M. Ransom has disposed of his entire interest in *Modern Light and Heat* to Mr. R. F. Ross, for the past four years Mr. Ransom's associate. Mr. Ross is now sole owner and publisher of that paper.

NEW YORK NOTES.

Mr. H. D. Stanley, of the Bridgeport Brass Company, was in town last week.

Mr. Alexander MacGruthar, of the Edison Phonograph Works, Orange, N. J., has relinquished his position on account of ill health.

Mr. S. S. Bogart, the well-known ex-telegrapher and telegraph superintendent, has been appointed inspector of new roads equipped by the railway and motor department of the Edison General Electric Company.

It was decided last week by the Gas Commission to accept the bids for street lighting from the electric light companies. The commission agreed to pay at the rate of 35 cents a light, but to bring the expenditure within the appropriation only 627 out of 890 lights will be lighted, unless better terms can be secured.

Missing.—Mr. William P. Adams, the electrician for the Scott Electrical Works, at 27 Liberty street, has been missing for several days. He was 32 years of age, and it is said that he had been complaining for some weeks of severe pains in the head.

All of the electrical supply houses in this city were heavily taxed in consequence of the Western Union fire, but, as far as known, all orders were filled with reasonable despatch. It is no common thing for such a demand for telegraph goods to be sprung on the dealers so suddenly, and to meet the demand as promptly as they did speaks well for the enterprise of these people. In reality a double equipment had to be supplied, inasmuch as the various offices opened throughout the city and in New Jersey had to be fitted out, in addition to the new equipment for the main office.

The Edison Industrial Works is the title of a company incorporated in Newark, N. J., on July 25th. The capital stock is $1,000,000, and the company will begin business at Silver Lake, N. J. The incorporators are Thomas A. Edison, Samuel Insull, and Thomas Butler. It is said the new company proposes to buy as well as to manufacture almost every kind of mechanical appliances. Mr. Edison has invented many devices with which electricity has nothing to do, and has become financially interested in others. The recent increase in the capital of his electric light company, and the transfer of its active management to other parties, enable him to devote attention to other branches of development. Mr. Edison also proposes to make a venture in gold mining. He has at odd times invented appliances for separating and handling metal which promise good results It is announced that he has recently purchased 1,000 acres of land in the wildest part of Moore County, South Carolina, and will prospect there for gold.

No better acknowledgment of the worth of the Edison-Lalande battery could have been wished or given than the orders received from the Western Union Telegraph Company in their extremity resulting from the fire in their building. Mr. James F. Kelly, the General Sales Agent for the Edison-Lalande battery, received an order at two p. m., Saturday, the day after the fire, for three hundred 6 x 8 cells (300 ampère-hour). On Saturday night 50 cells were delivered at the 415 Broadway office, and on Sunday 50 were delivered at 195 Broadway. The balance of 300 cells were delivered to the company as fast as required. 800 sounders are being worked by these 300 cells, and to get the same amount of work from the ordinary bluestone, or gravity battery, no less than 1,600 cells would be required. Thus a saving in the maintenance and room of 1,300 cells is effected. Mr. J. F. Kelly showed extraordinary enterprise in filling the order on such short notice. It was necessary to bring the cells into the city by wagon from the factory as the regular express companies could not deliver them early enough.

R. J. G.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE.
35 COMMERCIAL BUILDING,
CHICAGO, July 26, 1890.

MR PLATT of the Council Bluffs, (Iowa) Gas & Electric Light Company, was in the city this week.

MR. THOMAS LOWRY, president of the Minneapolis, Minn., street railway returned to Minneapolis on the 22d, from a trip to Europe.

THE BURLINGTON, (IA). ELECTRIC RAILWAY COMPANY have issued $300,000 worth of 6% twenty years' bonds and will use the proceeds for converting the old horse railway lines into an electric system.

AN ELECTRIC BRAKE.—Some interesting tests have just been made by Mr. E. A. Sperry on a new electric car brake devised by himself. With a current of 36 watts energy (2 ampères × 18 volts), a pressure of a ton and a half was applied to the periphery of each wheel. The brake was under perfect control and was highly commended by several prominent engineers who witnessed its operation.

MR. J. L. BARCLAY, of the railway department of the Westinghouse Co., returned from Pittsburgh, Pa., this week. Mr. Barclay reports the Westinghouse factories, which employ over 1,500 men, overcrowded with work, and says there were sixty street car equipments on the floor near completion when he was there. An instance of the great facilities possessed by this company for rapid work is shown by a blue print of a car truck exhibited by Mr. Barclay, which was made on June 26 and the car turned out complete on July 24, all w rk on same having been done within that time.

NEW COMPANIES.—Columbia Street Car Co., Chicago, to manufacture and operate cars and machinery and railway appliances; capital stock $1,000,000; incorporations, Patrick A. McArdle, Freeman J. Short, Arthur H. Walker. United States Electric Car Co., Chicago, to manufacture electric cars and motors and operate same; capital stock, $3,000,000; incorporators, M. S. Debolt, J. H. Donnelly, and John A. Qualey. The Underground Electric Light Co., Chicago; capital stock, $1,000,000; incorporators, Andrew J. Cooper, Frederick J. O'Connell, Charles A. Munson. This company propose to erect a plant at State and Twentieth Streets, Chicago, using the Jenney system, and will ultimately establish plants in other sections of the city. A company has been formed at Leavenworth, Kansas, with capital stock of $300,000, to construct electric street railways. They propose to put in twenty miles of track and will use the Sprague system. Incorporators are J. W. Fogler, W. N. Todd and others.

TO ANNUL WESTERN UNION CONTRACTS.—A bill in equity was filed on the 22d inst. in the United States Circuit Court at St. Paul, Minn., against the Northern Pacific Railroad Company, Western Union Telegraph Company, and the Northwestern Telegraph Company, setting forth that the defendant corporators have failed to carry out the provisions of the acts of Congress of July 2 1864, and April 10, 1869, in which the railroad company was granted valuable concessions from the United States in lands to the amount of twenty alternate sections through any State. One of the provisions of the act was that the railroad should erect and maintain a telegraph system. Subsequently the Northern Pacific made contracts with the Western Union Telegraph Company, and the complaint alleges that the contracts were beyond the powers of the railroad to make or the telegraph companies to receive and were induced by improper and corrupt considerations, and were against public policy and in violation of the rights of the United States under acts of Congress. The court is therefore asked to annul the contracts The complaint is signed by Attorney-General Miller.

F. M. L.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET.
BOSTON, July 26, 1890.

The Gloucester Common Council are to appoint a superintendent of electric wires.

The Manet Street Railway in Quincy is now operating satisfactorily a car making the trip, 3¾ miles, in 17 minutes.

At a meeting of the Milford Electric Light and Power Company, held this week, G. M. Greene was elected president.

Some of the pavers on the Essex Electric Road struck last week. They were immediately paid off and discharged.

Successful trial trips were run on the Augusta, Hallowell and Gardiner electric road last Tuesday night. Everything worked smoothly.

Work on the electric road between Dover and Great Fall, N. H., is progressing slowly and will not be finished until the last of August.

The directors of the Anglo-American Electric Light Co. at Kensington, Conn., whose plant was burned out recently, have decided to rebuild at once.

The East Side Electric Railway Company of Brockton have petitioned the selectmen for a location for their track. The petition will no doubt be granted.

An exhibition of the practical workings of the Port Electric Railroad was to have been given to-day, but was postponed on account of the inclemency of the weather.

The Thomson-Houston system will be used on the projected electric railroad between Naugatuck and Waterbury, Conn. The capital stock of the company building it is $50,000.

The New England office of this paper will hereafter be at 74 Federal street, where the writer would be pleased to see any of the electrical fraternity. They will be sure of a welcome and a soft chair.

President Smith of the Brown Electric Protector Company has been quite sick the past week but by his indomitable will has kept at work; to use his own expression "business first, pleasure afterward, no time to be sick now."

The Erie Telephone Company, during the past year, paid out for construction and repairs $133,000 which does not include $65,000 invested in underground wires and new switch work in Cleveland, St. Paul and Minneapolis.

The contractors for building the new electric line of the Lynn and Boston Street R. R. have begun work. Eight miles of overhead and underground wire and 250 hard pine poles have been received. Eight new box cars have been ordered.

The electric light station at Ware, with the entire contents, was destroyed by fire early last Monday morning. The loss is estimated at $12,000 and there is only $5,000 insurance. The fire was probably of incendiary origin. The plant will be rebuilt at once but on a new site and nearer the railroad.

The Lowell Electric Light Company has received the new five hundred horse power engine made by the Harris-Corliss Company, of Providence, and the foundation for it and the new boilers will be completed next week. The new plant will be ready for operation next month. Four new boilers will be put in.

Last week the Thomson-Houston Company at their factory assembled the largest generator for the transmission of power it has ever built. It is 250 horse power, 8½ feet high and weighs 23 tons. It is for railway work and will go to the West End Railway Company's power house in Boston.

It is unlikely that the proposed electric roa in Athol will be commenced this year.

The executive committee of the Newport, R. I Improvement Association has decided to rais $30,000 for the proposed new route of the elec tric cars to the bathing beach, $20,000 to be pai to the street railway company for the expens of changing its track and $1,000 to the city towar the laying out of the new road.

At a meeting of the directors of the New Eng land Telephone and Telegraph Company, hel in Lowell, a dividend of 75 cents per share wa declared payable August 15, to stockholders o July 31. The auditor's report for the last qua ter is as follows: gross earnings, $347,410.50 expenses, $264,914.47; net earnings, $82,496.03 construction, $18,122.69.

Superintendent Henderson, of the Newto Street Railway Company, declares that the lin will surely be put in operation August 1st. Th company has been somewhat delayed in openin the road owing to orders passed by the alderme requiring guard wires to be placed above th overhead wire. The Waltham Electric Ligh Company, which will furnish power for the new road, has introduced new boilers and engines i its plant.

The scheme to organize another street railwa at Holyoke, with electricity as the motive powe which was agitated several months ago, has bee revived, and it is understood that an applicatio has been made to the State authorities for charter. In case the latter is granted and a new company can secure a franchise from the cit government, it is proposed to put $75,000 int the venture and equip the road at once.

At a special town meeting held in Beverly las Tuesday evening, the report of the committe appointed at the Spring town meeting on ligh ing the streets was adopted with their recom mendations, that the subject be referred to a com mittee to devise a general system of lighting wit special reference to the use of electricity and wit authority to advertise for proposals and mak contracts for lighting, subject to the approval o the town.

A petition has been filed with the Whitma selectmen asking for the privilege of buildin an electric road from Abington to that place, being part of the system proposed to unite th towns of Rockland, Weymuth, Abington an Whitman. Should the line be built as propose there will be a direct communication with Bo ton via Weymuth and Quincy. The Whitma Electric Street Railway Company is interest in this new project.

W. J. P.

PORT-ELECTRIC.—The New England Port-Ele tric Company, which was ushered into existen with considerable *éclat* about a year ago, h since been gradually fading out of the memo of all except those who invested in the stoc A Boston reporter has been investigating t status of the company, and finds that it still e ists, but that everyone connected with it is v close-mouthed. It is still in its experimen stage of existence, and from all that could learned, is full of promise. It is said that t company is getting ready to pass into the han of a syndicate of Boston capitalists. The co pany was organized to carry mails and pac ages by electricity between New York a Boston by the system of the International Po Electric Company, of New York, of which t New England Company is a branch. Prof. A. Dolbear is said to be the electrician of the co pany, and a speed of sixty miles an hour is pro ised when the Port-Electric road is put in ope tion.

STREET RAILWAY ASSOCIATION.—The next ann meeting of the Street Railway Association w be held in Rochester, N. Y., on September 1 It is expected that the subject of electric railw will receive special consideration.

ANSWERS TO INQUIRIES.

"Inquirer" asks how many electrical horse power there are in one ton of zinc? One thousand three hundred and forty.

Editor of the ELECTRIC AGE—In the arc light why does the flame assume the form of an arc? I think I have read somewhere that it is from this fact that the light gets its distinguishing name: am I correct?

Galveston. W. J. HAIGHT.

Answer—The flame assumes the form of an arc from the fact that the electrical potential of the space between the carbons is much higher than that of its surroundings, including the air and external objects; consequently the incandescent vapor is repelled from this space by virtue of equality of potential within the space, and attracted outward by virtue of difference of potential between the space and its surroundings, and the flame being connected with the carbons above and below, the central part only yields to this outward pressure, producing the arc.

Yes, you are correct as to the name.—Ed. ELECTRIC AGE.

Rathbone, New Orleans—The rupture of incandescent filaments is attributed to the wasting away of the carbon, by its being driven off probably in the form of vapor, and in consequence of this structural weakness the filament yields to the intense molecular strain during incandescence. There are other causes for the weakening of the filament.—Ed. ELECTRIC AGE.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

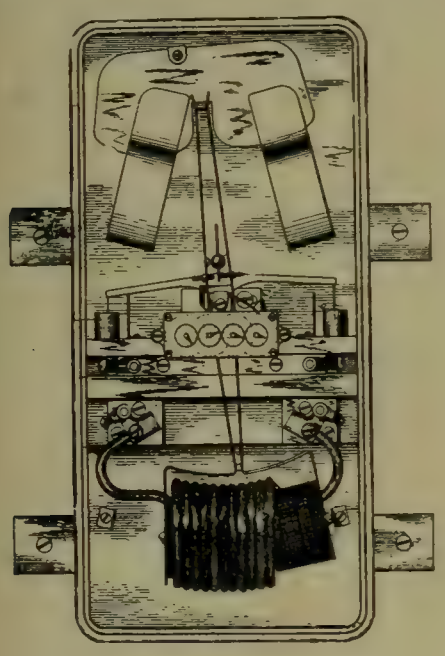
ELECTRICAL PATENTS ISSUED JULY 22, 1890.

432,512. Electric Stop Motion for Looms. David E. Coughlin, Milford, N. J. Filed July 5, 1888.

432,521. Electric Cut-Out. Stephen D. Field, Stockbridge, Mass., assignor of one-half to Phœbus H. Alexander, New York, N. Y. Filed Mar. 22, 1890.

432,547. Telephone Exchange. John A. McCoy, Medford, assignor to the New England Telephone and Telegraph Company, Boston, Mass. Filed Jan. 23, 1888.

432,561. Brush Reverser for Electric Motors. Anthony Reckenzaun, London, England, assignor to the Electric Car Company of America, Philadelphia, Pa. Filed Mar. 22, 1888. Patented in England May 1, 1885.



NO. 432,654.—ELECTRIC METER.

432,571. Conduit System for Electric Railways. Nicholas Seibert, Malden, Mass. Filed July 24, 1889.

432,577. Dynamo Electric Machine. Henry W. Spang, New York, N. Y. Filed Nov. 13, 1889.

432,581. Frog for Overhead Wires. Elihu Thomson, Lynn, Mass. Filed May 5, 1890.

432,618. Electrical Communicating System. Alfred G. Holcombe, Long Island City, assignor to the Electric Signal Manufacturing Company, New York, N. Y. Filed Jan. 6, 1890.

432,619. Call Box for Electrical Signaling Systems. Alfred G. Holcombe, Long Island City, assignor to the Electric Signal Manufacturing Company, New York, N. Y. Filed Feb. 11, 1890.

432,623. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. Original application filed June 9, 1886. Divided and this application filed Mar. 27, 1890.

432,629. Electric Metal Working Apparatus. Hermann Lemp and John Tregoning, Lynn, Mass., assignors to the Thomson Electric Welding Company, of Maine. Filed Apr. 2, 1890.

432,630. Forming or Shaping Metals by Electricity. Hermann Lemp, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed Apr. 2, 1890.

432,644. Current and Switch Controlling Mechanism. Edwin W. Rice, Jr., Lynn, Mass. Filed July 29, 1889.

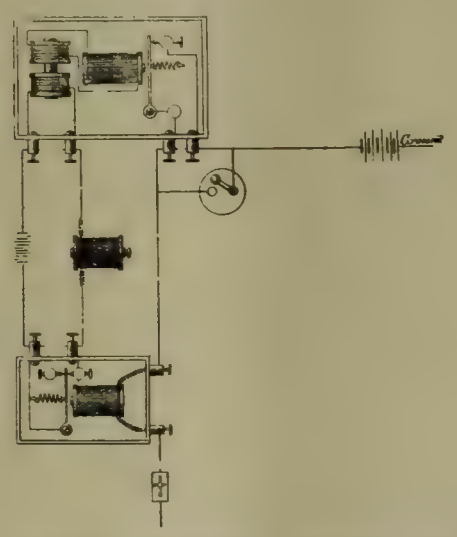
432,646. Motor for Electric Railways. Michael H. Smith, Halifax, County of York, England. Filed Oct. 29, 1887. Patented in England, Belgium, France and in Italy.

432,651. Method of Working Metals by Electricity. Elihu Thomson, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed May 17, 1888.

432,652. Welding or Other Dynamo. Elihu Thomson, Lynn, Mass. Filed Jan. 22, 1889.

432,653. Method of Welding Pipes by Electricity. Elihu Thomson, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Original application filed Feb. 21, 1887. Divided and application filed Oct. 19, 1888. Again divided and this application filed May 1, 1889.

432,654. Electric Meter. Elihu Thomson, Lynn, Mass. Filed Dec. 2, 1889.



NO. 432,724.—AUTOMATIC ADJUSTER FOR TELEGRAPH LINES.

432,655. Dynamo-Electric Machine. Elihu Thomson, Lynn, Mass. Filed Oct. 21, 1889.

432,656. Manufacture of Bands, Rings, etc., by Electricity. Elihu Thomson, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed Apr. 16, 1890.

432,657. Electric Lighting of Railway Trains. Illius A. Timmis, London, County of Middlesex, England. Filed Dec. 26, 1889.

432,670. Conduit Electrical Railway. Byron Jennings, San José, Cal. Filed Jan. 18, 1890.

432,672. Method of Making Secondary Battery Plates. William P. Kookogey, Brooklyn, N. Y., assignor to the Kookogey Electric Company. Filed Dec. 28, 1889.

432,673. Electric Railway. Frank Mansfield, Melrose, Mass. Filed Mar. 26, 1887. Renewed Jun. 17, 1889.

432,674. Electric Railway. Frank Mansfield, New York, N. Y. Filed Oct. 23, 1888. Renewed Apr. 12, 1890.

432,675. Electrical Railway. Frank Mansfield, New York, N. Y. Filed June 17, 1887. Renewed Feb. 9, 1889. Again renewed Apr. 12, 1890.

432,681. Battery Cell. Henry E. Waite, New York, N. Y., assignor to the Waite & Bartlett Manufacturing Company, same place. Filed May 6, 1890.

432,707. Electric Motor. Henry Humbert, Brooklyn, N. Y. Filed Feb. 5, 1850.

432,710. Filament for Incandescent Electric Lights. Lawrence N. P. Poland, Cincinnati, Ohio. Filed Apr. 21, 1887.

432,724. Automatic Adjuster for Telegraph Lines. Courtland P. Carr, Chicago, Ill. Filed Nov. 26, 1889.

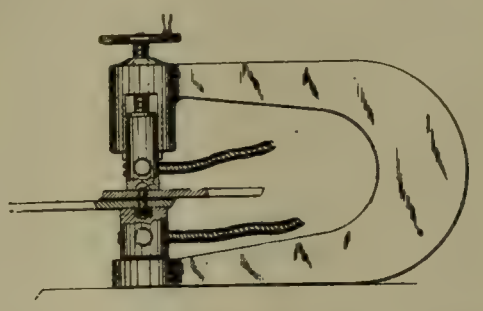
432,727. Method of Electric Riveting. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed Apr. 24, 1890.

432,745. Electric Lighting System. Edward T. Cooke, and William H. Mackay, St. Louis, Mo. Filed Dec. 6, 1889.

432,748. Armature for Dynamo Electric Machines. Nathan H. Edgerton, Philadelphia, Pa. Filed Oct. 26, 1889.

432,752. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed May 15, 1889. Divided and this application filed Apr. 11, 1890.

432,753. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed June 9, 1886. Divided and application filed Mar. 27, 1890. Again divided and this application filed May 28, 1890.



NO. 432,727.—METHOD OF ELECTRIC RIVETING.

432,823. Magnetic Separator. George S. Finney, Chicago, Ill. Filed Nov. 11, 1889.

432,858. Telegraph Pole. Charles M. Brush, Great Bend, Pa., assignor of one-half to Cornelius J. Waldron, same place. Filed Feb. 15, 1890.

432,883. Support for Telephone Hearing Trumpets. Simon Lebenberg, Berlin, Germany. Filed Mar. 31, 1890.

432,884. Electric Gas Lighter. Joseph H. Lehman, Philadelphia, Pa. Filed Jan. 23, 1890.

432,886. Phonograph. James P. Magenis, North Adams, Mass. Filed Nov. 14, 1889.

432,894. Rheostat. Thomas J. Parrish, Nevada, Mo. Filed Feb. 14, 1890.

432,927. Automatic Lubricating Device for Electric Motors. Samuel L. Barriett, Brooklyn, N. Y. Filed Mar. 13, 1890.

432,932. Heating by Electricity. Watkins L. Burton, Richmond, Va., assignor to the Burton Electric Company, same place. Filed Dec. 23, 1889.

432,944. Conduit Electric Railway. Byron Jennings, San. José, Cal. Filed Feb. 6, 1889.

432,949. Arc Lamp. Austin H. Lucas, Pittsburg, Pa., assignor of one-half to Asaph T. Rowand, same place. Filed May 1, 1890.

PATENT DECISION.

A decision of importance and of great interest to electrical inventors was decided by the Commissioner of Patents on July 2d. It was in the case of De Ferranti vs. George Westinghouse, Jr., on the question of priority of invention.

Commissioner Mitchell's decision is as follows:

This invention consists in an improvement in electric converters. Westinghouse has taken no testimony and relies upon the filing date of his application, December 27, 1886. De Ferranti filed his application April 18, 1887. The burden of proof is upon the latter, and the question to be determined is whether he has established by statutory proof an earlier date of invention than December 27, 1886.

The evidence relied upon by De Ferranti for that purpose is a publication of the British Patent Office, in the form of a pamphlet, containing the provisional specification describing his invention, bearing date December 9, 1885, and also his complete specification, dated September 9, 1886. It satisfactorily appears that De Ferranti was the inventor and not the mere importer of the invention described in the two specifications. The imprint at the bottom of the title-page indicates that the pamphlet, which purports to be a second edition, was published in 1887.

No dates are established on behalf of De Ferranti excepting those already stated as the dates of his two specifications and the date of said publication. Two of these dates, being the respective dates of the specifications, are, however, older than the filing date of Westinghouse, and the question to be determined, therefore, is whether the invention of De Ferranti was patented as early as the date of his complete specification. If so, he has established by proof recognized by the Revised Statutes as competent an earlier date of invention than that upon which Westinghouse has elected to rely.

Section 4923 of the Revised Statutes is as follows:

"Whenever it appears that a patentee, at the "time of making his application for the patent, "believed himself to be the original and first in- "ventor or discoverer of the thing patented, the "same shall not be held to be void on account "of the invention or discovery, or any part "thereof, having been known or used in a foreign "country, before his invention or discovery "thereof, if it had not been patented or described "in a printed publication."

In applying this statute it is to be borne in mind that although Westinghouse has a patent it was granted during the pendency of De Ferranti's application, and is to be treated, for the purpose of interference proceedings, as if it were still a mere application, and that as an applicant Westinghouse would be entitled to receive a patent as against all foreign knowledge or use of the invention of De Ferranti, unless the latter had been patented or described in a printed publication prior to the earliest date of invention established on behalf of Westinghouse.

In *O'Reilly* v. *Morse* (15 How., 62) the court said:

"Now, we suppose no one will doubt that "Morse believed himself to be the original in- "ventor when he applied for his patent in April, "1833. * * * And neither of the English "inventions is shown by the testimony to have "been patented until after Morse's application "for a patent, nor to have been so described in "any previous publication as to embrace any "substantial part of his invention. And if his "application for a patent was made under such "circumstances, the patent is good, even if in "point of fact he was not the first inventor.

It is obvious from the foregoing that if De Ferranti is to prevail in this interference it is because his invention was either patented or published on or before the 9th day of September, 1886, that being the date when his complete specification was filed.

Three periods of British legislation may be profitably considered in determining when an invention is "patented" under British laws: (1) The law as it existed prior to the English Patent Amendment Act of 1852; (2) the law created by the latter act and by acts amendatory thereof, and (3) the act of December 31, 1883, under which the De Ferranti patent was granted.

1. Prior to the English Patent Amendment Act of 1852, in order to obtain a British patent, the applicant filed his application stating the title or general designation of his invention and received his patent dated and sealed as of the day when it was actually granted. After receiving his patent he filed his specification, which was enrolled usually upon the same, but sometimes upon a later day. When enrolled, it was open for public inspection. As the law then stood the date of the enrollment of the specification was the date when the invention became "patented" within the meaning of the American statutes. At that date it became a public patent.

In *Elizabeth* v. *Pavement Co. et al.* (97 U. S., 126) the Supreme Court said:

"It would be very difficult to sustain Nicho'- "son's patent if Hosking's stood in his way. But "the only evidence of the invention of the latter "is derived from an English patent, the specifi- "cation of which was not enrolled until March, "1850, nearly two years after Nicholson had put "his pavement down in its completed form, by "way of experiment, in Boston. A foreign "patent, or other foreign printed publication "describing an invention, is no defense to a suit "upon a patent of the United States, unless "published anterior to the making of the in- "vention or discovery secured by the latter, "provided that the American patentee, at the time "of making application for his patent, believed "himself to be the first inventor or discoverer of "the thing patented. He is obliged to make oath "to such belief when he applies for his patent; "and it will be presumed that such was his "belief, until the contrary is proven."

2. Under the act of 1852 and subsequent acts prior to 1883 one method of obtaining a patent was by filing an application and the complete specification at the same time and receiving a patent subsequently granted and sealed as of the date of the application. The other method included an application and a provisional specification filed together, followed by a patent granted and antedated as in the other procedure, but conditioned on the filing within six months of a complete specification fully describing the patented invention. The enrollment of the specification was abolished by the act of 1852, and the invention was open to the inspection of the public at the filing of the complete specification. The decisions, so far as my attention has been directed to them, relate to patents granted on the condition that a complete specification be filed within six months. In all such cases where the question before the court involved the validity of an American patent, in view of the patenting abroad of the same invention, the courts have held that the latter became "patented" within the meaning of the Federal statutes at the date of filing a complete specification.

In *Smith* v. *Goodyear Dental Vulcanite Company* (93 U. S., 486) the Court said of the English patent to Charles Goodyear.

"It is enough to say that, though the pro- "visional specification was filed March 14, "1855, the completed specification was not "until the 11th of September following. It was, "therefore, on the last-mentioned date that the "invention was patented."

According to the authorities, an invention patented abroad was not "patented" so as to operate as a bar to the issue of a patent or as a defense to a patent already issued under the British law prior to the Patent Amendment Act of 1852, until the *enrollment* of the complete specification, and under that act and others prior to the act of 1883 the invention did not become "patented" until the *filing* of the complete specification. The date of publication was the decisive date, the theory of the law being that publication was essential before the invention could be held to be "patented" in a complete and adequate sense.

3. The procedure under the act of 1883, under which De Ferranti's foreign patent was granted, is as follows: An application is filed, accompanied by either a provisional or complete specification. If the specification is provisional, notice of its acceptance is given to the applicant and such acceptance is published in the office journal. Within nine months after the application the complete specification is required to be filed. The subsequent procedure is the same as when a complete specification is filed with the application—that is to say, the complete specification is sent to an examiner to determine whether certain requirements of law have been complied with. When the complete specification is adjudged to be satisfactory, an advertisement of the fact of acceptance is made by publication in the Offical Journal of the Patent Office, which advertisement specifies date of application, title of invention, and name of applicant. Upon this advertisement of the acceptance of the complete specification the latter is, by express provision of law, open "to the inspection of public." The specification is thereafter officially published in print, either as provisional and complete or as complete only, according as the fact may be. Two months from the date of the advertisement of the acceptance of the complete specification the patent is sealed, unless there has been opposition, in which case the sealing awaits a decision favorable to the grant. The patent is sealed as of the date of the provisional specification, if there be one; if there be none, of the date of the complete specification. The term of patent begins at the date of the application.

The leading features of the present law distinguishing it from the laws repealed are that the complete specification must be filed before the patent is granted; that the complete specification is not open to the inspection of the public when filed, nor even when afterward accepted, but only when advertisement is made of the fact of acceptance, and that the sealing of the patent is now, as in the case of an American patent, the last step preceding its publication as a patent.

Such being the law, the question to be determined is when a British invention can be said to be *patented*, under the patent act of 1883, within the meaning of sections 4,886 and 4,887 of the Revised Statutes, and whether De Ferranti's invention can be said to have been patented in England prior to the American application of Westinghouse. The first branch of the question is of some difficulty, but the latter branch seems to present no difficulty whatever. De Ferranti's application reached the stage at which the complete specification is filed before Westinghouse filed his application; but the filing of the complete specification is not accompanied by publication, as was the case under the British acts prior to 1883, nor does the filing of the complete specification cause any security or protection to be afforded to the inventor. The filing of the complete specification no more represents the stage at which an invention becomes a patent, under the present British statute, than does the filing of the specification cause an American invention to be thenceforth patented, and I can discover no reason why an invention, under the existing law of England, can be said to be patented before the seal is finally attached, which would not prevail with equal weight to show that a domestic patent becomes patented at an earlier stage of the proceedings than the final act of affixing the seal.

The only proven dates of De Ferranti are the filing of his provisional specification December 9, 1885, the filing of his complete specification September 9, 1886, and the second publication of the complete specification in 1887.

It will not be contended, in view of what has been said, that on either of the first two dates was the invention either patented or described in a printed publication, and the latter date, being the date of the publication of the specification

is subsequent to the application of Westinghouse.

But it is contended on behalf of De Ferranti that his complete specification was accepted and made accessible to public inspection on December 9, 1886; that the complete specification was published and printed January 1, 1887; that the patent was sealed and issued on the 15th of February, 1887, and that although these facts were not duly proven they should be considered by the Commissioner. It is not necessary to consider whether the Commissioner may resort to sources of information outside of the proofs in the case, because the earliest date at which it is claimed that the complete specification was printed and published was January 1, 1887, which was subsequent to the filing of Westinghouse's application. Still less would the date of the patent, if duly proven, furnish the basis of an adjudication in favor of De Ferranti. The fact that the specification was accessible to public inspection December 9, 1886, is immaterial, for it was not then a printed publication and it certainly was not a patent. It is also claimed that the specification was published in the Official Journal of the British Patent Office, December 10, 1886. The only publication that then appeared was the publication of the fact that the complete specification had been accepted.

Whatever view of the case is taken and whether I am limited to the immediate record or may, as De Ferranti contends, resort to other sources of information, there was no printed publication or patent in existence on the 27th day of December, 1886, disclosing the invention in controversy as the invention of De Ferranti, and therefore the decision of the Examiner-in-Chief, adjudicating priority in favor of Westinghouse, must be affirmed.

CARS FOR ELECTRIC TRACTION WORK.*

To doubt their abilities to turn out the best possible designs of cars for electric lines as well as general tramway work may, perhaps, appear no great compliment to the carriage and wagon builders of this or any other country; and yet without absolutely wishing to impute a want of being up-to-date-ness, one cannot help wondering whether every single detail of these designs has received such consideration as details notoriously deserve.

In dealing with vehicles to be propelled for public use along roads or tramways, it seems to me (especially in the present state of our knowledge and experience) most essential that every conceivable care should be taken to cut down useless weights and employ only such material in such proportions as may be truly consistent with two great requirements—*strength* and *lightness*.

In any case, of course, it is a simple matter of common sense to save the expenditure of power in moving superfluous weights; more especially is this so when such power is obtained at considerable cost owing to natural disadvantages, or when the weights necessary to be moved are of large amount.

A true engineer—whose business it is to economize natural forces and use them to profitable advantage with little waste—will gladly avail himself of all improvements which tend to such results.

It may be too much to expect that he will adopt them if there be no personal profit likely to accrue; but he should certainly not be found opposing the introduction of improvements that bring about a great economy of time and energy.

This is *àpropos* of what forms, without doubt, a characteristic of this country: we are decidedly slow in adopting proposed changes, even when they are shown to be beneficial.

Returning to our cars, however, the question at issue resolves itself into an enquiry as to whether a tolerable state of perfection has been reached in the design and construction of tram-

* Frank B. Lea, in London *Electrical Review*.

way cars, more especially in view of the rapid spread of electric traction even in England.

As for America, of course, we are far behind the results there attained; and, perhaps, it is as well. We have, at any rate, the experience of others to profit by, and the changes made here will be more permanent and enduring when they do come to pass.

There is no need in this place to enter into a discussion of the various methods or systems of electric traction; it may be assumed with safety that throughout our English towns and cities but one system will be permitted or will prove really workable along crowded streets and thoroughfares.

The public authorities are dead against the use of overhead wires for such purposes; underground conduits are very expensive to instal, and sometimes the groove presents disadvantages, so that the plan of using accumulators in automotive cars proves to be the only resource left.

The weight of these accumulators forms a very heavy item in the total car load, being, as a rule, quite as much, if not absolutely more, than that of the passengers or paying load, and hence it becomes a most important question to ascertain whether all that is possible has been done to lessen the dead weight of electric tramcars.

At present, unfortunately, there seems little or no prospect of any great saving being affected so far as the accumulators themselves are concerned, much as it might be desired. Until our inventors have devised some better material than lead as a basis for secondary batteries, we shall be able to gain little or nothing in this direction.

There is, however, a tendency (even with the employment of lead) towards increasing the output of energy per pound of battery weight, but this has a theoretical as well as practical limit. The electric motor and gear do not form a large fraction of the total weight, so that even if a further saving of weight could be made in them, it would not be worth the corresponding decrease in strength or efficiency. The experience already obtained with generators and motors enables us to construct them with almost perfect efficiency, and the proportion of output to weight has practically increased to its greatest limit under present conditions.

The greatest reduction should certainly be looked for in the accmulators, but, pending developments in this direction, there is no possible harm in making sure that our cars themselves are as light as they can well be, consistently with the needful strength.

The most general types of tramcar at present in use, both in this country and the United States, are four in number. Taking these in their order of size, and starting with the smallest, we find that it has an average seating capacity for sixteen passengers inside; it is of the closed car type, and therefore without facilities for carrying passengers outside, The average weight of such a car ready for use may be taken at 30 cwt. or 3,360 lbs.

Sixteen passengers will average 150 lbs. each, so that the paying load is about 2,400 lbs., and the ratio of paying load to car weight becomes .71. These figures are taken from data supplied by the ordinary horse car service, but it may be shown that pretty nearly the same proportion holds good in the few instances where electric cars of this size are at work.

At Lafayette (Ind.) the twelve feet passenger cars, with seating capacity for about sixteen passengers, have each a total weight of 4,100 lbs. Deducting, say, 25 per cent. of this for the motors (two in number, of 7½ horse power each) and the necessary gear, we have, approximately, 3,000 lbs. as the dead weight of the car; and with the same weight of passengers this works out to a ratio of about .78 between paying load and weight of car.

This appears to show that American car construction is slightly better than that of this country, so far as lightness is concerned, but the difference is not very material. Proof of such a statement is better shown by the fact of so many cars of American origin being seen at work in our midst.

The second type of tram car, and the next in size, is that so prevalent in the States and known as a 16 feet closed car, having a seating capacity of about 22 passengers.

Taking the average of eight lines, all worked by electricity, and in operation throughout the United States, the weight of the car with motor or motors, gear, &c., complete, come to about 5,700 lbs. From this should be deducted at least 25 per cent. for motors and gear, assuming the same average weight for passengers, we have a total ratio of 3,300 to 4,275, that is .79—approximately the same result.

As a matter of fact, however, the practical ratio of paying load to dead weight of car would be found to average in the States nearly double the amount above named, for the simple reason that the seating capacity is barely half the carrying capacity.

There is no need to use outside seats on these cars; passengers crowd in utterly regardless of sitting room, and the proverbial barreled herrings (if they could only move them) would wag their tails in sympathy with fellow sufferers. Of course this overcrowding would not be permissible to such an extent in this country, and hence the seating capacity of cars is as fair a standpoint as any by which to judge of their merits or demerits.

Coming next to the third type of car, that usually seen on our English tramways drawn by two horses, and with seats on the top, the average weight, as given by a competent authority, is 50 cwt., or 5,600 lbs. These cars can seat between 46 and 50 passengers; but assuming 48 as a mean, we have a total paying load of 7,200 lbs., and a ratio between this load and the weight of car of 1.3.

This represents a considerable improvement and is perhaps the best result so far achieved.

From such data as may be gathered from the sadly too sparse instances of electric cars built on this plan, practically the same result is given, showing that the carrying capacity of cars increases, as might of course be expected, in a greater ratio than their weight.

The fourth and last type of car is that known as the double truck, or double bogie car, with top seats and carrying an average of 60 passengers.

The weight of such a car is given as about 80 cwt., or 8,960 lbs. With a seating capacity of 60 persons the ratio is a little over 1. This is a slightly worse result than in the last case, but might obviously have been expected because of the increased weight in trucks and wheels. At the same time, this increase is far more than compensated for, by the greater ease of travelling and better application of electric motor and accumulators.

This question of car framework is, to electricians, an extremely interesting and profitable one for discussion, but it opens up too wide a field to adequately occupy just now, although more may yet be said thereon in another connection and from a mechanical point of view.

So far as the figures given are able to prove anything they show that the large cars are the more profitable to run, so long, of course, as the conditions of traffic render their use advisable. That is, a frequent and heavy service will best be met by the employment of large cars with considerable carrying capacity in proportion to their weight.

When the traffic is at less frequent intervals over a long line, probably it would still pay best to run large cars at stated times, but this a matter that concerns the traffic manager rather than the electrical superintendent.

As to whether the weights of those cars might possibly be reduced even slightly so as to effect a saving in the power required to drive them, we may be able to gauge the likelihood of this by making a comparison with the weights of vehicles used for carrying goods or minerals,

English railway rolling stock is notoriously heavy and antiquated; one may, for instance, often see tranship vans designed to carry, say, 11 tons and having a net weight of no less than 14 tons. That is, the paying load is considerably less than the weight of the van itself.

Of course this follows as a result of modelling railway stock upon the lines of farm wagons; rigid axles and heavy construction might have served a useful purpose in the days of bad turnpike roads, but on the solidly built English tram or railway lines they are simply out of place—especially with the high speeds now employed.

On horse tramways some small saving might be made in the cars, although we have seen that the large type vehicle shows a fair proportion (1.3) between paying load and weight of car; but whether this saving is enough to warrant an entire change of the rolling stock is, to say the least of it, doubtful.

It is principally in the new accumulator cars (which must inevitably lead the way in electric traction for some time to come) that a saving of more considerable amount may be made. These cars must necessarily be of greater strength than those of the usual type, from the fact of their carrying at least 1½ tons of extra weight in the shape of lead accumulators.

There will probably be a tendency to gain such extra strength at the expense of lightness; and some cars will be needful in the design of these cars in order to obtain sufficient strength to bear the additional load with the same or less net car weight.

Judging from the results obtained in American freight car practice, as already instanced, there would seem to be considerable promise of economy in weight coupled with increase of strength, from the use of iron tubes in the car framework. Not only do they allow of easy construction and repairs, but by employing them a much better design of car is possible; the framewood resolving itself practically into what is certainly not the weakest of engineering structures, viz., the truss bridge.

A New Storage Battery.—Messrs. Shippey Bros., of London, are manufacturing a new type of storage battery, called the "Standard." It is specially constructed for traction purposes and boat propulsion. The elements are light in weight, and are easily handled; the plates, instead of being vertical as is usual, are placed horizontally, separated by china discs. At present only one size and type will be made, viz., seventeen plate cells, 200 ampère-hour capacity; size, $6\frac{1}{2} \times 6 \times 11$. The inventors do not limit the rate of charge between 10 to 100 or even the discharge, provided the cell does not fall below 1.7

Patent Sales.—Chadbourne, Hazelton & Co. have sold to the Wenstrom Consolidated Dynamo & Motor Co. of Baltimore, Md. their Patent Noiseless Gearing for electric street railways. This gearing will be manufactured by the Wenstrom Co. at their Baltimore factory. Chadbourne, Hazelton & Co. will be the general selling agents for these gears for the United States. The same firm have also sold their patents for their Electrically Actuated Elevator to the Wenstrom Consolidated Dynamo & Motor Co. of Baltimore, Md. and these Elevators will be manufactured by the Wenstrom Co. Chadbourne, Hazelton & Co. will be the general selling agents for the United States.

The Edison Convention.—The next annual convention of the Edison Electric Light companies will be held in Minneapolis, Minn., in September, the date to be appointed later on. The Minneapolis Industrial Exposition will be opened on August 27th. At this exposition the Edison Exhibit's which were displayed at the recent electrical exhibition at the Lenox Lyceum in this city, will be a prominent feature, and the enterprising people of Minneapolis will have an opportunity to gain some idea of the wonderful development of this great industry.

A COMPLETE ELECTRICAL LIBRARY.

We give below a list of books which cover the electrical field from beginning to end. Any one desiring to begin the study of electricity will find in this Library the first lessons in electricity, and with a moderate amount of perseverance and determination the science can be well mastered by the study of the contents of these books.

Elementary Lessons in Electricity and Magnetism. By Silvanus Thomson. Price, ... $1.25

Elements of Electric Lighting including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. Fifth revised edition. Price. . 1.50

Dictionary of Electrical Words, Terms and Phrases. By Edwin J. Houston. Price, ... 2.50

Electrical Engineering. By Slingo and Brooker. Price, ... 3.50

The Electric Motor and its Applications. By Martin and Wetzler. Second edition. Price, ... 3.00

Practical Information for Telephonists. By Thos. D. Lockwood. Revised edition. Price. 1.00

The Galvanometer and its Uses. By C. H. Haskins. Third edition. Price, . 1.50

These and all other electrical books for sale by the Electric Age Publishing Company, No. 5 Dey street, New York.

Secondary Batteries—Self Induction.—At the meeting of the Physical Society, of London, June 20th, last, two communications, "Notes on Secondary Batteries," by Dr. Gladstone and Mr. Hibbert, and "An Easy Rule for Calculating approximately the Self-induction of a Coil," by Prof. J. Perry, were read:

In the first of these, the authors show cause for believing that the beneficial effect produced by adding sodium sulphate to the ordinary electrolyte is due to its power to diminish local action between the electrolyte and different parts of the lead plates. As regards the chemical actions which take place during the working of ordinary cells, they see no reason to doubt the view put forward by one of them in 1882, that the substance produced in the voltaic reaction is ordinary lead sulphate $Pb\,SO_4$. They also conclude that the high E.M.F. of a coil immediately after stopping the charging current is due to the inequality of acid strength near the two plates, and the gradual fall of E.M.F. is caused by the equalization of strength produced by diffusion.

Prof. Perry's rule relates to hollow cylindrical coils, and is expressed by the following formula:

$$L\,(\text{in secohms}) = \frac{n^2\,a^2 \div 10^7}{1.844\,a + 3.1\,c + 3.5\,b}$$

where

n = number of windings,
a = mean radius of winding in centimetres,
b = axial length,
c = radial depth of winding,

and b and c are less tha $\frac{a}{2}$.

The time constant of such a coil is given in terms of the volume of copper (v') in cubic centimetres by

$$\frac{L}{R} = \frac{v' \div 1{,}000}{.728\,a + 1.33\,c + 1.5\,b}$$

and the conditions for making this small are pointed out in the paper.

New Quarters.—The Edison Electric Light Company, of Des Moines, Iowa, has just moved into new quarters situated on the banks of the Des Moines river. The new location is more central than the old and will enable the company to reach its customers with less cost for material.

Electric Light in Hotel.—The new Hollender hotel in Cleveland, Ohio, has been equipped with 2,500 Edison incandescent lights.

Paris Lighting.—The provisional station of the Compagnie Continentale Edison, in the Avenue Trudaine, Paris, is nearly complete, but the permanent station has made but little progress. The system of underground mains differs somewhat from that laid down along the Grands Boulevard. As previously, bare copper strip is used; but in order to get more conductors into a given space, they are arranged side by side on notched porcelain bridge pieces and also in vertical layers. This arrangement enables a much larger number of feeders to be laid in the small conduit.

Personal.—Mr. A. P. Trotter has been appointed editor of the London *Electrician*. The proprietors of that journal have done well to acquire the services of this gentleman.

The Phonograph in Mexico.—The Mexican government has granted Mr. Peniche, Mr. Edison's representative, an extension of six months to establish a postal phonograph system.

The Meudon Balloon Experiments.—According to *La Lumière Electrique*, the Meudon dirigible balloon is worked with a seventy horse-power electric motor, weighing only 490 kilogrammes.

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EXECUTION OF KEMMLER.—At the time this paper was going to press everything pointed to the probability of Kemmler's execution by the new method before the week was finished. The daily press are prolific in suggestions as to the possibility of Kemmler yet escaping the penalty of his crime. In the interest of humanity it would be well to do something definite at once. Either execute the poor wretch or commute his sentence to life imprisonment. There is more inhumanity in this prolonged parleying over electrical executions than there is in the reality—to the condemned man at least. There is no doubt he would prefer to have his case disposed of one way another as quick as possible He has already suffered a thousand deaths, if the daily papers are correct in their reports, yet this is no reason why he should not be punished according to law for his inhuman crime.

THE ELECTRIC LIGHT CONVENTION.—The programme of the National Electric Light Convention at Cape May, on August 19th, which is printed on another page, is an interesting one. The subjects of the papers to be read are all timely and important, and the information each will contain will no doubt be valuable to every one interested. The Secretary, in arranging the programme, has given abundant evidence that he appreciates the necessities of successful electric lighting, and to make electric lighting further successful he has invited certain gentlemen, who are acknowledged authorities in certain lines, to read papers on the subjects with which they are specially familiar. These papers, no doubt, will be valuable, as they will cover methods and practice up to date. All things considered, there is every prospect that the coming meeting will be of much greater importance than any one of all the previous conventions. The invigorating atmosphere of Cape May, too, will aid materially in its success, and when the members turn their backs on the place, they no doubt will feel benefited both mentally and physically for having been present.

ELECTRIC LIGHTING FOR BEGINNERS.—Owing to the press of other matter, we have been compelled to omit from this issue Part IV of our article on "Electric Lighting for Beginners." It will appear in our next issue.

ELECTRIC LIGHT SIGNALLING IN THE NAVY.

The U. S. Squadron of Evolution arrived at New York, July 30, after an eight months' cruise in European and South American waters. Admiral Walker, on being questioned in regard to use of electricity in European navies, said:

"The European navies are ahead of us in many things. They have a system of electric light squadron signals which makes it possible for a fleet to receive, answer, and obey orders with wonderful quickness. All the orders at night are made by three red and three white lights set perpendicularly. The lights are flashed by an operator at a keyboard placed out of the reach of danger. Of course, three red and three white lights are susceptible of many combinations, and any order may be conveyed by them."

The Admiral stated that, on the ships ove which he has command, there was an arranger ment of three electric lights, which were devised af er the ocean was crossed, and which have been found to be very useful.

In America the inventive genius is applied to industrial progress rather than the building up of the army and navy, as in many European countries; hence, it is not surprising that European navies are ahead of us in the matter of the uses of electricity on shipboard. As a matter of pride, however, our navy should equal, at least, other navies in this respect. Electricity is a most valuable agent of communication between ships at sea, and in battle any deficiencies in this regard would undoubtedly be calamitous. Electrical engineers would do well to give this important matter some attention. Admiral Walker has told us where we are deficient and we ought to profit by it.

BEAUTIES OF NATURE.—No human ingenuity or skill is a match against nature in producing artistic effects. In his efforts to secure the most pleasing effects on the human senses, man is very apt to overdo and become conventional but nature is simplicity itself. Artists are more and more accepting the idea that the simplest things produce the most pleasing effects. Nature is always called upon for the best in art, and with this thought uppermost in his mind a prominent wall paper manufacturer of this city was recently found drawing from natures beauties in a most unique manner. Every one has noticed the beautiful shadows cast on the ground by the electric light among the foliage of trees. The gentleman in question with the aid of photography has secured a record of these beautiful effects, which he proposes to use in connection with his business His goods will no doubt be very attractive if he does not try to improve upon nature.

SELLING HORSES BY ELECTRIC LIGHT.—The electric light has in one sense turned night into day. By its use work can be carried on at night as well as during the day, whereas without it operations would necessarily have to be suspended on the approach of darkness. A few evenings ago a horse sale was conducted at night by electric light at a well known horse market in this city. It was an experiment, but from all reports, it was eminently successful. The electric light brought out the points of the stock as well as if the animals stood in broad daylight.

MOTONEER.—There is nothing about the sound of the word "motoneer" that is pleasing to the ear; moreover there is no real necessity for the coining of a word to signify, specifically, the driver of an electric car. What is the matter with the word "driver"? To talk of "motoneers" only adds to the mystery with which many people regard everything involving electricity. The word "driver" is ample in significance to cover electric cars, and is a word that everybody understands. What is needed to make electricity popular is greater simplicity in electrical terms. When we talk to a layman about "motoneers," "watt-hours," "ampéres," "volts," etc., he mentally resolves to drop the subject and give electricity a wide berth. As long as there are current words that are perfectly applicable, the introduction of new words should be discountenanced.

OBITUARY.—C. B. Hotchkiss well-known in telegraph circles, died on July 24th, at Paul Smith's in the Adirondacks. About three years ago Mr. Hotchkiss was attacked with what was pronounced hasty consumption. He then went to the Adirondacks and lived there with his wife up to the time of his death. Mr. Hotchkiss was 42 years of age. He organized the American District Telegraph Company in 1871, and in 1881 he took part in organizing the Mutual District Messenger and Telegraph Companies. Latterly he was prominently identified with the manufacture of Kerite telegraph cables and wires, being a partner of the late A. G. Day. This was his chief business, although he held official positions in other companies.

INCANDESCENT LAMPS.—The Brush Electrical Engineering Company, Limited, says a London contemporary, has acquired the Edison lamp patents for Australasia, India, the Cape of Good Hope, and Natal, and notifies that it is an infringement of the rights now secured by assignment to that company, to import, sell, manufacture, or use any incandescent electric lamps in those colonies except under license from the company. While the Brush Electrical Engineeringn Company is resolved to assert and to maintain its rights, it will supply incandescent lamps at prices not higher than those which now generally prevail in the colonies.

ENGLISH ELECTRICIANS AT EDINBURGH.—About seventy members of the British Institution of Electrical Engineers met at Edinburgh, July, in the Phonograph Room of the Exhibition now being held in that city, and listened to the reading of papers. The meeting was continued on the following day, and, after the reading of papers, the party viewed the new Forth Bridge which was generally admired.

ELECTRIC POWER IN A FACTORY.—The entire power of the shoe factory of A. Packard & Co., Brockton, Mass., is supplied by Sprague Motors, and a large saving is effected thereby.

ELECTRICAL SOCIETY.—Several gentlemen in Nashville, Tenn., who are interested in electrical matters, are talking of organizing an association for mutual instruction.

WANTS ELECTRICITY.—There is an evident sentiment among the Brooklyn Street Railway authorities in favor of electricity as motive power, but there are in that city, as in all large cities, many conflicting interests, and the desire to have electric railways is one thing and to have them is another.

ELECTRIC WELDING.—The Thomson-Houston Welding Company have just built a machine for welding scrap steel to be drawn into fence wire. This application of the welding process will effect a great saving to the company using the scrap for fence wire, and at the same time yield a liberal income to the Thomson-Houston Company.

ELECTRICAL ENTERPRISE IN SAXONY.—A concession has been granted to a civil engineer and a firm of bankers in London, authorizing them to establish a network of cables for purposes of transmission of power and electric lighting direct from some coal mines through 168 towns in Saxony to Dresden.

A NEW SYSTEM OF ELECTRIC TRACTION BY STORAGE BATTERIES.

That the ideal system of electrical propulsion for street railway cars is that of the storage battery is acknowledged by electricians generally. The thought of cars containing within themselves their own electric power, and their ability to run on any track and independent of other cars and of underground or overhead wires is, indeed, a fascinating one. The great difficulties in the way of the realization of these hopes as is well-known have hitherto been, first, the uncertainty of the life time of the storage batteries and, second, the great weight of the cells. On these lines many inventors have been experimenting for many years, with, in the majority of cases, indifferent success. Buckling and disintegration of plates and great weight are still, in the main, the great obstacles in the way of the success of the storage battery. There are many inventors, however, who are thorough advocates of the storage battery system, and believe the day is not far distant when a perfectly reliable storage battery with much smaller weight will be an accomplished fact. Indeed it seems to have already been accomplished in the inventions of Prof. Wm. Main, whose patents are controlled by the River and Rail Electric Company, of 45 Broadway, this city and of which company he is the electrician and engineer. Both the battery and the motor of this company possess many valuable and interesting features, and all the details have been developed with great care during the past few years by Prof. Main, the inventor.

The car as represented in Fig. 1 is of the familiar type with the exception that it has a vestibule at each end, allowing ample space for the motor-man, and the free ingress and egress of passengers, and the arrangement under the car seats for the reception of the batteries. Fig. 2. shows this very clearly. Before proceeding further in the description of the car and its mechanism we will first describe the battery, which presents some novel features.

The E. M. F. of the battery is remarkably high, being 2.6 volts. The positive plates are composed of lead peroxide (see fig. 3) and the negative plates of zinc-mercury (see fig. 4). The zinc and mercury by the action of the battery is made into a spongy amalgam of zinc and mercury. The zinc plates are supported in a copper tray perforated (see fig. 4) and the plates placed horizontally in the battery, the whole being supported in a frame work which slides into the battery case.

The lead plates are composed of thick sheets of lead, between which is packed lead foil and the plate is minutely perforated. There is no active material placed in the cell. The electrolytic liquid is an acid solution of sulphate zinc.

The cell is made up on the Planté principle, and by the minute subdivisions and great surface of the lead plate, takes charge rapidly. Its capacity is increased over the ordinary lead-peroxide battery to the same extent as the increase in its electro-motive force. Combining the increased capacity and the increased electro-motive force, the output of the battery in watt-hours is about three times that of the same weight of lead-peroxide plates.



FIG. 1.—STORAGE BATTERY CAR.

The cells may be discharged at almost any rate without injury, and charged in like manner. Their capacity is very great, being from 17 to 22 watt-hours per pound of metal, as reported by experts.

The positive plates as shown in Fig 3, are perforated with small holes, and the layers of lead are riveted together. The negative plates are ⅛ of an inch in thickness and are perforated with larger holes as seen in Fig 4. We were shown a positive plate which had been taken out of a battery after a year's use, and it was in a remarkably good condition. There was not the slightest flaw discernable. It was stated at the office of the company that the plates were practically indestructible.

The copper plate referred to above acts only as a conductor. When charging the battery the lead foil on the positive plates becomes an oxide, and this oxide of lead is of a hard crystalline structure, and owing to the method of construction of the plates the oxide is permanently retained. There is no dislodgement either by handling or rapid discharge.

Referring to Fig. 2, the method of inserting into and withdrawing from the car the battery cells is well illustrated. Parallel to the main tracks are the tracks of narrow gauge on which runs a small car carrying the cells on a table. By turning the crank shown in the engraving the operation of withdrawing and inserting will be readily understood. It is said that the change of batteries can be made in one minute's time. When the

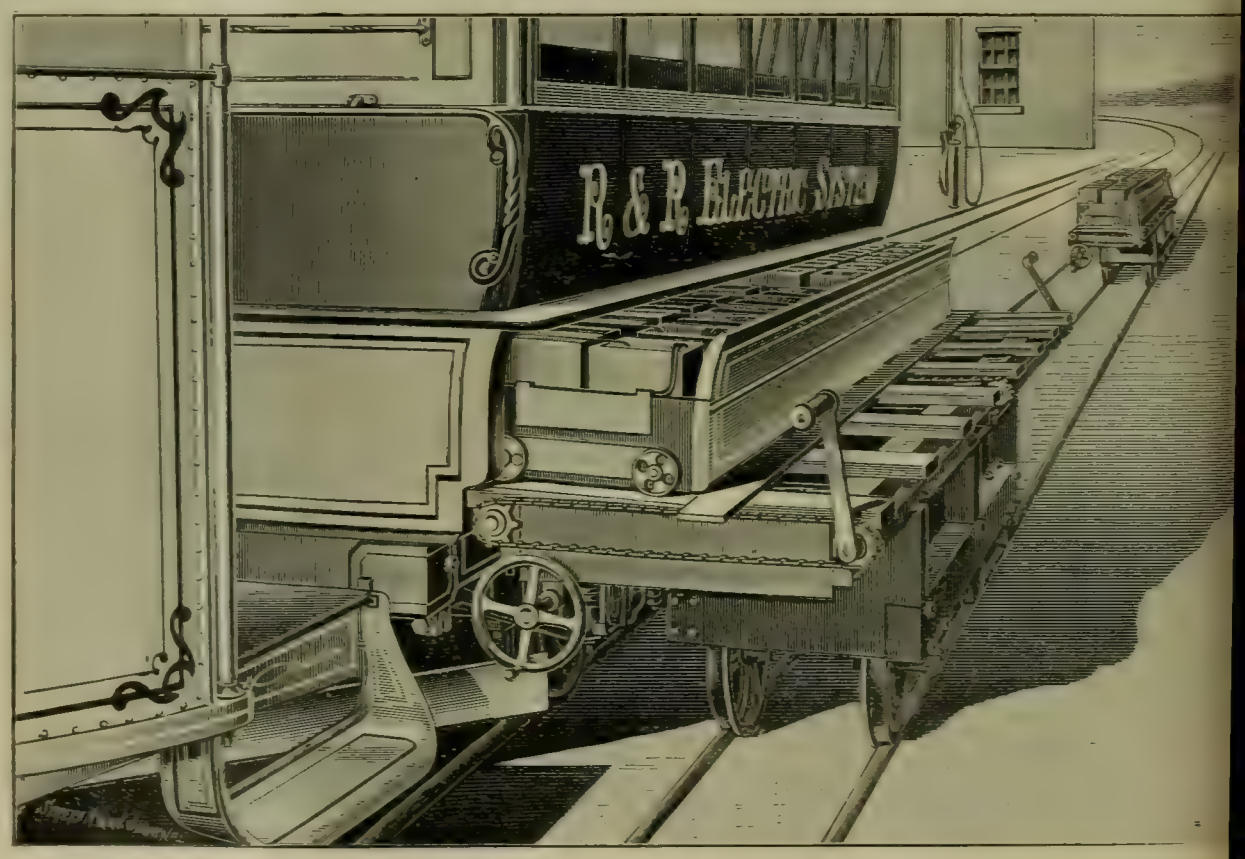


FIG. 2.—SHOWING METHOD OF CHANGING BATTERIES IN RIVER AND RAIL SYSTEM.

exhausted cells are withdrawn a truck behind with its load of freshly charged cells is run up alongside the car and the new battery inserted. The electrical connections between the battery and the motor is accomplished automatically as the batteries are slid into their places. Thus the

s no handling of wires necessary. The motor, of which Fig. 5 is an illustration, is of unique lesign and in one important respect it is differ-ent to other makes. There are no wires in mo-ion at any time, the armature and commutator being stationary while the brushes and fields otate. The weight of a street car motor is about 900 pounds, and the machine is of the nultipolar type, having two north and two south poles. The field core is a soft wrought iron cylinder and is concentric with the shaft. The ield coils are wound around its periphery upon a stationary spool. The two south poles are at opposite ends of an arm carried upon one end of he core and the two north poles are placed in ike manner at the opposite end of the core, ex-cepting that the two north poles are placed at ight angles to the south poles, making the ad-acent poles 90° apart. The magnetic circuit is closed through the centre of the field and arma-ure cores parallel with the axis of rotation. The armature is of the Gramme ring type.

The power transmitting mechanism is one of he interesting parts of the system. Fig. 6 shows n interior view of a River and Rail car with a portion of the seats and floor removed to expose

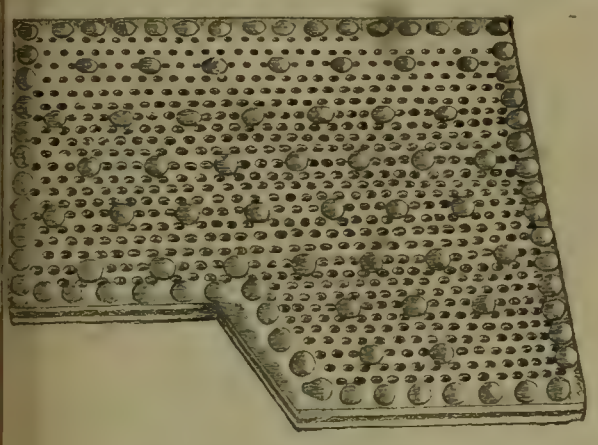


FIG. 3.—POSITIVE PLATE.

he mechanism to view. All there is of this is carried on one shaft which is coupled to the ro-ating part of the motor, or the armature shaft, as it would be called in a motor of the usual ype. It is very compact and occupies but little space, yet within this small compass there are wo different speeds mechanically provided for, also means of running the motor independently of the car.

The speed of the motor is governed electri-ally, but is not obliged to stop and start with he car or to run in a fixed ratio to the latter as n other systems. It is allowed to run to best electrical advantage and develop its maximum

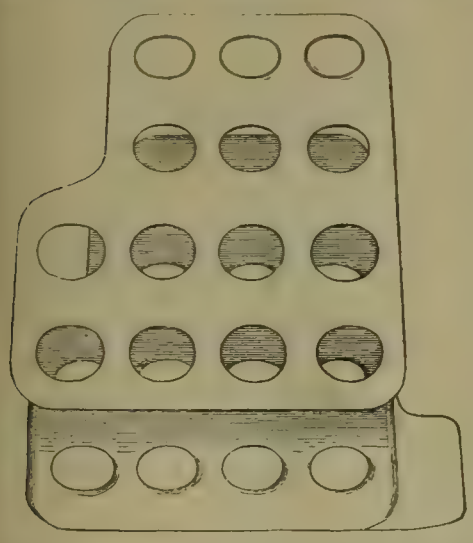


FIG. 4.—NEGATIVE PLATE AND COPPER TRAY.

horse power both in starting the car and in run-ning slowly around sharp curves. The greater ratio of mechanical reduction of speed gives a slow and powerful action to the car wheels while the motor runs with full speed. The advantage of this construction in starting a car, overcom-ing the inertia and sticking friction will be appa-rent to practical men. The speed ratio used in ordinary fast running comes into play when the car is fairly in motion or the curve is passed. These changes are effected, by the operation of a single lever on the front platform, without jar and without throwing teeth in or out of mesh. The motion is based upon the sun and planet motion with some essential modifications. The central shaft revolves at all times with the speed of the motor. Two portions of this shaft are slightly eccentric with loose pinions mounted upon them. These mesh at all times with the internally toothed gears which surround them. These pinions may revolve idly within the gears or may drive them according as they are allowed to gyrate with the eccentric and revolve, or to gyrate only. The pinions are connected by double gimbal joints to disks concentric with the central shaft. Each disk will revolve with its pinion when idle, but when arrested by the grip jaws will cause the pinion to drive. One pinion or the other is driving, or both are idle according to the position of the platform lever.

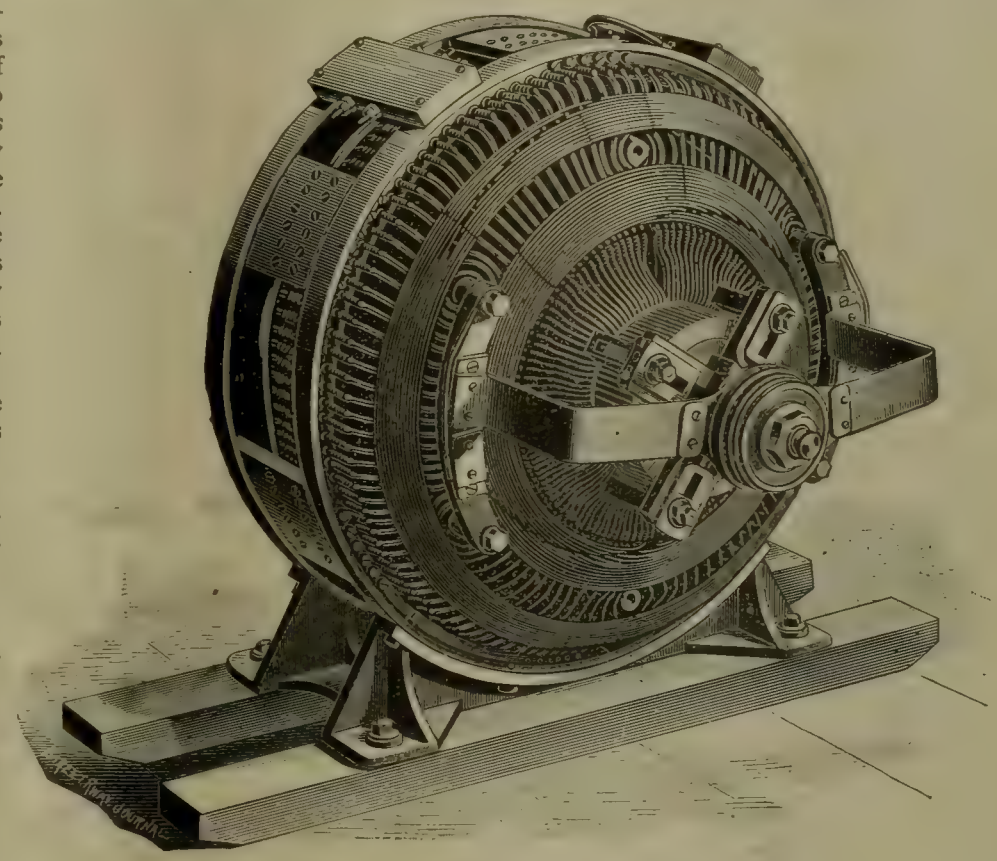


FIG. 5.—THE RIVER AND RAIL MOTOR.

The mechanism drives both axles by means of sprocket wheels and chains, as will be observed, and on the axles are drums to which the sprocket wheels are attached, which contain springs so arranged as to keep the chains taut and to re-

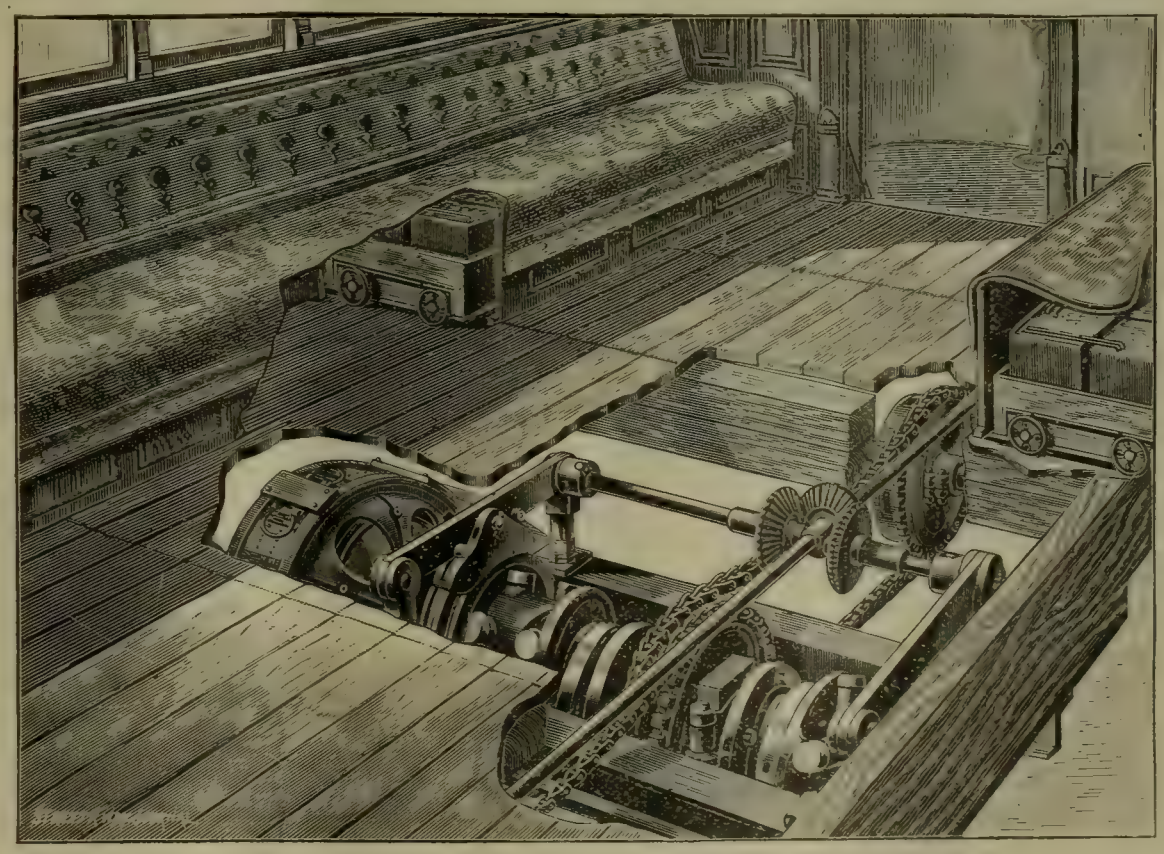


FIG. 6.—VIEW SHOWING DRIVING MECHANISM.

ceive the first impulse in starting.

To summarize the foregoing, the main features of the system are :

1. Increased capacity of storage. 2. Indestructibility of the battery ; it cannot be injured by rough handling or by using too large currents in charging or discharging. 3. High efficiency of the motor—its avoiding revolving wires by which motors are thrown out of balance and disarranged,—and perfect means of controlling the motor. 4. The mechanical connection between the motor and work done, which is of very great importance in all heavy work and especially in the propulsion of cars. 5. The running or starting of the motor by means of this mechanical connection before any load is put upon it, by which great electrical advantage is derived, first, in the matter of being in a condition when the work is applied to do work efficiently and at the same time preventing strain on the motor and the batteries ; second, by being able to avail, or make use of the momentum of the moving motor in starting machinery or a car from rest, overcoming the inertia of the work by the momentum that is acquired before the motor is applied to the work, and, 6, means of taking the batteries out and putting them into cars with great rapidity and ease.

WELL LIGHTED.—St. Louis, Mo., is said to be the best electrically lighted city in the land.

EDISON ARC LAMPS.

In a recent circular issued by the Edison General Electric Company, attention is called to that Company's new arc lamps for constant potential circuits. The illustration given herewith represents the method of installing these arc lamps on incandescent circuits.

The lamp is specially adapted for low tension, incandescent circuits. It is of novel construction and differs from other arc lamps in that it is more sensitive in its feed. As is well known, lamps burning on multip'e arc circuits are subject to fluctuations of current in ampères. The resistance of the arc has to be maintained very evenly in order that the current used may be as nearly uniform as possible. This is accomplished in these lamps by a combination feed, that is, any variation of the ampères passing through either of the coils of the lamp is immediately transferred to the mechanism controlling the feed. The lamp is provided with an automatic cut-out, which controls the current perfectly under all conditions, and with a separate switch renders the trimming of the lamps easy.

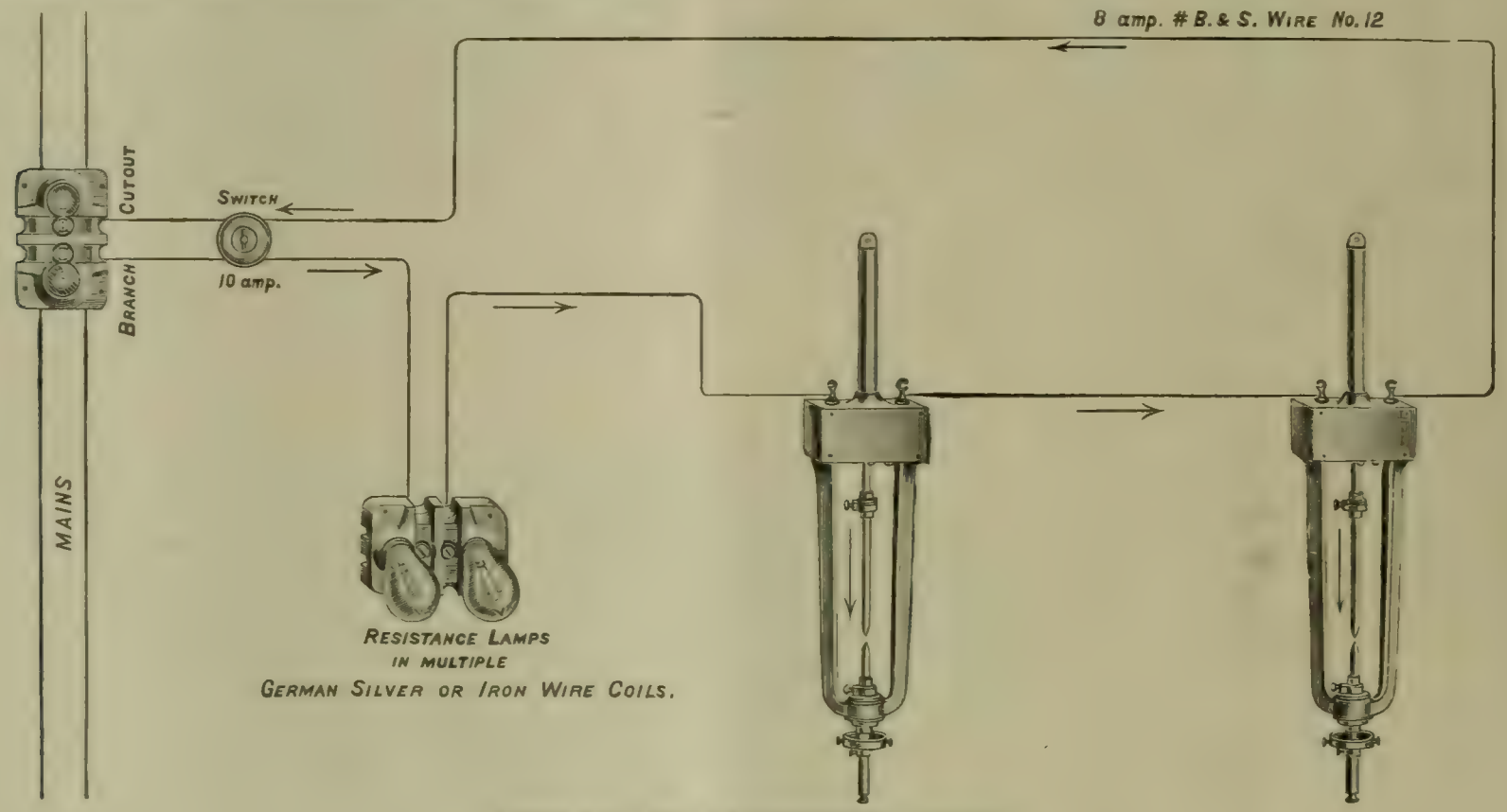
These lamps are wound to use 8 ampères, when burning two in series across 110 volts. They can be run two in series on any constant potential, direct current of from 100 to 125 volts.

More than two can be run in series where the arc lamp, a resistance of about 1 ohm for each 10 volts above 90 volts, the amount used by the two lamps in series.

For short runs use No. 12 B. & S. wire. and for longer runs in proportion. All the joints should be securely made.

The current passes through the lamp from the top or positive carbon to the bottom carbon, and the direction of the current can be told by the carbons, that is, the hottest one at its point being the positive carbon. Should the lower carbon be the hottest, when current is turned on the lamp, simply reverse the connections where the current enters the lamp, and the desired result will be produced.

For inside lighting the company furnishes specially made incandescent lamps for resistance, and uses a branch cut out, wired so that the two resistance lamps are connected in multiple, their resistance being of the proper amount, according to the voltage of the circuit on which lamps are connected. For outside lighting they use a resistance best suited to the position in which the lamps are to be placed, and have a hood, specially designed, containing a resistance which is interchangeable, and can be adapted to varying voltages. The hood is so connected up that, when the lamp is hung within the hood, both lamp and resistance are in circuit.



EDISON ARC LAMPS ON INCANDESCENT CIRCUITS.

voltage is higher than 120, each lamp requiring about 50 volts. The mechanical parts of the lamp are simple in construction. The feed is strong and reliable, and the controlling cut-outs and magnets are highly insulated.

Every precaution has been taken to procure a lamp requiring the least possible repair. They give a clear, steady light, and are adapted to incandescent circuits of any system of continuous current. They can be used on such circuits in connection with incandescent lamps and motors, without affecting any part of the system, as the current consumed by the arc lamps is practically constant. It is the only commercial arc lamp for incandescent circuits, and the company guarantees it both electrically and mechanically.

Directions for wiring for these lamps are given as follows: In installing these lamps, a branch cut-out should be put in at the mains, and the wire of the lamps to the arc lamp should be of a size sufficient to carry the current, 8 ampères, with the usual drop in practice for multiple arc work.

A 10 ampère fuse should be used in the cut-out. Place in the positive lead, leading to the

The alignment of the lamp should be carefully looked to, the fixture carrying the lamp should be well guyed; and porcelain insulators should be used between the fixture and the hood carrying the lamp.

A ten ampère switch to control each pair of lamps should be placed in the most convenient position.

The following are the station directions:

In case of trouble with lamps, examine as to the following points: See that the movable parts connecting the magnet cores and dash pot work freely in their joints, and in all positions. That the rack feeds down freely and all the bearings of the part moved by it are perfectly free. See that the armature of the cut-out is free and its contacts even and clean. Also that, when the armature is in contact. the end attracted by the magnet does not come quite in contact with the insulating piece in the magnet core. The upper carbon rod should be in line with its carbon holder, and also in line with the lower carbon holder, when in a central position. The lamp should be kept throughly clean in every part, and carbon dust should not be allowed to accumulate in the globe or carbon holder. All screws and binding posts should be kept tight and the switch contacts clean. The rack should be wiped every day with a clean cloth; do not use emergy or crocus cloth. If the rack in time should become rough, have it carefully polished on a buff wheel. Wire nets should be put on all globes to prevent pieces from falling out, if the globes become cracked. Adjust the lamp to feed at 8 ampères. This should be done at the test rack, where the feeding of each lamp can be seen before hanging up for service.

Electric Light on River Steamboats.—Some new steamboats in process of construction for the river trade at Kansas City, Mo., are to be equipped with electric head and side lights. The head lights are to be of 10,000 candle power, and those on the sides 5,000 each. One steamer is already running and she attracted a good deal of attention at night with her electric lights. The lights are so arranged that the pilot can turn them in any desired direction.

Incandescent Lamp Manufacture. — Messrs. Fritsche and Pischon have built an incandescent lamp factory at Fürstenwalde, near Berlin, which is now nearly complete. A distinguishing feature will be a special type of air pump made by the firm.

Berlin.—The arc lamps along the Unter den Linden have hitherto been connected 12 in series, and supplied by special machines in the Centrale Manerstrasse, giving 600 volts. As soon as the cables for the private supply of current in the above named street are laid and at work, the lamps are to be connected two in series across the ordinary mains.

The Old and the New.—The Old Hall, which now forms a portion of the works of Messrs. Clarke, Chapman & Co, of Newcastle, England, is the house described by Charlotte Bronté in her famous novel, "Jane Eyre." The place is now virtually the firm's lamp factory, and in the entrance there is fixed and in use what is said to be the largest incandescent lamp in existence.

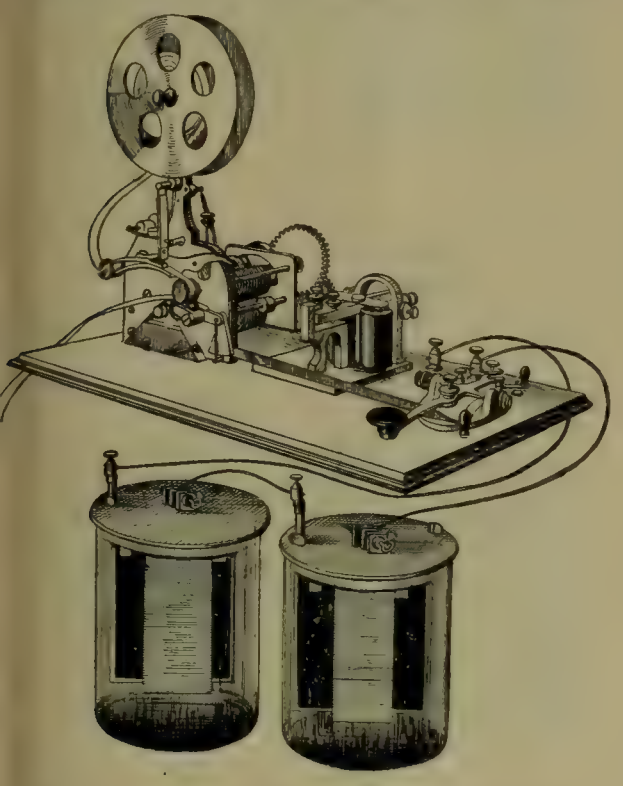
A Gaulard Monument.—A statue to the late M. Gaulard will be inaugurated in the course of the month at Lanza, Turin. Gaulard will be represented crowned with laurel and oak leaves, and at his feet will be sculptures in low relief, emblematical of his achievements in the domain of electricity and of his untimely death. The monument is by Cesare Biscarra, of Turin.

THE UNIVERSAL AUTOMATIC TELE GRAPH SENDER.

It is possible to learn music and languages without a master, or teacher, and books without end have been published with this object in view, but hitherto it has not been possible to learn telegraphy without a teacher. The teachers in many cases are very little better than none at all, but a teacher has been necessary, nevertheless. Now, however, telegraphy may be included among the accomplishments that may be attained without the aid of a master.

The Electrical Novelty Company of this city are putting on the market a very ingenious piece of apparatus called the Universal Automatic Telegraph Sender of which an illustration is given below :

The Universal Automatic Telegraph Sender is an apparatus that practically illustrates and teaches the Morse characters, causing the same to be tapped out upon the sounder without the aid of operator or teacher, rendering sound reading more easily acquired. By this device, which is to be used in combination with the sounder and key, the student is enabled to obtain practice in receiving as well as in sending, it making the only "Complete Learners' Outfit" in the market,



THE UNIVERSAL AUTOMATIC TELEGRAPH SENDER.

and also furnishing a convenient apparatus for college and school use in illustrating the Morse system of telegraphy *for transmitting signals at regular or arbitrarily chosen intervals*, and for other experimental work in the laboratory, or wherever an automatic arrangement for breaking the electric current is desired. To the student of telegraphy this apparatus is invaluable, as it furnishes practice in sound reading, which practice heretofore could only be had at the telegraph office or by the employment of a teacher, both of which were difficult to procure. The above named outfit supplies this want, and furnishes a complete telegraph office at home, where the sounds may be tapped out continually, or whenever desired, by simply starting the electric motor. Many pupils have been compelled to give up learning the art for the want of this essential practice in listening to the sounds as they are tapped out upon the instrument in the telegraph office. This fact led to the invention of this simple, yet valuable apparatus, which renders the once difficult task of learning to read by sound a pleasurable pastime.

The operation of the automatic sender is simple, the exercises being embossed on the paper, and furnished all ready for use. The sending instrument virtually represents the distant sending telegraph station, and when the paper is drawn forward, the characters embossed on it pass under a transmitter which keeps breaking the circuit, producing corresponding characters upon the sounder, in precisely the same manner as if made by the operator with the ordinary telegraph key. The exercises are prepared by experienced operators, and are graded to meet the requirements of the pupil. By observing the style of these letters as they are produced upon the sounder by the automatic instrument, the pupil may be able to imitate them when making them with the key. This furnishes excellent instruction in sending, as the pupil, from constantly hearing the correct manner of making the letters, is quite certain to avoid the ungraceful style which characterizes nine-tenths of the beginners who learn telegraphy in the ordinary way.

The school of telegraphy will find the automatic sender a valuable labor-saving machine in teaching. One instrument may be put in circuit so as to operate several sounders. It will save the employing of assistant teachers, and give better satisfaction in many respects to the pupil, as the exercises given with the instrument are prepared by first class operators of the day—well up in the latest punctuations, etc., as used on the United Press and Associated Press wires. Managers and operators in service, and some who have retired, for whom good Morse sending has a fascination, are ordering the outfit for home amusement.

Press operators, who are desirous of receiving on the typewriter, will find this instrument to be of inestimable value, as the automatic sender will furnish press news at uniform speed, and may be set up at home near the typewriter, thus giving the very best material for testing and perfecting their skill in that direction. It will be seen that the automatic sender is instructive as well as amusing alike to the student, operator or manager, whether in active service or retired.

Railroad employés can learn telegraphy at home without a *teacher*, and should not be without this valuable apparatus.

This machine is a most patient and submissive teacher. When the student desires to practice receiving, all that is necessary is to start the transmitter and the characters are produced on the sounder with great precision. If they are too fast for the student they can be slowed down as much as necessary until the proper speed is attained. For practical operators this instrument is a great aid in learning to use the typewriter in telegraph work, and it never tires or loses patience as a human teacher is liable to do.

There is, unquestionably, a great demand for an instrument of this kind, and it will likely meet with a welcome, especially among those who are anxious to learn the art of telegraphy but for various reasons cannot enjoy the benefits of a first-class teacher. This instrument supplies the need perfectly.

Agencies for the rental of these learners' outfits are being established by the Electrical Novelty Company in all the principal cities. The Company's headquarters are at No. 5 Dey street, New York city.

THE BERMUDA CABLE.—The Halifax and Bermuda Cable Company opened for business on July 14th. It was the occasion of much rejoicing on the part of the population in Bermuda. In the evening of that date, after congratulations had been flashed through the cable by all the prominent rulers of the world, banquets were held and a grand display of fire works took place. The *Gazette*, published at Hamilton, Bermuda, got out an extra on this happy occasion. The cable extends from Halifax, N. S. to Bermuda, a distance of 850 miles. It connects at Halifax with the Commercial Cable and the Canadian Pacific Companies. Mr. Joseph Rippon is the general superintendent with headquarters at Hamilton, Bermuda. Quite a business has already been created for this company. The American business of necessity goes via Halifax.

ELECTRICAL BOOKS.—All Electrical publications can be had of the ELECTRIC AGE PUBLISHING CO.

THE ELECTRIC LIGHT IN FRANCE.

On June 21st the central station of the Compagnie Nationale d'Electricité, at Troyes, France, was inaugurated. The system used is that of Ferranti, and the following facts concerning the station will be of interest to those interested in electric lighting.

The station is situated in the suburb of Sainte-Savine, and the plant comprises two Babcock and Wilcox boilers, one Brasseur steam engine of 150 N.H.P., and one Ferranti dynamo giving 50 ampéres at 2 400 volts. As the demand for light increases it is proposed to install two similar groups of machines. Underground two wire conductors are employed and extend about 4⅓ miles. The cables are well insulated, and are protected by an external steel wire covering. Insulated branches are jointed to the mains, which are laid at a depth of about 20 inches in the ground. The distribution is affected at an E.M.F. of 100 volts, and transformers are erected in certain places according to the consumption ; current is supplied both for public and private lighting. In the former case arc lamps of 8 ampéres and 50 volts are used, and in the latter incandescent lamps, of which there are 800 already in use. Light is sold at a fixed sum per lamp hour, and each subscriber has installed a Ferranti Borel meter modified and graduated in lamp hours. The rent for the meter varies from 1s. 3d. to 4s. 10d. per month, according to the capacity. The price per lamp hour of 10 candles is ⅜ of a penny, and for one of 16 candles about ⅝ of a penny. Those persons using the light subscribe for five years, and guarantee a minimum consumption of light amounting to 29s. per annum. The company has to pay to the town a rent of 2d. per metre of mains laid, including the return.

REORGANIZATION OF EDISON INTERESTS

The business of the United Edison Manufacturing Company and the Sprague Electric Railway and Motor Company have been transferred to the Edison General Electric Company, and business heretofore conducted by the two former companies will hereafter be conducted by the Edison General Electric Company. The Edison General Electric Company will have district offices as follows: Eastern District, Charles D. Shain, manager, 16 Broad street, New York City; Central District, John I. Beggs, manager, Rialto Building, Chicago, Ill.; Rocky Mountain District, Geo. W. Coster, manager, Masonic Building, Denver, Col.; Pacific Coast District, W. S. Heger, manager, San Francisco, Cal.; Pacific Northwest District, S. Z. Mitchell, manager, Portland, Ore.; Southern District, O. T. Crosby, manager, Cotton Exchange Building, New Orleans, La.; Canadian District, M. D. Barr, manager, Bank of Commerce Building, Toronto Ont.; Mr. H. Ward Leonard is General Manager of the Light and Power Department including Motors; Mr. J. Muir is General Manager of the Railway Department, and Mr. Samuel Insull is Second Vice-President and General Manager of the Sales and Manufacturing Interests.

BUSINESS NOTES.

Mr. H. T. Paiste, the Electric Switch Manufacturer, of Philadelphia, Pa., is securing a large number of orders for his excellent goods in England and France, in which countries he has spent the last two months.

The Baxter Motor Company, of Baltimore, Md., is just about completing a motor which is intended to be placed on exhibition at the coming Electric Light Convention at Cape May, N. J. The speed of the motor has been reduced from 2400 to 800 revolutions per minute. Much interest is centered in the experiments on this machine and if it should prove the success anticipated by the management of that concern, they will have created at once a good market for their motor.

WORKING EFFICIENCY OF SECONDARY CELLS.

At the meeting of the British Institution of Electrical Engineers, held at Edinburgh, July 16th, a paper entitled "The Working Efficiency of Secondary Cells," was read. The authors were W. E. Ayrton; C. G. Lamb, E. W. Smith and M. W. Woods, Associates. The following is the full text of the paper, taken from the London *Electrical Review*. The article is a valuable one and will be read with considerable interest.

I.—PREVIOUS TESTS OF CELLS.

Since 1881, when the formation of Planté storage cells was greatly accelerated by Fauré's device of pasting the plates, numerous tests have been made in different parts of the world on the capacity and efficiency of secondary cells. The first tests that were carried out were conducted simultaneously, at the end of 1881, in England, by Prof. Perry, with one of the authors of this paper, and in France by a committee consisting of Messieurs Tresca, Potier, Joubert and Allard, working at the Conservatoire des Arts at Metiers, with a staff of assistants.

In the report—communicated to the Physical Society in February, 1882—by the two English experimenters, it was pointed out that the great "resuscitating power" of the cells made it very difficult to say when they were entirely discharged, and therefore, in order to test the efficiency, the cells were first "emptied" of charge by discharging them until the discharge current

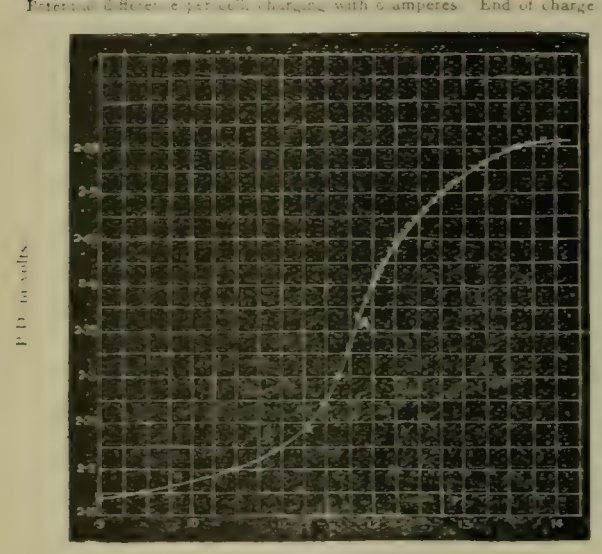


FIG. 1.

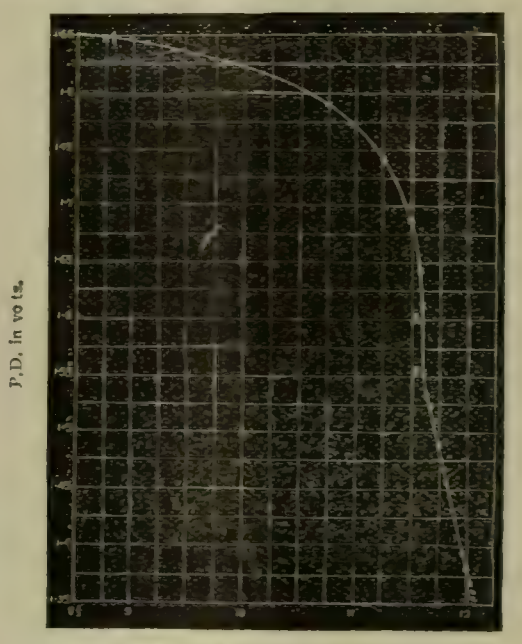


FIG. 2.

was very small, and finally leaving them short-circuited for many hours with a short bit of thick wire. Next, a measured amount of energy was put into these "empty" cells, and they were then thoroughly discharged on three successive days, being insulated and allowed to recuperate during the two intervening nights. Although the energy efficiency thus obtained, and which was not less than 82 per cent probably represented much more than could be obtained in practice at that period, if the discharge were stopped before the E.M.F. fell to so low a value, this efficiency represented something quite definite, since all the energy given out by the cells in the discharge must have been put into them during the measured charge, no demand being made on some inexhausted store of energy previously put into the cells.

The French committee, on the other hand, considered the cells as being discharged when a certain current, which was originally produced through a fixed resistance by 30 cells, could no longer be kept up, even when the number of cells had been increased to 35. But unless, subsequently to the receipt of the cells from the manufacturers, they had been charged and discharged several times until the same cycles of values of E.M.F. with time were repeated with each charge and discharge, there was no guarantee that in the experimental discharge the cells were not drawing on a store of energy put into them before leaving the manufacturers' premises, and thus giving a higher value than the "working efficiency."

And we are afraid that a very possible neglect of the powerful resuscitating power of accumulators may have vitiated some of the published results of experiments that have been made on them. At the middle of 1889, when we had nearly completed our investigation, there appeared two very important contributions to the subject—one on "The Inherent Defects of Secondary Batteries," by Dr. Louis Duncan and H. Wiegand; the other, "Ergebnisse von Versuchen an Akkumulatoren für Stationsbetrieb," by Prof. W. Kohlrausch and C. Heim. These investigations are extremely interesting, as they confirm some of the results which we had also arrived at, and to which reference will be made in this paper; Prof. W. Kohlrausch and C. Heim, for example, laying great stress on the fact that the discharge of an accumulator does not depend merely on the previous charge, but on the previous history of the cell.

At the Central Institution there are three distinct types of E.P.S. cells in daily use. The cells, however, used by us for the investigation were twenty out of a group of fifty of what is known as the 1888 type. This type we selected since it was the latest constructed by the Electrical Power Storage Company. The particular specimens of this 1888 type, which are at the Central Institution, contain each two positive and three negative plates, each plate, exclusive of the lugs, being 9¼ by 9¼ inches. The glass vessels containing these plates are large enough to each hold 7L plates, but we preferred to use 7L glass boxes to having smaller boxes specially constructed.

The total weight of each of these cells is about 59 lbs. 12 oz., made up as follows:

		lbs.	oz.
3 negative plates	about	17	2
2 positive "	"	11	8
Ebonite strips	"	0	8
1 glass vessel	"	7	8
Dilute sulphuric acid	"	23	2

and the cells are intended to be used with a maximum current of 9 ampères on charging and 10 on discharging.

The first point to settle with reference to the discharge was whether the resistance in the circuit should be kept constant, or whether as the E.M.F. fell the resistance should be varied in such a way as to keep the current constant. This latter method, although it involved much more labor, was adopted. At first the current was kept constant by varying the resistance by hand as the E.M.F. of the cells altered. But this required the constant presence of one of the observers day and night, partly to vary the resistance from time to time, and partly to start the charging directly the discharging was finished, in order that the cells might never be left discharged. Hence an automatic arrangement was subsequently devised, and by means of it the current was maintained more constant than could be achieved by even very careful hand regulation, and the circuit broken during discharging and during charging the moment the P. D. reached certain pre-arranged values.

We had next to adopt a criterion by which to settle when a charge or discharge could be said to be completed. Such a criterion may be made to depend on a variety of changes that take place in a cell, three of which are in common use—viz., change in the specific gravity, gassing, and change in the P. D. In the case of the cells tested by us, and which have more liquid in proportion to the plates than is usually the case, the change in specific gravity from charge to discharge is from 1.2 to about 1.17; and, as our experiments show that the change is directly proportional to the time, when the current is kept constant, the change in the specific gravity per hour is only about 0.002, which is far too small to be read very accurately with ordinary hydrometers. But it is known the fall in the E.M.F. of the cells at the end of the discharge is very rapid, so that half an hour more or less in the time of discharge produces a great difference in the value of the E.M.F.; hence it follows that, if a specific gravity test were alone employed with our cells as a criterion of charge and discharge, it would be necessary to read the specific gravity accurately to less than 0.001 at the end of the discharge. The amount of gassing is also far too rough a test, and cannot be employed at all in the discharge, hence we were led to resort to the variation in the P.D.

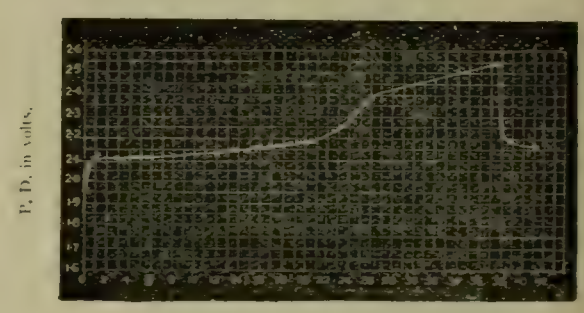


FIG. 3.

A number of experiments were now made on two of the cells, in order that the *exact* shape of the curves of P. D. at the *end* of the charge and discharge might be ascertained. The curve shown in fig. 1 is the end of the P. D. curve for one cell on charging with 9 ampères for 14 hours; from which we see that the rate of variation of the P. D. with time is greatest when the P. D. is about 2.36 volts, indicated by the point, A. In fig. 2 is shown the curve of P. D. during the last 3½ hours of discharge with 10 ampères, the discharge being continued for 12 hours. In this particular experiment the discharge was allowed to continue until the P. D. fell to 1.365 volts, indicated by the point, C, which is far lower than we have dared on any other occasion to allow the P. D. to fail. At about 1.8 volts the P. D. curve begins to fall pretty rapidly, and the slope of the curve, or the rate of diminution of the P. D. with time, goes on increasing until the P. D. has fallen to 1.6 volts, indicated by the point A, on the curve in fig. 2. Here $\frac{dv}{dt}$ per cell has reached a value 1.4, v being measured in volts and t in hours. Below this the curve has a shape that has not hitherto been noticed, for when the P. D. per cell has reached 1.556 volts, indicated by the point, B, the curve suddenly alters its

shape, becoming the straight line B, C, with a less inclination to the axis of time, $\frac{dv}{dt}$ being for this line only 0.44.

Just as we have in the curve in fig. 2 continued the discharge much below the usual limit, so we examined what would take place if the charging was also prolonged much beyond the usual limit. Curve 3 shows the rise of the P. D. when the charging at 4.52 ampères was continued for 37½ hours, 25½ hours being sufficient to fully charge the cells with this constant current of 4.52 ampères—that is, to charge them until the P. D. per cell was 2.4 volts. It will be observed that whereas the volts rise from 2.25 to 2.38 between 23.1 and 25.5 hours—that is, 0.13 volt per cell in 2.4 hours—the rise in the following 12.3 hours is only from 2.38 to 2.35 volts: this is only 0·17 volt. The continuation of the curve shows the drop of P. D. on breaking the charging circuit; there is an instantaneous fall of 0.28 volt per cell, and a further fall of 0.1 volt in the E. M. F. in two hours.

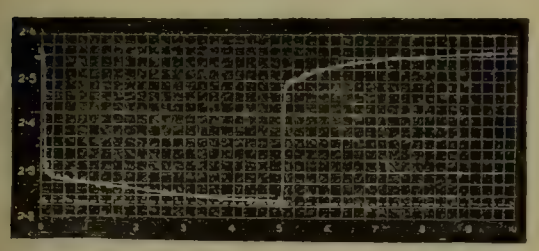


FIG. 4.

The curve on Fig. 4 shows on a larger scale this drop on breaking the charging circuit when the cells are very well charged, leaving it broken for five minutes, and then closing it again; the charging current in this experiment being 9 ampères. There is, we see, a nearly instantaneous drop of the terminal P.D. per cell from 2.56 to 2.31, then a steady fall in the E.M.F. from 2.31 to 2.24 volts in five minutes. On reclosing the charging circuit at this moment, there is an instantaneous rise of the P.D. to 2.48 volts, and then a slow rise to 2.56 volts in five minutes; so that after reclosing the charging circuit it took, in this experiment, the same time for the P.D. to recover the value it had just before breaking as the time during which the circuit remained broken.

Experiments were also made on the time rise of the E.M.F. on stopping the discharge. Later on, however, the time rise of the E.M.F. on breaking the discharge circuit, as well as the time fall of the E.M.F. on breaking the charging circuit, for various currents, was measured in a far more sensitive way than in the early part of this investigation; this subject will, therefore, be left until farther on in this paper.

On starting a discharge the P. D. generally falls slightly to the value that is maintained fairly constantly during a long portion of a discharge After a prolonged rest, however, we have found that the P.D., on the contrary, shows a *decided rise* at the commencement of a discharge, and that it is not until the third discharge takes place that the curve resumes its normal character with the slight drop in the value of the P.D. at the commencement of the discharge.

(*To be Continued*).

THE ELECTRIC LIGHT CONVENTION.

The following is the official programme of the annual convention of the National Electric Light Association to be held at Cape May on the 19th instant.

The Committee on Papers of the National Electric Light Association have selected the following topics and have invited the persons named to prepare a paper or open the discussion on the subject assigned him.

1. Electrical Industries and the World's Columbian Fair. J. P. Barrett, Chicago.

2. Electric light as supplied to steam railroads. W. H. Markland, Altoona, Pa.

3, Standards of economy in the generation of power and steam under best conditions. Editor of *Power and Steam*, New York.

4. Triple expansion high speed engines for central station work. ——Williams, Beloit, Wis.

5. The model boiler room and the duties of a fireman. Jarvis B. Edson, New York.

6. Ferranti station at London, England. Caryl Haskings, Lynn, Mass.

7. The proper care and management of alternating currents. T. Carpenter Smith, Philadelphia.

8. Distribution of energy by alternating currents and transformers and the proper method of proportioning conductors. A. H. Rohrer, Lynn, Mass.

9. The proper basis for determining electric motor rates. H. L. Lufkin, New York.

10. Actual cost of furnishing arc lighting (1,200 C. P. and 2,000 C. P. lamps) under the best possible conditions. J. C. Ayer, St. Louis.

11. Municipal ownership of electric lighting plants. M J. Francisco, Rutland, Vt.

12. Accidents in electric lighting stations and plants. Prof. Charles R. Cross, Boston.

13. Care and labor in electric light stations and its value. A. J. DeCamp, Philadelphia.

14. How can the National Electric Light Association best serve the interests of central station companies? C. R. Huntley, Buffalo, N. Y.

The reports to be considered are as follows:

1. Committee on national insurance rules. George Cutter, chairmam.

2. Committee on electrical data. A. J. De Camp, chairman.

3. Committee on copper tariff. Charles A. Brown, chairman.

4. Committee on underground conduits and conductors. Joseph E. Lockwood, chairman.

5. Committee on revision of constitution. M. J. Francisco, chairman.

6. National committee on legislation. Allen R. Foote, chairman.

7. Committee on relations between manufacturing and central station companies. Marsden J. Perry, chairman.

8. Executive committee. C. R. Huntley, chairman.

9. Finance committee. John A. Seely, chairman.

10. Secretary and treasurer's report. Allen R. Foote.

At each session of the convention a call will be made for the proposal of questions to be discussed at a subsequent session, and for the introduction of resolutions to be considered at a subsequent session when reported by the committee on resolutions for action.

Members desiring to take part in the discussion of any subject stated or proposed, who send their names to the secretary previous to the time appointed for its consideration, will be called upon by the president and be given time before the subject is opened to the convention. By this means every member can secure recognition and time to express his views fully on any subject that may come before the convention.

An announcement of the order of proceedings will be made for each day on the preceding day. The subjects and reports will be taken up in the order there named. Each session will be prolonged until the calendar for the day has been cleared.

The last session will be an executive session, to be attended by active members only. The business to be brought before the session will be:

1, Secretary and Treasurer's Report; 2, Report of Finance Committee; 3, Report of Executive Committee; 4, Action on Report of Committee on Revision of Constitution; 5, Election of Executive Committee; 6, Selection of Next Place of Meeting.

NEW YORK NOTES.

Mr. Frank A. Perret, electrician of the Elektron Company, is just finishing one of his motors of ½ horse power, which he intends to use for the propulsion of a small boat. The boat is to be fitted with feathering side wheels, and is for Mr. Perret's own use. The motor is of extra light weight, laminated field and waterproof. Mr. Perret will obtain his current from a Mason battery of special construction.

A few days ago Mr. Edison was presented with a phonographic verbatim report of the proceedings of the Convention of Phonographic Companies recently held in Chicago. The entire report comprises 40,000 words.

The C. & C. Electric Motor Co. report that over ten thousand of their motors are in actual operation to day. The sales since the first of the year to the present time, amount to more than ever before delivered in an entire year. This is a wonderful development, but the enterprising gentlemen who head the concern, are keeping pace with the unusual boom in the motor business.

Mr. F. J. Sprague, of the motor department of the Edison General Electric Company is spending a well-earned season of rest in Europe. He sailed the week before last.

Mr. F. W. Jones, assistant general manager and electrician of the Postal Telegraph Company, was last week granted a patent on a system of dynamo telegraphy, which is said to be the most complete and efficient yet devised.

Messrs. Zimdars & Hunt, of 127 Fifth Ave., have secured the contract for putting in all the bells and tubes in the large new hotel at Lakewood, N. J. This hotel will contain 400 rooms, and is one of the largest in this vicinity.

The new building of the Edison General Electric Company is rapidly progressing towards completion. The front is of granite and of massive and handsome proportions. When completed it will be one of the most attractive structures in that part of the city.

In the Bureau of Information of the Edison General Electric Company, at 16 Broad street, a large map of the United States hangs on the wall. This map shows very clearly at a glance the boundary lines of the various districts of the Edison General Electric Company. These cover the entire country and the province of Quebec. In each district the city in which the head office is located is prominently marked. The map will be found very convenient and useful for reference, now the country is divided up into districts for the purpose of facilitating the transaction of business. The business of this department is under the supervision of Mr. W. H. Fleming who has things so systematically arranged that he can give any desired information pertaining to the vast industry in a moment's time.

R. J. G.

A COMPLETE ELECTRICAL LIBRARY.

We give below a list of books which cover the electrical field from beginning to end. Any one desiring to begin the study of electricity will find in this Library the first lessons in electricity, and with a moderate amount of perseverance and determination the science can be well mastered by the study of the contents of these books.

ELEMENTARY LESSONS IN ELECTRICITY AND MAGNETISM. By Silvanus Thomson. Price, ... $1.25

ELEMENTS OF ELECTRIC LIGHTING INCLUDING ELECTRIC GENERATION, MEASUREMENT, STORAGE AND DISTRIBUTION. By Philip Atkinson. Fifth revised edition. Price, . 1.50

DICTIONARY OF ELECTRICAL WORDS, TERMS AND PHRASES. By Edwin J. Houston. Price, ... 2.50

ELECTRICAL ENGINEERING. By Slingo and Brooker. Price, ... 3.50

These and all other electrical books for sale by the ELECTRIC AGE PUBLISHING COMPANY, No. 5 Dey street, New York.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Aug. 2, 1890.

Clock registers have been substituted for bell punches on the Brighton electric cars.

Harry Baum of the Fidelity Carbon Manfg. Co., of St Louis, was in Boston last Monday.

The cable repair steamer Minia, Capt. Trott, has been lying in Boston harbor the past week.

An electric lighting plant is to be established in Exeter, N. H., immediately. The Thomson-Houston system will be used.

The Thomson-Houston Company are to furnish motors in any part of the building at the Mechanics Fair where power is required.

The breaking of a guard wire which came in contact with the trolley wire, last Saturday afternoon killed two horses belonging to the West End Railway Company.

The Thomson-Houston Electric Co., will immediately build a 500-horse power dynamo, twice as large as any it has yet constructed, of the style patented by Prof. Thomson last week.

Last Monday Mayor Hart called the attention of the City Council for the second time to the urgent necessity for municipal regulation of electric wires. He urged immediate action in the matter.

The company which the Hartford, Conn., board of trade has formed for the erection of a large power factory building will soon begin work on the structure. Electricity will be used extensively as a motive power.

The manager of the Anglo-American Electric Light Company, whose works were recently burned out at Kensington, Conn., states that the company will rebuild at once and put up a factory 110x80 feet, two stories high. The debts of the company are $17,000, while the assets are $75 000.

Superintendent E. W. Rice, Jr., of the Thomson-Houston factories, Lynn, Mass., has patented a current and switch controlling mechanism, which is designed not only to make it possible to stop electric cars quickly, but which will prevent the car going at all unless the driver's hand is upon it

J. W. Moore, superintendent of the Brookline electric division of the West End Railway Co., has been transferred to the first division, in the same official capacity, vice W. H. Powell transferred to Brookline The change is made on account of Mr. Moore's longer experience in electrical affairs.

The directors of the Erie Telephone Company meet this week to consider the matter of dividends. The earnings of the company for June will enable a one per cent. dividend to be paid and reserving a surplus of not less than $5,000 in addition to the payment of the American Bell portion of the earnings.

Electrician Hermann Lemp and Supt. John Tregouing of the Thomson-Houston welding works have patented a new apparatus for electrical metal working. It covers the combination with the sliding clamp in an electrical welding machine, of a guide rest having internal passages for circulation of a cooling medium. It is of cast metal, such as copper, provided with circulating tubes or pipes enclosed in a casting.

The cylinder head of a large engine in the station of Edison Illuminating Company, on Head Place, blew out last Sunday night. There was no other damage. The engine was used in supplying power for the Northampton street, and depot and Allston lines, of the West End Railway Company, and, until it is repaired, the railway company will supply the power from their central power station on Albany street.

The largest engine in use in Rhode Island is now being set up at the station of the Narragansett Electric Lighting Co., Providence, R. I. It is known as the Reynolds-Corliss engine and is a triple expansion condensing machine of 1,500 horse-power. A duplicate engine is contemplated by the company.

Judge Wheelock has made his report in the inquest over Terrence Creamer who was killed by an electric car in Warren street, July 12. He says: "I do not think that his death resulted wholly or in part from the unlawful act of any person or persons, unless the transportation of passengers in an electric motor car constructed without any barrier to prevent passengers from getting off the car on the side next to another track on which electric motor cars were running at such a high rate of speed as eight or ten miles an hour be so considered."

Since the consolidation of the Electric Light and the New Bedford Gas Light Cos., the price of the electric lights in New Bedford have been advanced considerably. The storekeepers are strongly protesting against this. Notices have been issued through the daily papers, to the users of the electric light to call at two prominent stores and sign a call for a public meeting to protest against the advance in rates, and to advise means of securing desirable light at less prices.

An order has been presented to the Board of Aldermen recommending the appointment of a superintendent of electric wires whose term of office shall be for three years at a salary of $4,000 per year. He will have the supervision and regulation of all electric wires including telegraph, telephone, light, power and other wires incidental thereto, whether under or over the streets and buildings throughout the city and shall make and enforce reasonable rules and regulations for the construction maintenance and removal of all dynamos, electric machines and appliances, and all electric and other wires. No application for the erection of electric machinery or wires, or of poles, conduits and other appliances incidental thereto, shall be deemed complete unless approved by the superintendent of electric wires. High power or pressure is defined to mean an electro-motive force of 500 volts or more. This superintendent is to have the control and management of the fire alarm of the city of Boston and of the public bells and clocks. He shall render such services to the fire department as the fire commissioners may require, provided such services are directly connected with the fire alarm or with the necessary protection of buildings from fire caused by electric appliances.

W. J. P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, Aug. 2, 1890.

WEBSTER CITY, IA., is to have a central station of 1,000 incandescent lights of the Mather system.

MR. FOREE BAIN is completing designs for a new motor for the Pennock Railway System, for street car work.

ELECTRIC LIQUID DISPENSING COMPANY has been formed at Chicago, to manufacture apparatus for dispensing liquids; capital stock $50,000; incorporators, H. H. Heimerdinger, Isaac Meyer, and R. H. Little.

MR. J. H. REID, for several years representative of the Mather Electric Company and also of the Easton Electric Company, has resigned his position with the Mather Company.

CITIZENS' ELECTRIC RAILWAY COMPANY has been formed at Leavenworth, Kan., with capital stock of $300,000; directors W. D. Kelly, J. W. Folger, L. Hawn, W. N. Todd, W. B. Nickels, E. A. Kelly, Otto H. Wulfekuhler.

THE CRYSTAL PALACE THEATRE, soon to be erected on Wabash avenue, in this city, will be lighted by 1,000 Mather Incandescent and twenty-five Easton arc lights, the contract having been already closed.

THE CALUMET ELECTRIC STREET RAILWAY CO., recently organized to operate an electric railway in the southern portion of this city have decided on equipping their line with the Rae system, of which Mr. Frank B. Rae, of Detroit, is the inventor. The line will be three miles in length and will start with three cars to which others will soon be added.

THE ELGIN ELECTRIC RAILWAY, Elgin, Ill., started on July 4th, with what was deemed a sufficient equipment, but such is the favor with which the electric cars have been received that it has already been found necessary to increase their facilities and they have ordered from the Sprague Company three additional cars and another generator.

E. W. HAMMER, who had charge of the Edison exhibit at the Paris Exposition, is now in Minneapolis putting in order Mr. Edison's exhibit at the Minneapolis Exposition. He is enthusiastic and says the exhibit will be by far the finest ever seen in America. The electric light tower, which will be the crowning feature of the exposition, will be much larger and more elaborate than the one in New York, which attracted so much attention.

THE PULLMAN PALACE CAR CO., will equip their experimental line at Pullman, Ill., with a complete electric power plant of the Sperry System. The dynamo will be wound for 500 volts and 75 ampéres furnishing about 50 horse power. The installation also includes improved switch board apparatus consisting of lightning arrester, new multiple fuse, ampére meter, volt meter, etc. The line at Pullman is about one mile in length and will be used for testing cars made by the Pullman Company, and perhaps will be extended somewhat and made to carry passengers.

MR. JOHN I. BEGGS, formerly Vice President of the New York Illuminating Co. arrived in the city this week to take charge of the Central District of the Edison General Electric Company. Mr. S. D. Greene who has had charge of this office for the past few months leaves the middle of next week for New York where he will be Assistant General Manager of the Edison General Electric Co. Friends of Mr. Greene tendered him a complimentary dinner at Kinsley's, Friday evening, and the occasion is spoken of as a very pleasant one by those present.

MINNEAPOLIS, MINN.—A trial trip was made with one of the new electric cars on the 29th. Those on board the car were President Lowry, of the road, Vice-President C. G. Goodrich, Engineer Clift Wise, and Superintendent D. W. Sharp. The car was of the open or summer class, with seats running crosswise, but differs from the cars in general use in having an aisle running lengthwise, and the seats are reversible. There are sixteen seats in the car each capable of accommodating two passengers. Ten single candle power lights, two chandeliers of four each, and a single lamp at each end of the car furnish the light, and the car is also provided with electric headlights. Sixty of these cars have been received by the electric company, and are of an order calculated to make the citizens proud.

F. M. I.

ELECTRIC RAILWAYS.

In New Haven, Conn, the street railway authorities are giving electric power serious thought

Electricity is to be adopted as the motive power on the Savannah (Ga.) Belt Line Street Railway; a Nashville syndicate is back of the enterprise.

Prominent property owners in Orange, N. J. are active in their opposition to the granting of permission to the Essex Passenger and the Suburban Railway Companies to operate electric cars in that place.

NEW CATALOGUES.

We have received from Mr. James F. Kelly, the genial general sales agent of the Edison Manufacturing Company, at 17 Dey street, a copy of a handsome catalogue just issued by that company descriptive of the Edison-Lalande battery. The catalogue is replete with valuable information regarding primary batteries in general, and points out the essential requirements of an efficient cell. A brief history of the Edison-Lalande battery is given, followed by a full description of the varied types of that battery now made by the Edison Manufacturing Company. The various applications of this excellent battery are fully set forth, and much other valuable information regarding it is given. Testimonial letters are given throughout the catalogue showing that the battery is giving the best of satisfaction wherever used.

The New York Insulated Wire Company, 649 and 651 Broadway, have just issued Price List No. 17 with the date of August 1st. It is a handy and attractive little book, giving much information regarding the goods manufactured by that company. It also contains much other information of value and interest to electricians

EARTHQUAKE SHOCKS AND TELEGRAPHIC CABLES.—The Eastern Extension Company has given notice of the interruptions of telegraphic communication with Australia by the sudden and simultaneous breakage, on the morning of July 11th, of their three cables between Java and Australia, presumably by earthquake, as shortly before the interruption a shock, said to be the sharpest felt for many years in the neighborhood, passed over Bangoewangie, at the eastern end of Java, close to which all three breakages occurred. It was expected that communication would be restored in a week's time after the interruption.

ELECTRIC LIGHT STATION BURNED.—The Thomson-Houston Company's electric light plant in Seneca Falls, New York, was entirely destroyed in the fire which occurred in that place on July 30th. Their loss is about $100,000, on which there was but $10,000 insurance. The dynamos, motors, etc., were completely ruined.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED JULY 29, 1890.

432,965. Electric-Light Fixture. Fred H. Aldrich, Cadillac, Mich. Filed Sept. 16, 1889.

432,973. Galvanic Battery. Horatio J. Brewer, New York, N. Y. Filed Apr. 17, 1890.

432,978. Electric Cut-Out. Henry A. Chase, Boston, Mass. Filed Mar. 27, 1890.

432,979. Electric Cut Out. Henry A. Chase, Boston, Mass. Filed Mar. 31, 1890.

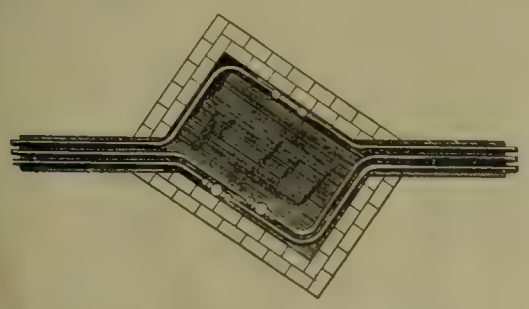
432,980. Fuse-Block and Lightning-Arrester. Henry A. Chase, Boston, Mass. Filed Mar. 31, 1890.

432,988. Automatic Electric Switch and Cut-Off. Chas. B. Doyle, Maywood, Ill. Filed Nov. 18, 1889.

433,022. Electro-Magnetic Cut-Out. Bernice J. Noyes, Boston, Mass. Filed Feb. 5, 1890.

433,025. Conduit for Telegraph-Cables. William R. Patterson, Chicago, Ill., assignor to the Western Electric Company, same place. Filed July 18, 1887.

433,041. Electrode for Arc Lamps. Llewellyn Saunderson, Kingstown, County of Dublin, Ireland. Filed May 14, 1890. Patented in Belgium and in Italy.



NO. 433,025 CONDUIT FOR TELEGRAPH CABLES.

433,045. Safety Cut-Out. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Apr. 28, 1884

433,047. Test-Circuit for Multiple Switch-Boards. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 6, 1888.

433,051. Dynamo-Electric Machine. Henry W. Spang, New York, N. Y. Filed Nov. 13, 1889.

433,082. Dynamo Telegraphy. Francis W. Jones, New York, N. Y. Filed June 11, 1889.

433,120. Telephone. Stephen D. Field, Yonkers, N. Y. Filed June 21, 1887.

433,170. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. assignor to the Electric Car Company of America, same place. Original application filed June 9, 1886. Divided and this application filed Mar 26, 1890.

433,174. Separator for Secondary Batteries. William P. Kockogey, Brooklyn, N. Y., assignor to the Kookogey Electric Company. Filed Mar. 10, 1890.

433,430. Lightning Arrester. Alexander Wurts and Oscar H. Baldwin, Pittsburg, Pa., assignors to the Westinghouse Electric Company, same place. Filed July 1, 1889.

433,181. System of Electrical Transportation. Albert L. Parcelle, Boston, Mass., assignor to the Florence Motor Company of Maine. Filed Aug. 16, 1889.

433,210. Electric Apparatus for Railways. John B. Odell, Chicago, Ill. Filed Apr. 4, 1890.

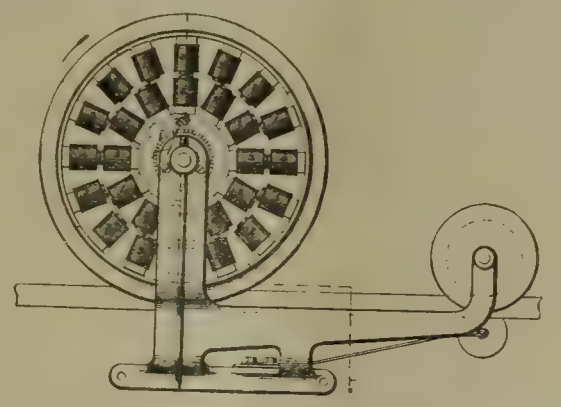
433,215. Insulating Compound. Israel Rabinowicz, Schenectady, N. Y., assignor of two-thirds to Charles Strattmann and J. Teller Schoolcraft, same place. Filed Mar. 29, 1890.

433,216 Automatic Electric Train-Signal. Albert W. Reppy, Oakland Cal., assignor of one-half to Thaddeus C. Masteller, same place. Filed January 14, 1890.

433,229. Thermal Cut-Out. Alexander Bernstein, London, County of Middlesex, England, assignor, by mesne assignments, to the Bernstein Electric Company, Boston, Mass. Filed July 28, 1888.

433,266. Pole for Supporting Electric Wires. Leonard Atwood, Philadelphia, Pa. Filed June 7, 1890.

433,269. Regulator for Dynamo-Electric Machines. Perley P. Belt, Fredonia, Kans. Filed Apr. 9, 1890.



NO. 433,181. SYSTEM OF ELECTRICAL TRANSPORTATION.

433,307. Telephone-Call Register. Willis E. Robinson, Faribault, Minn. Filed Feb. 15, 1889.

433,359. Rheostat-Switch. James F. McLaughlin, Philadelphia, Pa. Filed Dec. 4, 1889.

433,360. Electric Switch. James F. McLaughlin, Philadelphia, Pa. Filed Apr. 16, 1890.

433,371. Holder for Incandescent Electric Lamps. Adolf Lchirner, Berlin, Germany. Filed Mar. 31, 1890.

433,375. Electric Heat Regulating System. Frank M. Sparrow, Mattapoisett, Mass. Filed Sept. 26, 1889.

433,381. Electro-Magnetic Transmitter. John T. Williams, Mount Vernon, N. Y., assignor to the International Port-Electric Company, N. Y., N. Y. Filed Oct. 24 1889.

433,384. Electrical Syringe. James H. Woodward, Seward, Nebr. Filed Apr. 7, 1890.

433,390. Brush-Holder for Electrical Machines. Warren S. Belding, Englewood, Ill. Filed July 5, 1889.

433,391. Armature for Dynamos, Etc. Warren S. Belding, Englewood, Ill. Filed July 5, 1889.

433,392. Blank for Armature Coil Guards. Warren S. Belding, Englewood, Ill. Filed Nov. 2, 1889.

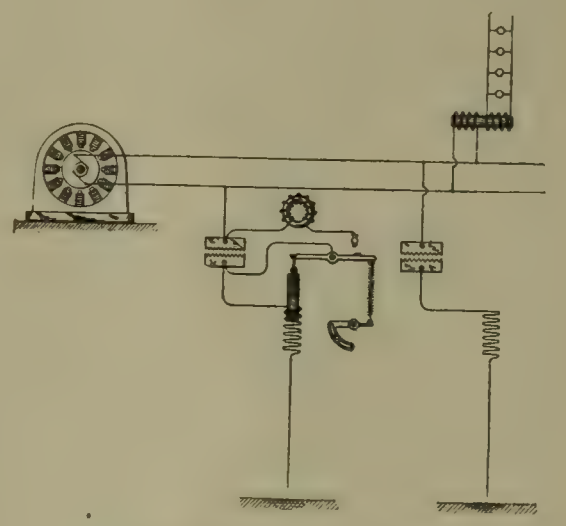
433,393. Commutator for Dynamos. Warren S. Belding, Chicago, Ill. Filed Jan. 30, 1890.

433,394. Power Transmitting Mechanism. Warren S. Belding, Chicago, Ill. Filed Apr. 28, 1890.

433,400. Magnetic Coupling Device. Theodore M. Foote, Boston, Mass. Filed July 18, 1889.

433,401. Variable Speed Gearing for Electric Cars. Theodore M. Foote, Boston, Mass. Filed Nov. 6, 1889.

433,402. Reversing Gear for Electric Cars. Theodore M. Foote, Boston, Mass. Filed Nov. 6, 1889.



NO 433,430 LIGHTNING ARRESTER.

433,407. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed Sept. 23, 1886. Divided and application filed Sept. 11, 1889 Again divided and this application filed May 7, 1890.

433,408. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed June 9, 1886. Divided and application filed Mar. 26, 1890. Again divided and this application filed June 20, 1890.

433,409. Electric Railway. Herbert R. Keithley, Denver, Colo. Filed Feb. 17, 1890.

433,421. Telegraphic Circuit. Arthur C. Robbins, Brooklyn, assignor to William S. Andrews, New York, N. Y. Filed Apr. 6, 1887.

433,424. Combination Telephone Key. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed June 1, 1889. Renewed Apr. 17, 1890.

433,425. Contact Device for Electric Railways. Frank J. Sprague, New York, N. Y., assignor to the Sprague Electric Railway and Motor Company, same place. Filed July 2, 1889.

AGAINST FAURÉ.

On July 7th, last, the Supreme Court of the District of Columbia, in General Term, rendered a decision in a case of considerable importance and interest to those interested in storage batteries. It was an appeal from the decision of the Commissioner of Patents refusing a patent to Camille A. Fauré on the 21st of February, 1890.

His application, the decision reads, was filed May 25, 1887, for "an improvement in the application of electricity as a motive power for driving or propelling vehicles."

In his description of the invention he says:

"It consists in the application of secondary "batteries or accumulators, perfectly carried by a "vehicle or upon one of a train of vehicles, to "supply electrical energy to one or more electro-"magnetic motors also carried by or upon the "said vehicle, or one or more of a train of ve-"hicles, combined with means for varying the "amount of energy supplied by the battery."

Plainly stated, he claims to have invented an improvement upon all previous devices for propelling vehicles by electrical energy through storage batteries carried by the vehicles moved, and not connected with any arrangement of wires outside of the carriage.

In January, 1882, Fauré had obtained a patent "for polarization, or secondary electric battery, claimed to be an improvement in secondary batteries," which he had previously patented in France in 1881. This patent is a constituent of the new invention for which he now claims a patent.

The specifications attached to the present application contain twenty-three claims for different combinations of the patent of 1882, applied through certain mechanical contrivances to the propulsion of vehicles. In August, 1888, the application was rejected by the Examiner in charge. Thereupon more than one-half of the claims were erased and the others amended. The application in this form was rejected by the Examiner in October, and it was again amended in November, 1887, by erasing all the remaining claims and inserting four others. These were again reduced, on further objection by the Office, to two, which were also rejected in February, 1888. On appeal to the Board of Examiners-in-Chief this decision was affirmed in August, 1889. An appeal was then taken to the Commissioner of Patents, and affidavits of experts were allowed to be filed in behalf of the applicant. In February, 1890, the Commissioner affirmed the decision of the Board of Examiners, and from this decision the present appeal is taken. Each step in the case was taken after argument. These facts in the history of the case are stated to show that the application has received apparently the most careful examination in the Office. The rejection of the claims by these successive officers was placed substantially upon the ground that there was no patentable novelty in the elements of the combination described in the application, and that the new result claimed was not a new product of the combination, but a mere aggregate of several results, each the complete product of one of the combined elements. This familiar test of patentability is thus stated in Hailes *v.* Van Wormer (20 Wall., 353) by Justice Strong:

"Merely bringing old devices into juxtaposi-"tion and there allowing each to work out its "own effect without the production of something "novel is is not invention. No one by bringing "together several old devices without producing "a new and useful result, the joint product of "the elements of the combination and something "more than an aggregate of old results, can ac-"quire a right to prevent others from using the "same device. &c."

It was conceded by the applicant that vehicles had previously been propelled on land by batteries carried on the vehicle. But it was contended that this was done in an unsatisfactory manner, by reason of the imperfect character of the batteries employed; and also, that the batteries so used were of the description known as primary batteries, in which the capability of furnishing electrical energy is not due to the previous action of an electrical current derived from some other source of electrical energy, but is created during the use of the machine itself while upon the vehicle to be propelled. This force was necessarily feeble and insufficient for practical success in such locomotion. Fauré suggested in his present application the use of his own patented secondary battery, claimed to be made of lighter material, and superior to all others of its kind, which when placed upon the vehicles was already charged with previously-accumulated energy, and when exhausted was capable of being "recuperated," or "regenerated," as the phrase is differently used, by an electric current from another source. This re enforcement, according to his claim, could be introduced while the battery remained upon the vehicle; or the exhausted battery could be removed and its place supplied by one already charged and in full vigor. And it was also insisted that no vehicle had ever been propelled on land by means of a secondary battery; that Reynier's battery, referred to by the Examiner, was not properly a secondary battery, and that all secondary batteries previous to Fauré's were inferior to his and practically useless.

After quoting the various decisions of the Examiner, rejecting the original and amended applications, and of the Board of Examiners and of the Commissioner on successive appeals, the decision of the Court concludes as follows:

We think we would be doing a wrong to previous patentees and to the public generally if we should hamper the success of the very important problem of electric locomotion now attracting public attention everywhere, by assisting in the grant of the patent now applied for.

The subject of a patent, in the absence of a specific grant from the Government, belongs to the public as common property. In proper cases a monopoly is granted to the inventor and during its continuance it will be protected. Fauré has already obtained a prolonged monopoly for his valuable improvement in secondary batteries. If they are the best obtainable, the public will be forced to use them, and their use will remunerate him for his labor. But this furnishes no reason why seventeen years in addition should practically be given to his patent by the grant of the very broad claim to use this device.

The decision of the Commissioner is affirmed.

ANSWERS TO INQUIRIES.

Editor ELECTRIC AGE—I have a lot of No. 14 bare copper wire which I desire to use in wiring my house for some small lights, bells, etc. Do you think it will answer the purpose? I am an amateur and am doing this work for instruction more than anything else.

Portland, Me. S. B. L.

Answer—We would advise you to let the uncovered wire alone for your purpose. Covered or insulated wire should be used for all interior wiring. The uncovered wire should not be used save by an expert, and even when it is properly run it is always liable to cause no end of trouble.—Editor ELECTRIC AGE.

Editor of ELECTRIC AGE—In electric lighting is the wire used for the external circuits of the same gauge throughout?

Meadville, Pa. J. L. W.

Answer—No; the gauge of wire is proportioned to the current—the largest wire being used at the dynamo end of the circuit and the smallest at the opposite end, where the current is smallest.—ED. ELECTRIC AGE.

"Richmond" asks: "What is the cause of the short circuiting that storage cells are so liable to?"

Answer.—There are various reasons for this common trouble, among them being "buckling" of plates; the flaking off of the material with which the plates are coated, and falling in between the plates, and the formation of "trees" of lead, or specular crystals of lead, which form between the plates. These crystals are needle-like and are quite imperceptible. They form a short circuit between the plates.—Ed. ELECTRIC AGE.

PERPIGNAN.—The civil tribunal at Perpignan has just condemned M. Bartissol, who has undertaken the electric lighting of the town, to pay 15[illegible] francs as compensation to a M. Campana for the damage done to his house by the noise, smoke and vibration due to the proximity of the central lighting.

THE TELEPHONE IN ITALY.—Telephonic communication is to be established between Rome and Naples, Florence, Genoa, Turin, Milan, Venice, Spezzia, as well as between Turin and Milan, Milan and Venice, Genoa and Turin, Genoa and Florence, Naples and Palermo, and Messina and Palermo.

$400 Media (Pa.) Military Academy—Boys. Brooke Hall—Girls. Circulars free.

EDISON LAMPS,

½ TO 36 CANDLE POWER.
2½ TO 40 VOLTS.

For Battery or Dynamo.

These Lamps can be used in series on dynamo circuits for all kinds of decorations and displays.

WE WILL SEND FREE. CATALOGUE E.

which gives prices and descriptions of lamps, and directions

HOW TO MAKE A CHEAP BATTERY

to run them. Any intelligent boy can make these batteries under these directions.

EDISON LAMP CO., Harrison, N. J.

The DOUBLE CYLINDER LAW BATTERY

The Standard for all Open Circuit Work.

ITS NINTH YEAR.

The Negative Element has 147 square inches of surface, which is more than double the surface found in any other. The Cell contains 2½ pints of solution, which is nearly double that in any other cell!



4½ ins. square, 7½ ins. high.

No Running over or Creeping Salts. No Evaporation. No Corrosion. No Renewal of Negative Element. Requiring No Care. Costing nothing for Renewals except for Zinc and Solution a trifle in from two to four years. White Flint Glass Jar. Black Rubberoid Cover. Lock Seal Top. Pure Zinc. Pure Sal Ammoniac. Fewest Parts.

The Law Battery is kept in stock and for sale by all reliable supply houses.

AGENTS: GEO. I. HENZEL, San Francisco, Cal., for Pacific Coast. CHAS. A. STRELINGER & CO., Detroit, Mich., for Detroit.

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THE KEMMLER EXECUTION.

The first electrical execution in history took place in Auburn, N. Y., August 6th, and judging from present indications it may be the last. William Kemmler, murderer, was the victim, and the case will probably stand as the most celebrated on record in criminal jurisprudence. The story of the case up to the time of the execution is an old one. Everyone is familiar with the extraordinary efforts that were made to prevent the carrying out of the sentence, and the repeated failures of these efforts, until finally the highest court in the land was appealed to to settle the question as to whether the execution of the sentence should be carried out or not. When this court of last resort decided against the appellant the last hope was gone, and nothing but executive clemency could stay the execution of the sentence. This did not come and the sentence was carried out as stated.

There is wide difference of opinion among those who witnessed the execution as to the success of the experiment, and it may require a legislative and expert investigation to determine this question. Even then there will remain grave doubts in the minds of many as to the advisability of substituting the electrical method of execution for that of hanging.

From all reports there appears to have been some bungling in the manner of applying the current to the body of the condemned man, and it is also evident that the apparatus was inefficient to perform its deadly work. The result of all this is that each one having a part in the affair accuses the others of blundering, and the responsibility cannot be placed on the shoulders of any particular one. It seems to be settled that the current when first applied was not sufficiently strong to accomplish its deadly work instantly, as it should have done, and that the current had to be turned on the second time. If the first application of the current had been successful all of the wrangling that has ensued would not have taken place, and the method of execution by electricity would undoubtedly have been declared a success.

It was the necessity for the second application of current that turned what should have been a success into a failure—if failure it can be called. The consensus of opinion, however, is that Kemmler was rendered unconscious by the first shock, and that he suffered no pain. But was he killed by it? There is where the grave question lies. It is said that he breathed and gave other indications of returning life after the current was withdrawn the first time. It was then that the second application was rendered necessary. It is also stated that the strength of the second current was greatly augmented. Why was not the full current turned on in the first place? This is an awful blunder that some one must be responsible for, and a thorough investigation should be made to determine if possible where the responsibility lies. Warden Durston was the person in direct charge of the execution, and it would seem that he is the person to whom all responsibility should be charged. Whether he can be legally held responsible or not, there is no question that he should have had the advice of an expert electrician, which he evidently did not have.

The stories regarding the intensity of the current used are very conflicting, and as yet it is not definitely known what it was. Some persons place it at less than 1,000 volts while others claim that it was 1,700. Warden Durston states that it varied between 700 and 2,000 volts. It is claimed that by the Warden's own statement of the facts Kemmler received only a 700 volt current the first time, and the impression appears to be gaining that the miserable wretch was in a semi-conscious state when the current was applied the second time.

In the light of all the obtainable facts there is no doubt that serious blunders were committed, and what should have been a success was turned into ignominious failure.

What the result of this horrible experiment will be no one can with certainty forsee. We should not be surprised, however, in view of what has occurred in the death chamber at Auburn to see efforts made at the next session of the Legislature to have the electrical execution law repealed. There is no gainsaying the fact, however, that when a current of sufficiently high tension is properly applied it is as far as known the quickest and most humane method of extinguishing life. There are a good many things to be taken into account, however, when the application of a killing current to a human body is considered, and the experience at Auburn only goes to show that this important subject is as yet little understood.

This execution was in reality on experiment, and the revolting feature of the affair is the fact that the experiment was tried on a human life. Yet, after all, was the sight as revolting to the on-lookers as a sample case of the majority of hangings would have been? We think not. What more horrible scene could be witnessed than the strangling to death of a criminal? And this is what very frequently happens, and is not much thought of, simply because it is of frequent occurrence and is an old story.

THE ELECTRICAL CENSUS.—We have received from Mr. Allen R. Foote, special agent of the Eleventh Census, a copy of the schedule for Central Lighting and Power Stations. The questions contained therein cover every detail of electric lighting, and it is desirable that they be correctly answered and returned to the office as promptly as possible, in order that the work may not lag. The electrical census will be a feature in the census reports, and no one can question the great value and usefulness the information will be to central station companies. The latter already know in a general way the extent and importance of the electric light industry, but the public have no conception of its magnitude. The reports, therefore, will be a revelation, and no doubt will aid very materially in making the light more popular than ever. It would seem to be to the material advantage to all companies to answer thoroughly the questions contained in the schedule. It is needless to point out the great value this census of electrical industries will be to all concerned if each company will do its part well and co-operate in the effort that is being made to collect reliable statistics of one of the greatest industries of the century.

ELECTRIC RAILWAY ASSOCIATION.—Of all of the great electrical industries the electric railway is about the only one that is not represented by an organization. Every other branch of electrical operations has its national association, and there can be no question of the value of membership in these organizations. The stated meetings at which experiences and suggestions are exchanged are beneficial in the extreme to all directly interested, and there is no reason why such would not be the case in an electric railway organization as well as in the others. Electric railway managers are enterprising and wide awake persons and are disposed to have everything of the best and the latest. An organization among them would be of unquestionable benefit to them in this regard, and through its agency they would be kept thoroughly posted of what was new and valuable in their line. There is much for all to learn pertaining to electric railways and there is no better way of acquiring such knowledge than by the method suggested.

INSURANCE RULES.—The New England Insurance Exchange has adopted a sensible and perfectly fair method of enforcing its rules. It has instructed the electrical inspectors to report such apparatus as is not installed in accordance with the rules of the exchange, and the secretary to notify at once both the assured and the parties installing the apparatus of the defects, and if no action is taken at the expiration of thirty days after such notice is given to remedy the defects, the rate on the building and contents will be advanced at least ten cents. If there was more of such insurance management throughout the country there would be more popular confidence in electricity.

SUBWAY LITIGATION.—Recently the North American Underground Telegraph and Electrical Company sued the Consolidated Subway Company for $2,500,000, for an alleged violation of contract in discontinuing the use of the Johnstone system of subways. Argument was heard on the 7th inst. in this city before Judge Beach, on an order to show why the defendant should not be enjoined from using any other system. Judge Beach reserved decision.

A GOOD SUGGESTION.—It is suggested that, in view of the liability to breakage of guard wires on electric roads using the overhead wire system, a pair of rubber gloves be hung up in each car in plain sight. These, of course, are for use only in case of breakage of the wire, and the idea is that any one may put on the gloves and remove the broken wires out of harm's way. The idea is certainly an excellent and sensible one, and should be carried out. On most all railroads axes and other implements are carried in plain sight on many passenger cars, and are placed with the idea of accessibility in case of accident.

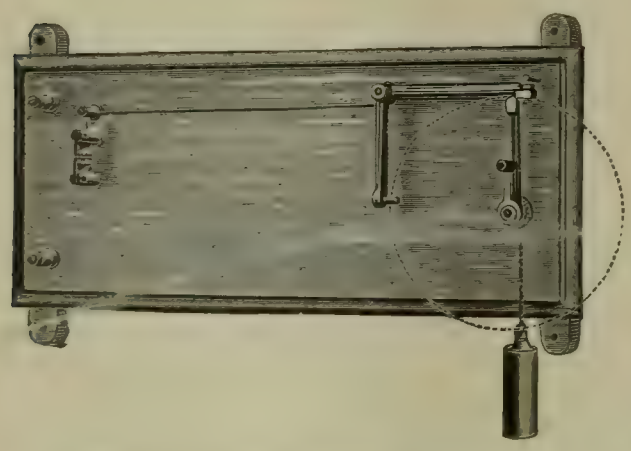
THE MINNEAPOLIS EXPOSITION.—We are in receipt of an elaborately gotten up prospectus of the Minneapolis Industrial Exposition which opens Aug. 27th, and closes Oct. 4th. The feature of this exhibition, as is already well known, will be the electrical department which will include the Edison exhibit and many other novelties in the electrical field. The prospectus gives a history of the exposition, and is full of illustrations of interesting places and buildings in and around the city. The outlook for the success of the show is exceedingly gratifying.

ZANESVILLE.—After a prolonged fight for a franchise an electric railway for Zanesville, Ohio, s now an assured fact.

BAIN'S HOT WIRE LIGHTNING ARRESTER.

There is great demand for a protector that will absolutely guard all electric circuits from danger arising from a supercharge of electricity usually due to lightning. A number of devices have been recently suggested, some of which are said to be based upon fallacious and impractical ideas.

A lightning arrester to be practical should protect the circuits when they are idle with as great fidelity as when the dynamos are in operation. It should be so constructed as to have no self induction, therefore it should have no magnetic coils or condenser plates, of more or less thickness in the circuits. An absolute break of sufficient distance to interpose enough resistance to open the arc should be made with every flash of lightning that comes in on the lines. These breaks should be absolute and not depend upon any equilibrium establishing mechanism for the length of break, they should be automatic so as to take care of a number of flashes in rapid succession without any manual attention, and a further requirement is that they should protect circuits used for alternating currents with an equal degree of promptness and certainty as circuits which are used for straight currents.



BAIN'S HOT WIRE LIGHTNING ARRESTER.

Such a device has been recently designed and patented by Mr. Foree Bain, of Chicago. The cut shows how the circuit to ground is absolutely opened through the expansion of a small iron wire, due to the passage of the flash or the dynamo current. The iron wire forms a part of the circuit to ground, the lightning leaves the line at the comb, passes over this wire which it expands; a spring acting against the wire causes the trigger to unlatch the metallic winch, which forms part of the circuit; to this winch is attached a string, wound round a drum, which is a part of the winch; to the string is hung a small weight which caused the winch to revolve when released. When the wire has been expanded by the passage of current, the winch makes three quarters of a revolution and stops against an insulated stud on the arm, part of which forms the trigger; it rests against this insulated stud, leaving the circuit to ground open until the wire contracts sufficiently to release it from this stud; it then completes the revolution and once more rests against the trigger and is ready for another flash to repeat the operation.

This arrester is said to be thoroughly reliable and may be placed on either side of converters of alternating circuits or in dynamo rooms, on either alternating or straight circuits. In actual operation the wire does not get warm enough for the heat to be detected by touch.

The instruments are for sale by the Central Electric Company, Chicago.

RAILWAY MOTOR.—Michael H. Smith of Halifax, County of York, England, assignorto the Thomson-Houston Co., has patented an electric railway motor, which consists of the combination with a car of a motor, the magnets, yoke and armature spindle of which are all in the same plane, the motor being supported in swinging bearings beneath the car.

IMPROVED RAILROAD SIGNALS.

At the convention of Railway Telegraph Superintendents at Niagara Falls, last June, railroad signals received greater consideration than all other subjects put together. Very properly so, as this subject is, of all others, the one of greatest importance in railroad operations, and while in America great strides are being made towards perfection in railroad signalling, considerable attention is given to the matter in England as well.

The following description of an improved apparatus recently brought out in London is taken from an English contemporary, and will be read with considerable interest by all concerned. Its object is to stop railway trains during foggy or snowy weather when the distant signal is at danger, and to dispense with the use of ordinary fog signals, and therefore with the men usually employed to place them upon the metals. The apparatus consists essentially of three parts. The first is a telescopic spring box platform placed on the ground in the centre of the 4-foot way; the second comprises an electric contact roller placed underneath the headstock of the engine; and the third is an electric bell and disc fixed on the footplate or engine platform. The telescopic spring box platform is attached to the sleepers, and works in conjunction with the ordinary outdoor signals. It consists of two wooden boxes fitting telescopically inside one another, the outer or upper box having an overlapping lid resting upon two bent springs. Two similar springs are fixed at their upper ends to the underside of the overlapping lid. When the outer box is depressed in the manner to be subsequently explained, the lower ends of the two latter springs form an electric contact by being forced down upon a metal plate carried upon two supports. This act of making contact causes a current to flow through two wires connected with the metal plate, and to sound a gong attached to a suitable signal post erected in the 6-foot way. Upon the central part of the underside of the before-mentioned lid are fixed two brackets, to which is attached, by means of a pin, the upper end of a wire chain or cord. The lower end of this chain passes over two pulleys, and is connected to a pivoted quadrant which communicates by suitable leverage with the signal arm.

The electric contact roller consists of a roller mounted upon a hollow shaft, fixed in suitable bearings formed in the two arms of a forked metallic piece rigidly held by two springs, and having a shank which is bolted under the headstock of the engine. The roller is weighted at one end, and turns loosely upon the hollow shaft which carries a circular core of wood. This core has a portion of its upper part cut away, forming a flat surface which carries two metal bars with which a circular spring bearing against the core and arranged eccentrically establishes a contact whenever the roller accomplishes an entire revolution. The two metal bars are connected at each end with two wires passing through the hollow shaft and leading respectively to the battery and to the bell arranged on the footplate of the engine.

The third apparatus comprises an electric bell, an indicator or disc connected with the bell by suitable springs, a cord to raise the indicator or disc, and a battery by means of which the bell and disc are operated when the contact roller passes over the spring box platform. It may here be mentioned that the latter platform is by means of the ordinary signal wire depressed so as to be level with the ground when the weather is clear and the signal open, and is raised during foggy or snowy weather, when the signal is moved to danger. In summer time the signal may be entirely disconnected from the platform which is then permanently held in a depressed condition, or the signal may be continuously operated in conjunction with the spring box platform for ordinary signalling purposes, whatever may be the state of the weather.

It may be well to explain the working of this apparatus. When the locomotive passes over the telescopic platform, the upper box is depressed by the contact roller, the circuit is completed, and the bell on the foot plate of the engine is caused to ring, and the disc falls into the position of danger. The bell continues to ring and the disc remains at danger until the engine driver pulls the cord, thus interrupting the circuit and raising the signal to its safety position. Simultaneously with the depression of the platform, the second electric circuit is completed and the gong on the signal post sounds.

This system of signalling has been invented by Mr. J. A. H. Child, of East Greenwich, and Mr. J. Emery, of Erith. It has now been in operation on some sidings on the South Eastern Railway at Erith, for nearly a year, and has given complete satisfaction.

THE MINNEAPOLIS ELECTRICAL EXPOSITION.

The electrical exhibit which is to be made at the Minneapolis exposition which opens Aug. 27th, and closes Oct. 4th, will be the most complete display ever held. It will include not only the Edison exhibit as made at the Paris Exposition in 1889 but will be more complete in every way, and in addition an exhibit by the Thomson-Electric Welding Co., of Lynn, Mass. The Edison exhibit is already on the ground and is being arranged under the direction of Luther Stieringer of New York. Nearly three carloads of electrical material to be used in the exhibit has arrived. The principal feature is a "Tower of Glory," the plans for which were drawn by Mr. Stieringer. The tower has been built in the center of the building, and is about 70 feet high and eight feet in central diameter. It is of Egyptian design and is to be covered with 7,500 incandescent lamps. From the top of the tower festoons of lamps will hang in various designs making it the most brilliant lighting spectacle in the world.

The Edison exhibit includes the wonderful talking dolls and electric railroad; the various telephone plants; the telegraph instruments as seen in Paris and at the Lenox Lyceum, and the phonographs and dynamos. The workings of all this apparatus is to be illustrated by experts from the Edison laboratory.

The Thomson electric welding apparatus by which dissimilar materials are united will also be in actual operation. Much interest is being manifested in the exhibit.

The convention of the Edison Illuminating Companies will be held in Minneapolis September 16th. A large number of delegates are expected to be present.

There will also be a very extensive exhibit by the Carpenter-Nevens Electric Heating Co., who will have in practical operation a number of very recently patented electrical apparatus such as soldering tinware, ironing, laundry work, pressing clothing, frying doughnuts and various other appliances of heat by electricity.

There will also be a very extensive exhibit by the power department of the Edison General Electric Co., and a very extensive line of exhibits of electrical merchandise and apparatus.

THE FRANKLIN INSTITUTE.—The Journal of the Franklin Institute, for August, contains a valuable and complete article on "The Oxidation of Sulphides by means of the Electric Current," by Edgar F. Smith. The paper was read at the stated meeting of the chemical section June 17th last, and is an extremely interesting addition to the fund of knowledge on electro-chemistry. The lecture of Dr. Louis Duncan on "Modern Conception of Electricity," which was delivered before the Institute, February 3d last, is also printed in the number.

KILLED BY LIGHTNING.—The artillery barracks at Comorn, Austro-Hungary, were recently struck by lightning. The electric fluid penetrated three rooms, and threw twelve men out of their beds. Two of the men were killed on the spot.

VORKING EFFICIENCY OF SECONDARY CELLS.

(*Continued from page 7, issue of Aug. 9.*)

II.—Efficiency.

In the earlier of the experiments made by us on the efficiency two distinct groups, each of 10 cells, were employed. The current passing through the two sets of cells also passed through two platinoid strips, and the P.D. at the terminals of each of these platinoid strips was measured by a suitable low-resistance galvanometer, whose indications, therefore, measured the respective currents passing through the two sets of cells. The P.D. at the terminals of either group of cells was measured by means of a high resistance D'Arsonval galvanometer, which by means of a switch could be connected with the terminals of either of the two groups. The high resistance and one of the low resistance instruments have been absolutely calibrated very frequently during the past few years, by means of the silver voltmeter, known resistances, and Latimer Clark standard cells. A special calibration was also taken of these instruments, both just before these experiments were commenced, and at their conclusion.

Group No. I. of 10 cells was first charged with 9.05 ampères and discharged with 9.933 ampères, there being four discharges alternated with four charges, without intermission, from January 8th to January 12th, 1889, both days inclusive. One of the observers was always present (day and night) to keep the current constant by hand regulation, to take frequent readings of the P.D. at the terminals of the set of 10 cells, to stop the charging when the P.D. per cell reached 2.4 volts and immediately start the discharging, as well as to stop the discharging when the P.D. per cell reached 1.6 volts, and instantly start the charging again, so that the cells were never left discharged.

We used the limits 2.4 and 1.6 volts per cell as the criterions for stopping respectively the charge and discharge since, as already seen, the slope of the charge and of the discharge curves are greatest for about these values of the P.D.

Next, Group No. I. was charged with 4.519 ampères and discharged with 9.933 ampères, twice, without intermission, from January 14th to January 19th, inclusive; the P.D. limit for charge being 2.4 volts, and for discharge 1.5.

And while the two sets of tests were being made with Group I., Group II. was first charged with 9.104 ampères, and discharged with 4.858, without intermission, from January 9th to January 12th. And lastly, Group II. was charged with 4.519 ampères, and discharged with 4.858, without intermission, from January 14th to January 19th, both days inclusive.

Shortly, then, the tests were—

	Charge.		Discharge.
Group I.	9	..	10 ampères.
	4½	..	10 "
Group II.	9	...	5 "
	4½	..	5 "

The coarse adjustment of the resistance for keeping the current constant was effected by means of resistance coils made of bare German silver wire suitable for standing large currents; the fine adjustment was performed by means of horizontal mercury troughs, through which the current passed, the lengths of the mercury in the wooden troughs through which the current passed being varied by copper bridge-pieces. This mercury trough arrangement forms an extremely convenient resistance for delicate adjustment by hand. To keep the current as constant as possible, a dynamo was not used to charge the accumulators under test, but they were charged instead from other accumulators of much greater storage capacity.

The general expressions for the ampère hours and watt hours given out by an accumulator are, of course,

$$\int_o^{t_1} A_1 \, dt, \text{ and } \int_o^{t_1} V_1 A_1 \, dt,$$

where A_1 and V_1 are the current in ampères passing through accumulator, and the P.D. at its terminals at any moment, and t_1 is the time in hours during which the discharge lasts. Consequently, if A_2, V_2, and t_2 have similar meanings for the charge, the complete expressions for the quantity and energy efficiency are, respectively,

$$\int_o^{t_1} A_1 \, dt \div \int_o^{t_2} A_2 \, dt$$

and

$$\int_o^{t_1} V_1 A_1 \, dt \div \int_o^{t_2} V_2 A_2 \, dt.$$

In our experiments A_1 has a constant value during the discharge, and A_2 a constant value during the charge, so that the expressions for the quantity and energy efficiency reduce themselves to

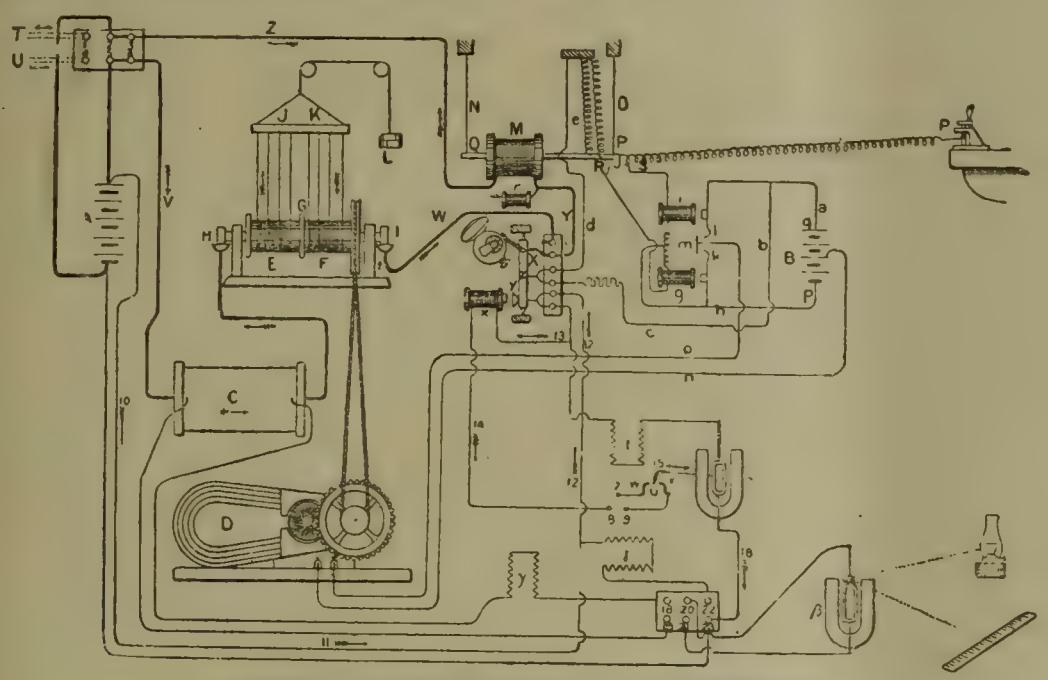
$$\frac{A_1}{A_2} \cdot \frac{t_1}{t_2},$$

which is very easy to calculate,

and $$A_1 \int_o^{t_1} V_1 \, dt \div A_2 \int_o^{t_2} V_2 \, dt$$

To obtain $\int_o^{t_1} V_1 \, dt$ a time curve of the values of V_1 is drawn and integrated; similarly, to obtain $\int_o^{t_2} V_2 \, dt$ a time curve is drawn for V_2 and integrated; then, multiplying the first integral by the steady value of the discharge current A_1, and the second integral by the steady value of the charge current A_2, we have, respectively, the watt-hours given out in the discharge and the watt-hours put into the accumulators in the charge.

After drawing a series of time curves for the P. D. in the various experiments already referred to, and integrating them with an Amsler's integrator, we obtained the following results for the successive charges and discharges:



AUTOMATIC CURRENT REGULATOR AND INTERRUPTER.

Group of Ten Cells—No. I.

Discharge at 9.933 amp.		Charge at 9.05 amperes.		Percentage.	
Ampere hours.	Watt hours.	Ampere hours.	Watt hours.	Quantity efficiency.	Energy efficiency.
119	2,280	114	2,435	105	94
105	2,045	102	2,220	103	92
101	1,970	101	2,220	100	87
104	2,020	104	2,270	100	89
Discharge at 9.933 amp.		Charge at 4.519 amperes.			
112.5	2,170	115	2,485	98	87
113	2,190	115	2,485	98	88

Group of Ten Cells—No. II.

Discharge at 4.858 amp.		Charge at 9.104 amperes.		Percentage.	
Ampere hours.	Watt hours.	Ampere hours.	Watt hours.	Quantity efficiency.	Energy efficiency.
154.5	3,005	138.5	2,910	111.5	103
141.5	2,770	129.7	2,820	109	98
Discharge at 4.858 amp.		Charge at 4.195 amperes.			
143	2,785	141	3,075	102	90.5

Now not only are quantity efficiencies of 105, 103, 111, 109, &c., per cent. impossible, but energy efficiencies of 94, 92 per cent. are also too high, when accumulators are being charged and discharged at the maximum rate allowed by the manufacturers. Further, it is noticeable that for each set of tests both the quantity and energy efficiencies diminish on the whole as the tests proceed. These cells, like the other cells in the Central Institution laboratories, have been charged at regular times; and as the number of ampère hours taken out of them for ordinary laboratory work varies very much, the intervals between the periodic chargings are so arranged that on the whole the cells are charged up much more than they are discharged.

Hence at the commencement of these tests the cells had a large store of energy in them on which to draw in the discharges, the results of which are given in the preceding table. From this we learn this very important fact—that *if accumulators be thoroughy well charged up before being tested, then five days' continuous charging and discharging alternately with even the maximum currents allowed by the manufacturers fails to give the normal quantity, or energy, efficiency.*

It will be noticed that both the ampère hours and the watt hours are increased by diminishing the current employed. This is partly due to the fact that if a fixed P. D. limit per cell be employed either in discharging or charging, the cell is discharged until the E. M. F. is slightly lower, and charged until the E. M. F. is slightly higher for a small current than for a larger one.

III.—Automatic Current Regulator.

We think it possible that a neglect of the power that accumulators possess of drawing on a store of energy put into them in former chargings may have led experimenters to conclude that the normal efficiency of certain types of accumulators was greater than was really the case. To ascertain the *working efficiency* of the accumulators we were testing, it was clear that they would have to be charged and discharged alternately with a definite charging and a definite discharging current continuously for a much longer period than five days. And as this would be a very laborious operation if the current had to be kept constant day and night during this

period by hand regulation, we proceeded to construct the automatic current regulating device shown in fig. 5.

A is a set of five accumulators under test, where B is a totally independent set of four used to provide the power for working the current regulator. C is a platinoid strip of sufficiently large cross section and surface that no appreciable change of resistance can take place by the largest current—10 ampères—that flows through it in these experiments. D is a permanent magnet motor, the rotation of which in either direction turns the brass roller, E, F, very slowly in one direction or the other, the pinion and toothed wheel of the motor, combined with the small grooved pulley on the toothed wheel shaft and the much larger grooved pulley on the roller, causing the angular motion of the roller to be about $\frac{1}{500}$th of the angular velocity of the armature of the permanent magnet motor. The brass roller, E, F, is electrically divided into two halves by the ebonite disc, G, and little amalgamated discs at the ends of this roller turn with but little friction in mercury cups, H, I. Round each half of the roller are wound four bare platinoid wires of No. 26 gauge, and each about 4½ feet long. Their lower ends are soldered to the brass roller, and their upper ends to the brass bar, J, K, small spiral springs (not shown in the figure) being introduced to keep the wires taut. The rod, J, K, is held up by a cord which passes over two pulleys, and to the end of which is attached the weight, L. An electric current entering at H follows the path, H, E, J, K, F, I, the path being longer or shorter depending on the amount of the platinoid wires wound on the two halves of the brass roller. M is a solenoid, being, in fact, the coil of an A. and P. ammeter, on the axis of which a rod, P, Q, was very delicately poised by its being supported by four very fine wires of No. 40 gauge, and each about one foot long. Two of the wires, N, on a plane at right angles to the path, joined together where they were connected with the rod at Q, but spread out at the top, and similarly O consisted of two wires. Thus, while the rod, P, Q, had great freedom of motion along its axis, it could not wobble sideways. This rod consisted of two pieces of brass at its ends, but the middle shaded portion was the well-annealed soft iron tubular core of the ammeter. A current passing round the coil, M, sucked in the core more or less against the pull of the antagonistic spiral spring, P, P′. This spring was made of platinoid wire of No. 26 gauge, wound round a ¾-inch mandril, and when pulled out in position it had about 30 turns to the foot, and was over 4 feet in length. One end of the spring was attached to the rod at P, while the other, P′, was fastened to a fine thread, which could be wound up more or less round a small roller and the tension of the spring very delicately adjusted.

At first the elasticity of this spring was not perfectly constant, but after about one month's use the pull it exerted when stretched to a given length became wonderfully definite, and the core, P, Q, could be adjusted so that for a current of exactly 9 ampères flowing round the solenoid, M, the projection at P remained midway between the contacts, R and S, without touching either. But on the current flowing round the solenoid, M, becoming very slightly greater, or very slightly less, than 9 ampères, the platinized projection of the rod at P made contact with either the platinized piece, R or S. The permanency that the spring eventually attained was so great that even when the apparatus had not been in use for two or three weeks, one had only to close the circuits to start the regulator, and no fresh adjustment whatever of this spring was necessary to ensure that the current would be kept absolutely constant at 9 ampères. This spring has, however, now gone the way of most bare fine platinoid wire, of breaking up into pieces.

When the cells, A, under test were being charged by means of a set of accumulators not shown on the figure, but attached to the leads, T and U, three copper bridge-pieces were put in to connect the mercury cups, 4 to 5, 2 to 6, and 1 to 3, respectively; whereas when the test cells were being discharged two copper bridge pieces connected the mercury cups, 2 to 3 and 5 to 6. The current passed, of course, one way through the cells, A, in charging, and the other way in discharging; but in both cases a positive current flowed, as indicated by the arrows, through the thick lead, V, the platinized strip, C, through H, E, J, K, F, I, through the thick lead, W, the thick lead, Y, the solenoid, M, and the thick lead, Z. As already explained, if the currents through this circuit exceeded in the very least 9 amperes, the core, P, Q, was sucked into the solenoid, M, until P made contact with R: whereas if the current fell in the least below 9 amperes, P Q was pulled back by the spring, P, P′, until P made contact with S. In the former case a smaller auxiliary current from the accumulators, B, follows the course, *a*, *b*, *c*, *d*, through the spirals, *e*,—several in number, so as to carry the current, but made of extremely fine wire, so as to oppose practically no resistance to the free motion of P, Q—then from P to R, through *f*, the electro-magnet, *g*, and through *h*, back to the other pole of the battery, B. If, instead, P be in contact with S, then the current from the auxiliary accumulators, B, passes from P to S through the relay electro-magnet, *i*, instead of through the relay electro-magnet, *g*. In the former case the spring tongue, *k*, is attracted so as to make contact with M (M being in reality a mercury cup into which dipped a platinum point with which *k* was tipped), and in the latter case the spring tongue, *l*, is attracted so as to make contact with *m*. If *k* makes contact with *m*, a positive current commencing from the middle of the accumulators, B, follows the path, *n*, the motor, through *o*, *m*, *k*, and back to the end of the accumulators, *p*; whereas if *l* makes contact with *m*, a positive current follows the path, *q*, *a*, *l*, *m*, *o*, the motor, through *n*, and back to the middle of the cells, B.

Accordingly, then, as P makes contact with R or with S, a current is sent one way or the other through the armature of the permanent magnet, D, and the roller, E, F, is turned around one way or the other so as to unwind, or wind up, more of the wire and automatically alter the resistance in the circuit. Although the whole apparatus was home-made, and looked very rough, it was able to automatically keep the current constant to 1 part in 600 for days at a time.

As the charge was affected with 9 amperes, and the discharge with 10, a shunt, *r*, exactly nine times the resistance of M, was connected across M during the discharge, and as the automatic regulator kept the current through M constant at 9 amperes, it kept the current through the circuit constant at 10 when the shunt, *r*, was attached to M.

The necessity of using the relay electro-magnets, *g* and *i*, arose from the fact that the only suitable permanent magnet motor which was at our disposal was a laboratory hand magneto Gramme machine, which required a current of about 1 ampere to work it, and to obtain great sensibility, the contacts between P and R, or P and S, had to be too slight to carry such a current.

It was very interesting to watch the regulator, since the armature of the motor was almost always in motion, now making half a turn one way, now one turn the other. It may be mentioned that one turn of the motor armature shortened or lengthened each of the platinoid wires by about $\frac{1}{65}$ of an inch—that is, by less than the $\frac{1}{3000}$ of its whole length.

At first all sorts of plans were tried for keeping clean the surface of the mercury in the mercury cap *m*; but alcohol floated on the mercury failed because it dried up, water was electrolyzed, oil was carbonized, and a long conducting point adhered to each of the platinum points *l* and *k*, and the auxiliary accumulators B were short-circuited. In despair we left the surface of the mercury completely exposed to the air, and were surprised to find that that answered perfectly: a thickish layer of mercury and mercurous oxide formed on the top, but the platinum wires easily forced their way through and always made good contact

To avoid, however, all risk of accidents, cut-outs were introduced into various parts of the circuit: and to prevent the motor overwinding the platinoid resistance wires on the roller E F and breaking them, should the current in the main circuit accidentally become much too small, as well as to prevent the motor unwinding the wires too far off the roller, should the current become much too large, safety keys (not shown in the figure) were provided. If the rod J K were drawn down dangerously low, or allowed to go up too far, it touched one or other of the safety keys and broke the electrical circuits.

IV.—Automatic Interrupter for Breaking the Charging and Discharging Circuits.

As it was extremely important that both the charging and discharging circuits should be broken at the exact moment when the potential difference in its rapid variation passed through certain specific values, and as in a long course of experiments, lasting for several months, it was quite possible that occasionally no one of the observers would be present at the exact moment, we arranged an interrupter to break the circuit automatically when the potential difference in charging reached 2.4 volts per cell, or 1.6 volts per cell in discharging. The automatic interrupter was arranged thus: *s* is a D'Arsonval galvanometer, the coil of which, wound with platinoid wire of 154 ohms resistance, is joined in series with a resistance box, *t*, as a shunt to the accumulators A under test. Electric connection was made with the bottom of the coil by means of a fine spiral spring, too thin to introduce any controlling moment, while above the coil was suspended by a phosphor-bronze strip 1-1,000th inch thick, 12-1,000ths broad, and 1¾ inch long. This strip had seven twists put into it by means of a head moving in a tight collar, the coil being prevented from turning by a pointer, *u*, attached to the frame-work or the coil coming into contact with the stop *v*. The thin phosphor-bronze strip being very thin, it had very little torsional rigidity, and being set up as described, this instrument acted as a "set-up voltmeter"—a type of instrument proposed some years ago by Prof. Perry and one of the authors of the paper for measuring with great accuracy a very small change in a potential difference. With a definite adjustment of the resistance in the box *t*, the platinum-tipped pointer *u* remains in contact with the stop *v* for all potential differences between the terminals of the accumulators A less than 2.4 volts per cell. When the potential difference reaches this value the pointer at once leaves the stop *v*, moves over through an appreciable distance, and makes contact with the platinum-tipped stop *w*. With another definite adjustment of the resistance in the box *t*, the pointer *u* remains in contact with *w* for all potential differences between the terminals of the accumulators A greater than 1.6 volts per cell, but the moment this value is reached the pointer moves away from *w* and makes contact with the platinum-tipped contact-stop *v*.

When charging, a copper bridge-piece connects the mercury cups 7 and 8, and when, on the potential difference at the terminals of the accumulators A reaching 2.4 volts per cell, the pointer *u* passes over and makes contact with *w*, an instantaneous small current is sent by the accumulators A through the electro-magnet *x*, which attracting the armature *y* downwards, tilts the spindle *z*, and thereby lifts X and the other two contact forks out of the three sets of mercury cups, thus breaking *all* the circuits. The tilting of the spindle *z* also brings a camel's-hair brush into contact with the balance of a watch, and stops it at the moment the charging is completed.

In discharging the cells A, mercury cup 7 is connected to 9 instead of to 8. During the dis-

Continued on page 9.

ELECTRIC LIGHTING FOR BEGINNERS.

BY THE EDITOR.

Part IV.—Brushes.

81—What are the brushes of a dynamo?

The brushes of a dynamo are the flat and straight strips of metal which bear on the commutator segments.

82—What are the brushes for?

The brushes are for the purpose of collecting the currents generated in the armature from the commutator segments, and conveying them to the external wire with which they are connected.

83—Do the brushes revolve, or are they stationary?

They are stationary; the commutator revolves.

84—How many brushes are there on dynamos?

On most machines there are two; on others there are as many as six.

85—Are brushes connected directly with the main, or external circuit?

Yes.

86—Of what material are brushes usually made?

Brushes are usually made of copper, but many are made of carbon.

87—What is the general form of brushes?

Brushes are generally rectangular in shape. Figure 5 in Part I. of this series of articles (issue of July 19th) shows the common form of brushes.

88—Are the copper brushes made solid?

No; they are usually made of strips of copper, flat bundles of copper wire, or slit plates of the same metal.

89—What is the object of making the brushes in this manner?

The object is to obtain the best contact with the armature segments, at as many points as possible, and to reduce the sparking.

90—How are the brushes held in contact with the commutator?

By means of brush holders.

91—What is the usual position of the brushes with reference to the commutator?

They are placed diametrically opposite each other and so arranged that one of their flat surfaces will press against the commutator. B B in the illustration accompanying Part 2, in the issue of July 26th, shows the brushes and their relative positions with each other and the commutator.

92—With how much pressure should the brushes rest against the commutator?

Enough pressure should be used to prevent the brushes jumping, yet not enough to cause excessive wear on the commutator.

93—What is the brush holder?

It is the device for holding the brushes.

94—Is the position of the brushes stationary?

No; the brush holder is so made that it may be shifted concentrically with the commutator, thus changing the relative positions of the brushes and commutator.

95—Under what conditions is it necessary to change the position of the brushes?

A change in the position of the brushes is necessary when any change takes place in the electrical demands of the external circuit, or when the speed of the dynamo is changed.

96—Are the brushes changed by hand?

In some machines the change is effected by hand, and in others it is accomplished automatically by the current itself.

97—What are the advantages in the use of carbon brushes?

They are less liable to heating than copper, and they do not wear on the commutator so much, and they spark less than copper.

98—What are the disadvantages of carbon brushes?

They have higher electrical resistance and are brittle.

99—What is the "lead" of brushes.

The lead means the angle at which the brushes must be set forward in the direction of rotation for the purpose of diminishing the sparking and to get the greatest quantity of current from the dynamo.

100—What results when the brushes are not set at the proper angles?

Destructive sparking.

101—What is the effect of sparking?

It burns the commutator segments and the brushes, which renders both uneven and inefficient to perform satisfactory work.

(To be continued.)

THE ELECTRICAL CONDUCTIVITY OF AIR AND THE FORMATION OF OZONE.*

More than a hundred years ago Van Marum observed that when an electric spark is passed through a vessel containing oxygen gas, a peculiar odor is developed and the gas becomes more chemically active; thus oxygen, which has been treated in this way, will at once tarnish the bright surface of mercury.

Nearly sixty years after this interesting discovery, namely, in 1840, Schönbein wrote calling the attention of scientists to it in Poggendorff's *Annalen der Physik und Chemie.* He stated that the action of the electric spark converted the oxygen into a new body, for which he proposed the special name of ozone, a word which is derived from a Greek verb meaning "to smell."

Schönbein described many of the properties of this ozone, and, amongst them, that special property of being able to liberate iodine from potassium iodide, which has since been made the basis of a characteristic test for ozone.

Ozone is capable of effecting many remarkable oxidizing reactions, and on this account has been the subject of much attention from chemists. In the early fifties it was a great *crux,* quite a bone of contention amongst the leading chemists, who were greatly puzzled concerning its constitution; amongst others, Baumert, Williamson, Frémy, Becquerel, Marignac, De la Rive, &c., joined issue.

The exact nature of ozone was discovered by Andrews. He succeeded in proving that ozone is not a compound of two or more elements, as Williamson and Baumert held, but that it is merely oxygen in an altered state, or, as chemists say, in an allotropic condition.

If a series of electric discharges be passed through dry oxygen gas, a portion of it is converted into ozone, and the change is accompanied by a diminution in bulk. Chemists explain this by assuming that three volumes of oxygen condense to form two volumes of ozone. And this theory is supported by experimental evidence, most of which has been supplied by Soret.

Ozone can be produced in a variety of ways, thus:

1. It is evolved at the positive pole during the electrolytic decomposition of acidulated water.

2. It is formed by the slow oxidation of phosphorus in air.

3. It is obtained when the discharge from an electrical machine is passed through dry air, or, better still, through dry oxygen gas. The silent discharge converts a portion of the oxygen into ozone. A Siemens's induction tube is the best apparatus for this experiment.

4. It is obtained by the acton of a heated glass rod on a mixture of ether vapor and air contained in a beaker.

5. When a stream of air is passed on a platinum wire heated to whiteness by means of an electric current, ozone is formed.

6. It is produced during the combustion of all substances containing hydrogen in the air or in oxygen, hence it is found surrounding the flame of hydrogen, alcohol, candles, coal gas, etc.

Ozone is always found in the air which is in the vicinity of a Bunsen gas flame. Further, it is a well known fact that air in the vicinity of such a flame possesses considerable electrical conductivity. These facts have recently attracted the attention of Messrs. J. Elster and H. Geitel, who have endeavored to discover whether any relation exists between them. They contribute an interesting paper upon their research to the *Annalen der Physik und Chemie.*

Suspecting that the electrical conductivity of the air in the neighborhood of a Bunsen flame might be due to the formation of ozone, Messrs. Elster and Geitel were led to examine the electrical properties of the air enveloping a stick of moist phosphorus undergoing slow oxidation with the formation of ozone. They obtained data in their experimental investigation which enabled them to decide that the process of converting oxygen into ozone in this case, also, determined a similar assumption of electrical conductivity by the air. They were unable to demonstrate, however, that any electro motive force was connected with it.

It seems, therefore, from these experiments, that the mere *presence* of ozone is not in itself sufficient to impart electrical conductivity to the air, though there does seem at first sight to be some connection between the two.

Other experiments were instituted with a view to throwing side lights upon this question, and it was shown amongst other results that the formation of solid particles of ammonium nitrite in the neighborhood of the stick of phosphorus did not exert any appreciable effect. A curious effect was observed, namely, that the formation of ozone is hindered by the presence of oil of turpentine, and that the electrical conductivity of the air at once disappears when some of the vapor is introduced. Not only turpentine, but several of the essential oils when acted upon by atmospheric air, transform a portion of it into ozone, and again turpentine will absorb ozone without decomposing it. These interesting results seem to indicate that there is room for still more research in this direction, which should be especially attractive to physical chemists, that is to say, to those scientists who delight in exploring the borderland between physics and chemistry.

*London *Electrical Review.*

To Hold Their Meeting in the United States.—The Iron and Steel Institute, of Great Britain, will hold its annual meeting in the United States this year. The sessions will begin in this city October 1st. Trips of inspection will be taken to various sections of the country. Among the papers to be read before the meeting is one on "Electric Welding," by Prof. Elihu Thomson.

Water Power for Electric Lighting.—An interesting example of an hydraulic electric light and power station was recently inaugurated at Locle, in Switzerland, which is situated in a deep valley, the far end of which is terminated by a high ridge, behind which a large reservoir has been established. Water is conducted in pipes from the reservoir to some turbines situated at the foot of the ridge. These turbines are coupled direct to 125 horse power Thury dynamos. The current, which is at a pressure of 180 volts, is taken to the town itself, three kilometres distant, by a three-wire circuit. At present 185 lights are employed for public and 1,500 lights for private purposes; 50 horse power is also absorbed by motors, ranging in size from ½ to 6 horse power each. The work was carried out by the municipality.

Electric Treatment of Sewage.—Experiments are now being conducted at the Salford Sewage Works, England, on an electric system of sewage purification. The water runs along a conduit in which are plates in circuit with a dynamo. The current precipitates the foreign matter from the water, whilst the effluent flows off at the end. The only drawback is that skilled attendance is necessary, and that this adds to the cost. Various corporations and local boards are sending to see the process with a view to its adoption.

THE EXECUTION OF KEMMLER BY ELECTRICITY.

After repeated postponements the electrical execution of Wm. Kemmler, the murderer, took place in the State Prison at Auburn, N. Y., at 6:40 a. m., August 6th. The scene immediately preceding the execution was very impressive, and the only one of the small party present who was not agitated was the criminal himself.

All reports agree that the affair was not a complete success, as far as details are concerned, although there is no doubt that Kemmler was rendered unconscious by the first application of the current The current was turned on twice before life was extinguished.

The story of the scenes in the death chamber, as told by a correspondent, is interesting in that it shows the wonderful nerve and coolness of the condemned man. After Kemmler was properly secured to the chair and all was in readiness for the application of the fatal current, Warden Durston asked him if he was all ready.

"Perfectly," answered Kemmler.

"Then, good-by," cried the Warden.

The words had not left his lips when, despite the strong fastenings with which he was bound, the entire upper part of Kemmler's body bent forward and upward. The Warden had given the signal, and some other guests heard the "click" of the fatal switch as some one in the old death chamber swung on the electric current.

Kemmler uttered no cry. Those who watched his face say that it turned first red and then pale, and that then a kind of flush appeared on the man's cheeks. His thumb nails cut into the flesh of his hands and drew the blood. Dr. Spitka held his watch open, and when seventeen seconds had elapsed from the time Kemmler hunched up in the chair, the Doctor said: "He's dead; turn off the current."

Dr. Spitzka stood at Kemmler's side. He, of course, did not touch Kemmler in any way. The current was turned off. The witnesses, all supposing that the man was dead, crowded around the death chair. Somebody removed the electrode from Kemmler's head. Then something occurred that almost froze the blood in the spectators' veins, and, as one witness said, made him long that he should be struck blind, for he could not close his eyes or turn his head, and yet what he saw fairly made him dizzy with horror. What happened was that the supposed lifelesss chest began to move up and down in deep-strained breathing. A gurgle came from Kemmler's throat. The sound of the breathing grew into an awful succession of wheezes. It was a half breathing, half-groaning sound, that grew more and more intense each minute. Finally foam began to spout from between Kemmler's clenched teeth, and the foam spattered all over his clothes. At the same time Dr. Balch, who was very near Kemmler, noticed the blood dropping from Kemmler's hand where his thumb nail had cut it.

"The man is not dead," said Dr. Balch.

But no one heard the remark, no one heard anything but that awful breathing and the cry that went up from everybody's lips, "put on the current, put on the current." There was an awful delay in getting the current on again. It seemed an age of waiting to the men in the death chamber. Mr. Bain nearly fainted and it took the effort s of two men to revive him.

Finally the dynamo started up again, and the full current coursed through Kemmler's body. The horror-stricken people in the death chamber could hear the click-clicking made by the workings of the switch in the old execution room as the operator there moved it, and thus gave Kemmler repeated shocks after repeated shocks. Between 3½ and 4½ minutes, according to different counts, were occupied in this way. All looked on in terror while Kemmler's body quivered and shook under the successive shocks. Horrible as it was, no one wanted the current turned off until it was definitely established that Kemmler was dead. This fact became known in a moment. Suddenly smoke was seen issuing from Kemmler's back and the air was filled with the fumes of burning flesh. A cry of "Stop the current!" went up, and this time Warden Durston rushed to the switch himself to attend to matters. The current was soon stopped. Kemmler's body was then released and plainly presented the appearance of death. The doctors established the fact of death by the usual methods, then the electrodes were removed.

The autopsy upon Kemmler's body was performed over three hours after he was pronounced dead. That there was some bungling there is no doubt. In the first place Warden Durston is blamed by every one for changing the death chamber so that the voltmeter and switch board were not in the same room with the death chair. All the doctors agreed that the man operating the switch should have been within a few feet, in plain sight of Kemmler, and thus have evaded the necessity for any system of signalling.

It may be that this Auburn tragedy will be the subject of legal investigation. Then and not till then will the facts be known. One more important fact which is not known is the voltage of the current which struck Kemmler the first time. Warden Durston says that this was 1,700 volts. Dr. Daniels says that the current was between 1,200 and 1,300 volts. Dr. Spitzka says that the current varied constantly between 700 and 1,300 volts. But medical opinion is clearly that the current, whatever its voltage, did not kill Kemmler at once. His ghastly movements after the first current was stopped were plainly not those of reflex nervous action. They were those of a live man. All the doctors say that they think Kemmler was unconscious at this time and that he did not suffer pain at any time.

Warden Durston is criticized for not having some electrical expert of great prominence take charge of the execution, and thus prevent bungling. But no expert of prominence could be found to do this work. The suggestion that a State expert be secured to take charge of all of the executions and have a State "plant" for this purpose, indorses a striking change in the law.

Dr. Spitzka is criticized by his brother doctors for ordering the current turned off while, as it turns out, the man was probably alive. In turn Dr. Spitzka criticizes Warden Durston for not having the dynamo in proper condition, "as good as a private firm would have it." In fact the striking fact about the whole affair is, that as soon as the people who officiated at it, each began to accuse the other of making the thing a failure.

The chair in which Kemmler was executed is already familiar to most people, having been described time and again, as also have been the electrical connections. In brief the latter may be described as follows: One wire from the dynamo connects with an electrode which presses down upon the top of the head of the victim. The other wire connects with the electrode which touches the base of the victim's back-bone. Both of the electrodes are metal cups or hollow half hemispheres. These cups have sponges which connect with the metal ends of the electrode. The sponges are filled with water just before being pressed into position against the person of the subject. Water is a conductor of electricity, and the elastic sponge and rubber cups are designed not only to insure no disfigurement, but to make a yielding connection between the metal electrode and the person of the victim which would insure that any slight struggle on the part of the victim would not enable him to break the circuit.

After the execution several of the witnesses were interviewed. These interviews developed much difference of opinion as to the results of the execution—some claiming that the whole affair was a dismal failure, while others held as strong opinions on the other side.

Dr. A. P. Southwick of Buffalo, one of the three State Commissioners who recommended that electricity be substituted for hanging, and generally known as the father of the electric death law, said that the execution was the grandest success of the age. "I believe," said he, "that Kemmler died the instant the current first stuck him. All those struggles and contortions and expressions of seeming agony were purely muscular contractions, and all in the abdominal region. I don't want to be quoted as criticising anybody at all, but I do not believe that the current was turned on long enough. I think it should have been left on Kemmler's body for at least thirty seconds. Then, again, I believe that the current should have been greater than that sent through Kemmler. But in any case I know that Kemmler died when the first shock struck him. The muscular contortions are in no respect different from those we saw in various animals that we experimented on before the law was passed. It occured after the animals were undoubtedly dead and upon the removal of the current. The phenomena soon passed away. I repeat, I believe this execution is the greatest success of the age.

In the course of an article written for a medical journal by Dr. Shrady, that gentleman says:

"As was reasonably anticipated, death was instantaneous, and, so far as can be judged, the unfortunate subject of the experiment died without pain. The spectacle presented was, however, by no means edifying to such as hope for improvements of old methods."

In conclusion the doctor argues in favor of the abolition of punishment by death.

Harold P. Brown was in Louisville Ky., at the time of the execution. He was interviewed by a reporter and in conclusion said:

"Kemmler was killed instantly and painlessly within the first second, but as the current was taken off before thirty seconds had passed there were reflex motions of the muscles, which frightened some of the attendants into thinking that he was not dead. The current was applied the second time, and at once, as the report reached me, an appearance was produced on the face and hands of the criminal which showed beyond doubt that the first shock had killed him."

"How do you account for the burns on Kemmler's body?"

"It seems to me," replied Mr. Brown, "that there was not sufficient moisture on the electrodes."

Mr. Thos. A. Edison was seen at his home in Llewellyn Park, Orange, N. J., and said:

"I have read the account of the execution, and while it is to be hoped that later advices will not prove so terrible, I see no reason to doubt that the account I read was essentially correct. The fault lies wholly with the doctors. Theoretically they are right, no doubt. The nerve centre of the human system lies in the base of the skull. But practically they are all at sea. Here we have had something like thirty perfect examples of instantaneous death by electricity in the accidents that have happened in and around New York. How was the electricity applied in these cases? Never to the head. Of what use has been the death of these thirty men? In every case the mortal charge entered through the hand. In no case was the strength of the current nearly half what was to have been passed through Kemmler's skull. The reason why contact by hand is so much more fatal than through the head is that electricity travels through the water in the human body. The hair of the head is a non-conductor; you see that, when you comb your hair with a rubber comb. Anything that electricity attracts is a non-conductor. The bones are also non-conductors, and in electrical executions, like that of Kemmler, the bones of the skull have to be penetrated. Accounts state that Kemmler's skin was burned at the back of the neck. This statement proves he got only a very small part of the current. Had he received the whole 1,300 volts into his body it would have burned him up. I testified as to the resistance of the various parts of the body dur

ing the Westinghouse litigation in New York last spring. I had experimented upon 1,100 people and I knew whereof I spoke. I said then, as I say now, that the true way to execute a criminal is to send the current through his body from one arm of the death chair to the other. The arms, hands and fingers are full of blood, which are good conductors of electricity. Let the hands be properly cleansed and moistened, and the charge would pass through the heart, causing instant death. It is true that I recommended the electrical machinery used at the execution. I see no reason to find fault with the machinery. I have no doubt that the electrical experts who assisted at the execution handled the machinery in the best possible way. The trouble, to my mind, lies wholly in the application of the current to the victim's body, the working out of a doctor's theory in the face of the plain demonstrations of experience."

The news of the execution excited deep interest in electrical circles in New York, particularly among electric light people. Mr. Paul D. Cravath, counsel for the Westinghouse Company, said:

"The very result which I feared has happened, and while I am not authorized to speak for the Westinghouse people, I will say as for myself from the reports which I have read that the first experiment under the new law has been very far from successful. If after months of preparation, and with all the care that has been taken to make the execution a successful one, no better results are obtained, it is pretty conclusive evidence that electricity is a mighty uncertain death agent. The very purpose of the law must be defeated when such a scene occurs as happened this morning in Auburn prison. Of course several executions might have taken place of condemned criminals under the new law which would have been practically instantaneous before there was a failure, and it is providential, perhaps, that the killing of Kemmler resulted as it has at a time when the fierce light of popular scrutiny will bring out every detail of this new method of doing away with a man. What a contrast there is between this method and the old-fashioned hanging! The hangman adjusts the noose firmly around the culprit's neck and knows that a drop of ten feet is sufficient to break his neck. It is simplicity itself, and there is no mystery about it. But with this electrical killing it is necessary to have the opinion of the best experts, and even then you have no certainty as to what the outcome will be. The delicate appliances of the machine must be carefully watched, and any break in any one of them may have a disastrous effect on the culprit if not remedied. The whole sum of the matter is, however, that the work at Auburn has demonstrated very conclusively that there is a tremendous amount of uncertainty in the use of electricity, and that in itself is sufficient to condemn its use.

Eugene T. Lynch, the electrical expert who has, according to his own statement, received, six years ago, a direct shock from a current greater than that applied to Kemmler and recovered, was of the opinion that the connections could not have been properly applied or the execution could not have failed of its purpose. "What I condemn most," he said, "is the use of a commercial system like the Westinghouse to its own detriment. It would have been quite easy for the Westinghouse people to have tampered with the machine so as to have rendered it practically useless for the purpose for which it was bought. Instead of having a machine whose capacity was 1,100 volts, death would have been much more certain and less painful if one of 10,000 volts had been constructed similar to dynamos in use in England at the present time."

The story of the execution as told by Sheriff O. A. Jenkins of Erie County, is a most graphic and interesting one. "Every arrangement for killing him, except the work of fixing him in the chair and connecting him with the electric apparatus, had been made," said Sheriff Jenkins. "His clothing in the back near the base of the spine had been cut apart in order to expose some of the skin for the electrode, and it appears that especial pains had been taken to have the few garments he wore as loose and easy fitting as possible.

"Pretty soon the Warden asked the victim to seat himself in the death chair. Kemmler got briskly up, and, placing his hand on the arm of the wooden chair, sat down on it. He seemed to try it like a man might try a chair in a furniture store in order to test its comfortable qualities. As soon as Kemmler was settled in the death chair, Deputy Sheriff Veling stepped up and began the work of binding him. He fastened the straps across his body, his arms, and his legs. He hurried in this, and Kemmler noticed this and said: 'Now don't hurry; take your time and do it right.' Veling worked more slowly after this, and after the straps had been drawn reasonably tight he tried them with his hands. Then Veling began adjusting the strap which bound his head. This was a contrivance which covered the condemned man's forehead and chin, running down the sides of the face, and leaving the eyes, nose, mouth, and cheek bones free. Before this bandage was drawn tight Kemmler said, again addressing everybody in the room as before: 'Gentlemen, I wish everybody good luck.'

"Plenty of light fell on Kemmler's face. The group of witnesses formed a half circle about the chair with the doctors, all pressing forward with their bodies bent, their heads stretched forward, and their eyes fixed steadily on Kemmler's face. The moment that Veling stepped back after his work of binding the murderer was over, Warden Durston moved toward the door leading into the adjoining room. When he reached the threshold he turned toward the bound man and said 'Good-by, William.' At the same moment he raised his hand, apparently as a signal to some person in the room. The lever for turning on the fatal current was in this adjoining room. Several electricians were in this room and one of them turned the lever. Who this person was I don't know. The instant the lever was turned the men in the death chamber saw a slight movement of the condemned man's body similar to that which might be caused by a blow. The current was turned on at 6:40 o'clock, just eight minutes after the time that Kemmler had entered the death chamber. The condemned man's face was frightfully pale when he was bound in the chair, not from fear, I believe, but from his long confinement. After the current had gone through his body for a few seconds it was noticed that the pallor about his cheek bones increased slightly, and was then rapidly replaced by a dark shade. The only movement that was especially noticeable was the convulsive gripping of the hands. The thumbs were turned in on the palms and pressed close against them by the fingers; there was a grinding motion of the chin as though the dying man was getting his breath, and when this motion ceased it was followed by an apparent attempt to bite the lips. The doctors kept their eyes riveted upon Kemmler's face, and when the pallor of the cheeks was driven out by the dark hue, Dr. Spitzka peered closer than ever into the murderer's eye. He said that the change of color in the cheeks showed conclusively that life was gone. The Buffalo doctors didn't think so.

"After the current had been circulating through the body for seventeen seconds Dr. Spitzka pronounced the man dead, and the current was turned off. The electrode on the head was loosened. Everybody was convinced that Kemmler was dead, and the semicircular group of men stood motionless for a minute or two and were on the point of dispersing, when a murmur of horror arose and every eye was again fixed on the murderer's face. Then we saw a horrible sight. First the chest rose and fell laboriously, as though the condemned man was struggling for breath. The struggle rapidly grew stronger and became convulsive. The entire body from the waist up shook and trembled violently. Flecks of foam appeared on the lips and were followed by a stream of saliva that ran over the strap on the chin and down on the tortured victim's shirt. Then came a gurgling sound and a labored rising of the shoulders. All this took place in a very short time, and was so terrible a spectacle that many of the witnesses turned their heads away. The eloctrode was rapidly set in place again on the murderer's head, and a little cry went up to turn on the current again for God's sake. This was done, not once, but several times, as could be seen by the shocks that came at the body viciously and struck it so hard as to make it quiver. With these shocks came a smell of burning hair that filled the room and added greatly to the horror of the scene. It was clear that the head of the poor wretch was being scorched and the scalp burned. As if the ghastliness of the spectacle was not enough the several shocks made the body quiver like a mass of jelly that is shaken. The blows appeared to be hard enough to kill any living thing, and under them all action of the body ceased, the muscles relaxed, and there could be no longer any doubt that death had mercifully come. Warden Durston removed the head straps while Veling took off the other bandages, leaving the body to settle down in the death chair like a bundle of old clothes.

TELEPHONE MATTERS.

In the monthly news letter of the National Telephone Exchange Association, Secretary General C. H. Barney urges prompt return to him of the statistical reports requested of the telephone companies some time ago, and for the proper tabulation of which blanks were furnished. General Barney calls attention to the fact that the time for the annual meeting is near and the work of consolidating and compiling reports cannot begin until they are all in. There are a few delinquent companies yet to hear from.

In regard to the general telephone service the circular says:

The development of telephony in this country is now so steady that it does not attract attention. According to the statement of the American Bell Telephone Company for the month ending June 20, there are now 466,334 telephones in use in the various exchanges and on private lines, as compared with 430,476 at the same period last year. This shows a gain for the year of 35,858 instruments, or about 3,000 per month. These figures do not represent, however, the whole growth of the telephone business, as there is going on at the same time a rapid development of what is known as the extra-territorial system and of the long-distance system. The extra-territorial system links together the places a few miles apart in the same territory; the long-distance system unities cities hundreds of miles distant from each other. There is now a large amount of telephonic work between Boston, New York, Baltimore, Washington, Philadelphia, Albany, Buffalo, New Haven, and other cities, while Chicago is again the centre of another field of activity in long-distance service.

ELECTRICITY AND ETCHING.—The *Papier Zeitung* of Berlin, announces that an important discovery has just been made in etching, and especially in photogravure. As usual, the drawing is traced on a plate of zinc, either by an artist or by photography, with any suitable etching ground. This plate, backed with asphaltum, is laid in a bath of dilute acid. It is then put in circuit with a dynamo, the other pole being merely placed in the acid. When a current is allowed to pass, the acid attacks the metal with surprising rapidity. A few minutes suffice to bite the plate, and the depth of the etching can be easily controlled. The action is probably due to the depolarization of the surface of the metal, which in the ordinary method of etching becomes covered with a film of hydrogen, or, at all events, with a number of minute bubbles, which make the biting irregular unless the plate is incessantly rocked and brushed.

THE THEORY OF THE ELECTRIC WELDING PROCESS.

In an article in the London *Electrical Review*, Mr. S. Alfred Varley criticizes, at considerable length, Professor Lodge's theory of the electric welding process. Getting down to facts Mr. Varley says :

In what I have published from time to time, since the Dr. Mann lectures of Professor Lodge were delivered, I have traced the connection between a whole series of physical phenomena which mathematical physicists have regarded separately, and dealt with, as though they were not in any way connected. In this way I have been able to get round physical phenomena to some extent, and to look at them from several points of view, and, as a consequence, I feel that the position I have taken up, in respect to the newer electrical theory, is a very strong one.

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The accumulated observations of a life largely devoted to scientific research has resulted in the development of a very simple theory, which, among other things, has enabled me to explain, in a natural common sense way, what at first sight seemed anomalous in Professor Lodge's "Alternative Path Experiments." According to my theory, performing a physical act involves the overcoming inertia—the overcoming inertia involves a transformation of energy, and every transformation of energy involves a storage of energy in matter to the extent that inertia has been overcome. It will be found that by this simple theory all physical phenomena can be connected together in a continuous chain, and that they can all of them be traced back to a simple duality—viz., active or positive energy, and inertia or negative energy. The active energy is external to the matter acted on, and when it becomes associated with matter such association is a more or less unstable one. Negative energy, on the other hand, is inseparable from matter under all known conditions, and is the most characteristic feature of matter—viz., inertia or weight.

In all physical acts or transformations of energy, for they are convertible terms, the positive and negative energies concerned are necessarily balanced, similarly as is the case in electrical phenomena, and whenever a transformation of energy occurs, the transformation in some cases results in a temporary association of positive energy with the negative energy of matter only, and in others there results a more or less stable combination. As a case in point, interpose a copper conductor in an active dynamo circuit, a certain amount of energy then becomes transformed into magnetism at the time the circuit is closed, and energy will also be transformed into heat, the energy transformed into magnetism remains statically occluded all the time the circuit is complete, but the energy transformed into heat is only temporarily and unstably associated with the matter of the conductor in which it is developed ; in fact, in some cases, as fast as energy is being transformed into heat it passes out of the conductor by radiation, and in other examples, such as electric welding, the heat becomes transformed and stored faster than it can escape by radiation, and in such cases there is an unstable association of positive energy with the matter of the conductor.

The transformation of energy into heat in an electric circuit is dynamic, whereas the transformation of energy into magnetism is a statical occlusion, and in all cases where positive energy becomes combined with matter, forming a more or less stable combination with it, the positive energy is statically occluded.

When a copper electric circuit is divided, the energy which was transformed into magnetism and statically occluded at the time the circuit was closed, is parted with *completely*, the copper conductor passing from the magnetically polar to the normal condition very rapidly, and the energy which remained occluded all the time the circuit was complete, becomes now dissipated through the medium of current developed during the act of demagnetization. If an iron conductor be interposed in a dynamo circuit, the transformation of energy into magnetism that then occurs will be enormously greater than when a copper conductor is interposed ; but when the circuit is divided, the energy transformed and occluded as magnetism will be parted with much more slowly than was the case with the copper conductor, and some of it will be retained ; the iron conductor, unlike the copper one, remaining more or less permanently magnetized ; and here we have an example of a more or less permanent combination of positive energy with matter.

A plating bath is an example where no storage of energy occurs, or, to speak more correctly, where no work is done beyond that involved in overcoming conductive resistances, energy is certainly unlocked at the anode to the extent that the anode is broken down ; but it becomes transferred to the cathode, where it builds up a structure the equivalent of that destroyed at the anode. In the case of a storage battery, where lead is oxidized, or a low oxide is converted into a higher oxide, altogether new structures are reared, and a very large transformation of energy occurs, the energy transformed becoming statically occluded in the new structure produced, which, being a very unstable edifice, readily parts with the positive energy entering into its structure whenever the conditions are at all favorable for doing so. Structures such as those developed in storage batteries are fairly comparable to fulminating compounds, which are simply very unstable structures, having relatively to their mass a very large amount of positive energy unstably occluded. From fulminating compounds we may pass to organic matter, such as wood or coal, and from organic matter we pass on by easy stages to such metals as gold or platina, which are very stable structures, and not readily broken down.

The cases cited are a few illustrations of the way physical structures, and the forces associated with them, are all of them connected, and the simple theory developed by me, will be found to join them all in a natural, common-sense manner.

The most unstable association of positive energy with matter is undoubtedly a statical accumulation in a Leyden jar, and the next in order to this is a statical occlusion of energy in the form of magnetism in a copper conductor closing an electric circuit. for in both these examples there is no affinity between the positive energy and the matter it is associated with, the accumulation of energy being maintained solely by pressure.*

Now let a mechanical illustration be briefly considered. (1.) Suspend a block of wood by a long string, and set it swinging by the hand ; the whole of the energy imparted to the block in this way will practically take the form of motion, and it will be eventually, but slowly, parted with in the form of heat. (2.) Strike the block with a mallet and a percentage of energy will be at once converted into heat ; but the greater percentage of energy transferred to the block will still probably be in the form of motion. (3.) Fire into the block a rifle bullet whose weight, multiplied by the square of its velocity, equals that of the mallet, and assume the bullet becomes buried in the wood, very little motion will be imparted to the block, nearly the whole of the energy associated with the bullet becoming transformed into heat.

Now let us consider what occurs when a Leyden jar discharges through an air space and a metal path. Energy accumulated as statical charge may be fairly regarded as a projectile unhampered by weight, whose speed under mentally conceivable conditions is infinitely greater than that of any rifle bullet, the time occupied by a Leyden jar in discharging being determined *solely* by the conditions that prevail in the path of discharge. Energy in the form of a statical electrical charge requires a path much in the same way as a fluid does, and space devoid of matter opposes as impenetrable a barrier to its passage as a solid mass of metal does to the flow of water ; the path of discharge consists of an air space and a metal conductor, and as there is a great deal more matter in the metallic conductor than there is in the air space, and as inertia increases as the mass, it is in the metallic portion of the path inertia is chiefly encountered, and where the transformation of energy mainly occurs.

The vehicle of transmission of a Leyden jar discharge is the electricity of the path itself, and if due allowance be made for the fact that neither energy nor its vehicle possess weight, then it will be found that a Leyden jar discharge comports itself in respect to metallic conductors very similarly to that described in reference to the illustration. In the mechanical illustration a much larger percentage of the energy was transformed into heat when the bullet was fired into the wood, than was the case when it was struck with a mallet ; and so, also, a much larger percentage of the energy of a Leyden jar discharge, if of very high potential, becomes transformed into magnetism developed in the metallic conductor than would occur if the same amount of energy were statically accumulated in condensers having a much larger surface than the Leyden jar, and in which case the potential of the energy, and the rate of discharge through the paths, would be greatly reduced.

I have in previous articles enphasized the fact that the energy of a statical charge is a limited quantity ; and if I am right in maintaining that overcoming inertia in a metallic conductor is simply a transforming of energy into magnetism, then it follows as a truism that the greater the mass in the conductor the larger the percentage of the energy that becomes so transformed; and, further, that the magnetism developed, however large the conductor, can only approach to, but never exceed, the total amount of energy accumulated in the Leyden jar.

If only the continuity which runs through all physical phenomena be recognized, I think it must be seen how naturally what is observed in connection with Leyden jar discharges through metal paths falls into its proper place.

* The rate at which a copper circuit demagnetises, is determined by the conductive resistance of the circuit.

ELECTRICAL EXHIBITION.—Plans are about completed for another electrical exhibition in St. Louis. It is said that the judges selected are Messrs. Carl Hering, of Philadadelphia, E. R. Weeks, of Kansas City, and Dr. Otto A. Moses of New York. Medals are to be awarded on electrical apparatus under the following general heads : Arc and Incandescent Lighting ; Storage Batteries ; Electrical Instruments (measuring) ; Wires and Cables ; Power Transmission ; General. A special award will be made for the best electrical display. Mr. Fred. H. Whipple, of Detroit, is the manager of the exhibition. Mr. Foree Bain, of Chicago, is to have charge of carrying out an electric fountain idea, and he states that it will surpass all previous efforts in this direction.

LONG DISTANCE TRANSMISSION OF POWER.—The Allegemeine Elektricitats Gesellschaft (Berlin) has announced its willingness, in conjunction with the Oerlikon Company, to transmit 300 horse power from the River Neckar, at Lauffen, to the Frankfort Exhibition, a distance of about 109 miles, on condition that an ordinary overhead cable, 5 mm. in diameter, connecting the two places, is provided free of cost.

TELEPHONE ACROSS THE ENGLISH CHANNEL.—Experiments have been carried on for some time with a view to laying a telephone cable across the English Channel, between England and France.

WORKING EFFICIENCY OF SECONDARY CELLS.

(*Continued from page 4*)

charge the pointer *u* rests against *w*, and on the terminal potential difference of the cells falling to 1.6 volts per cell the pointer moves over, comes into contact with *v*, and an instantaneous current passes round the electro-magnet, breaks all the circuits and stops the watch. The course of this instantaneous current at the end of the charge and discharge is indicated by the arrows numbered consecutively 10, 11, 12, 13, 14, 15, 16 and 17.

To prevent any sluggishness in the action of this interrupter from a possible sticking of the pointer *u* against the contact-stops *v* or *w*, the pedestal supporting the set-up galvanometer *s* was kept in a constant state of slight vibration by the going of an American clock that was placed on this pedestal.

V.—Ammeter and Voltmeter.

There remain only to be described the ammeter, by means of which the current passing through the accumulators could be measured from time to time, in order to see whether the automatic regulator was doing its duty; and the voltmeter, for frequently measuring the potential difference at the terminals of the accumulators, A, under test. As the current had only to be very occasionaly measured, one D'Arsonval Galvanometer, β, was employed for both purposes. Its coil was wound with platinoid wire of 52 ohms resistance, and suspended in the way that has been already described, which enables the deflection from one end of the scale to the other to be absolutely proportional to the current. The top suspension was a phosphor-bronze strip $\frac{1}{1000}$in. thick $\frac{1}{100}$in. wide, and about $1\frac{3}{4}$in. long; while electric contact was maintained with the bottom of the coil by means of an extremely fine A. and P. spring, offering no appreciable torsional rigidity. The permanent magnets employed belonged to an old magneto machine, and into the cylindrical space between the poles, in which the Siemens armature formerly turned, was put a coil made of the right shape to suit the covered ends of the magnets without it being necessary to employ any soft iron pole-pieces. Experiment showed that the deflection right across a scale 2ft. 9in. long, the zero for no current being at one extreme end, was rigorously proportional to the current—a result which, as has been already pointed out, is very far from being obtained with D'Arsonval galvanometers as usually constructed.

When it was desired to measure the current passing through the accumulators, A, a rocking switch was turned so as to connect mercury cup 18 to 20, and 19 to 21; whereas when it was the potential difference at the terminals of the accumulators that was to be measured, the rocking switch was turned so as to connect mercury cup 20 to 23, and 21 to 22. In the former case, with a resistance of 264 ohms on the resistance box *Y*, a current of 10 ampéres passing through the cells and platinoid strip C produced a deflection of 500 scale divisions, or 50 divisions per ampére; while, with a resistance of 71,570 ohms in the resistance box δ, a potential difference of 10 volts at the terminals of the five accumulators A under test produced the same deflection; so that 50 divisions corresponded then with 1 volt.

(*To be Continued*).

Platinum in Mexico.—It is reported that Mr. Flavio Lobato, a well-known mining engineer and analytical chemist, has discovered platinum in some ores from the Las Yedras mines in the State of Sinaloa.

Electrical Treatment of Hemorrhage.—Eugen Boér has successfully applied faradization to cases of profuse internal hemorrhage, applying the negative electrode to the affected part, the positive pole being pressed against the skin.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
Boston, Aug, 9, 1890.

At a meeting of the Salem Board of Aldermen, held last Monday evening, the Electric Street Railway Company were granted the right to erect poles and wires for the operation of their road.

A gang of linemen in the employ of the Continental Telegraph Company were assaulted and badly injured by a crowd of toughs at Waldsboro, Me., last week; some were so badly injured that they had to be removed to the hospital.

The Thomson Electric Welding Co., are building large works at Newark, N. J., for the purpose of welding tubes to go into ice machines and similar machinery. E. P. Ball, of Palmer, is the engineer and has furnished all the plans for the new building.

Work at the Thomson-Houston Electrical Works was never so rushed as at present. There are 38 men at work in the draughting room. In the motor department they have just completed the running gear of 18 street cars, which they are now loading on freight cars for shipment. These go to Wichita, Kan., Cincinnati, British Columbia and other places in Canada.

Twenty-five men employed by Contractor Young in digging trenches for the reception of pipes for the New England Telephone and Telegraph Company's underground system on High-st. were discharged last Monday morning. The men claim that they had worked thirty four hours and were discharged because they would not work longer without sleep.

The contract for the new factory of the Thomson-Houston Electric Co., was let out to-day. Dearborn Bros. were given the contracts for the mason work, and Frank G. Kelly the carpenter work. It is to be located on Federal st., and will be an extension of factory C. Its dimensions are 60x100, three story with a basement. It is to be completed in four months, and will be used for general factory work. Ground will be immediately broke for the foundations.

Another street railway deal is reported in Salem, in the sale of the Essex Electric Street Railway which is in process of construction between Salem and Peabody, and nearly ready to run, to the Lynn and Boston R. R. It isr eported that the sale is virtually complete, and that the Foster street extension of the Lynn and Boston in Peabody will give them virtually a through line. Superintendent D. N. Cook denies that the road has been sold. It is thought to be certain that a deal is on foot, and that the road will change hands very soon.

The electric light committee appointed by the town of Peabody last March will report at a special town meeting called for Thursday evening. They will recommend the adoption of the Sperry arc system of the Edison General Electric Company, and the location of a town plant at the corner of Foster and Church sts., with a capacity of not less than 150 1200 candle double arc lamps. They also recommend that the town sell for commercial purposes any surplus light and power it may have. An appropriation of $30,000 is asked for to build and equip the plant.

At the regular meeting of the New England Insurance Exchange on August 2nd, the following amendment was adopted: Voted, "that the Electric Inspector of this 'Exchange' shall report to its Secretary such electrical apparatus he finds is not installed in accordance with the rules of this 'Exchange.'" The Secretary shall at once notify both the assured and the party installing the apparatus of all defects; and if at the expiration of thirty days from such notice he shall not have been duly notified that said defects have been remedied, the rate on both building and contents shall be advanced at least 10 cents, and the new rate duly promulgated by him.

The Electric Light Co., at Springfield, is not losing any time in preparing for the new addition. They have already begun laying the supporting walls. This wall will enclose the cellar, which is 18 feet deep, and is divided into a lower and upper section. About 200 carloads of granite will be required for the work. The entire cellar flooring rests upon piles, 500 of which have been driven. The cellar will be used for the storage of oils and condensing apparatus. The deep foundation was rendered necessary by the unstable condition of the bank surroundings. It is hoped that the building will be in condition for the reception of the 800 horse power Corliss engine about October 1st. The company is now furnishing more power than during the busiest season of the year.

The city of Boston is now making a saving of $75,000 per annum in electric street lighting, and is getting its lights maintained for 40 cents a lamp a night instead of 65. It will be remembered that at the hearings last spring, when the suburban company offered to light the streets for 40 cents a light per night, E. O. Burdett, counsel for the Boston Electric Light Company, made a formal offer on behalf of his company to do the work for the same price. The contract, however, at 65 cents a light per night did not expire until May 1, 1890, and since that time the Boston Company has been doing the work at the reduced figure. There is no written contract however, binding either the city or the electric light company. The city is now using 800 arc lights a night, and numbers of new lights are being added constantly. No other contract now exists except that verbally made between Mayor Hart for the city and the president of the Boston Electric Light Company for the organization. This saving to the city will be used in the lamp department to give the city better lighting, and numbers of new lights will be placed in Roxbury, South Boston and the Dorchester district.

The West End Railway Co. recently put into service on its electric line between Dorchester and the Tremont House half a dozen open cars of novel design, elegant finish and increased seating capacity. The cars are a little over 30 feet in length, have 10 seats instead of eight, as in the ordinary open car, and will seat 50 people and give standing room for nearly as many more. They are mounted on two four-wheeled trucks after the manner of a steam railroad car, and as a result are very easy riding. All the rocking motion incidental to the four-wheel cars is done away with and the car runs smoothly, even over the old-fashioned flat rail and over switches and frogs at crossings. Each truck is equipped with a 15 horse power motor, so that both speed and power are equal to that of the ordinary car. In these cars an important advantage is gained in the matter of fenders. The wheels of each truck are so close together that the truck itself has very little tilting motion, and fenders can therefore be projected farther forward than from the ordinary four-wheel truck with a large wheel base. The trucks are also very near the ends of the car, so that a curved fender projecting nearly to the extreme end of the car can be carried. The effect of this fender, running close to the track, would seem to be to push anything on the track to one side rather than to drag it along. The trucks are the design, in their special adaptability to street railway work, of Master Mechanic Lewis Pfingst of the West End, and furnish just the support needed for the long car body. The cars as a whole show the rapid strides that are being made in improving electrical street railway service, and with their increased passenger accommodations furnish another step toward the solution of the rapid transit problem. Several more of the cars are now being equipped in the Albany street shops and will soon be ready for service. Some of them will be put on the Egleston Square line.

The Cohasset Electric Company of Cohasset, have organized with a capital of $30,000; Amos A. Lawrence, president, Melville P. Morrell, treasurer.

The Nantucket Street Railway Company of Nantucket, have organized with a capital of $30,000; George C. Scofield, Henry O. Reed, T. C. Macy, R. B. Hussey, H. S. Ayer, George C. Pratt and John Harps, directors.

Charles Harriman, of Des Moines, Ia., was granted a patent, May 13, for an electric car trolley. He has brought it to the city of Lynn, and the Thomson-Houston Co. have kindly given him the use of their experiment car. They have also furnished an expert electrician to assist him attaching it to the car. The invention consists of an extra arm run from the centre of the tip of the car, along the top to the end. The trolley proper is fastened to the end of the extra arm, so that the trolley wheel is brought directly over the rear, as in the ordinary trolley. The inventor claims that this will keep the wheel always running evenly and smoothly on the wire in passing around curves. W. J. P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, Aug. 9, 1890.

ST. CHARLES, MO.—A proposition has been made to the St. Charles, Mo., City Council to put in an electric street railway plant.

BELLEVILLE, ILL.—A corporation has been organized to construct an electric street railway and has applied to the City Council for a franchise.

THE ECONOMIC ELECTRIC LIGHT AND POWER COMPANY have just started a plant of arc lights of the Sperry system at Kensington, Ill. Thirty lights are now in operation and the plant has a capacity for as many more and the company will place more lights shortly. Mr. C. E. Gregory is superintending the plant.

A COMPLIMENTARY DINNER was given at the Union League Club Thursday evening by W. A. Kreidler to S. D. Green and C. A. Benton of the Edison Company. A large circular table with a beautiful bouquet in the centre and decorated with ferns, a tempting menu and brilliant speeches interspersed with an occasional song made the occasion an enjoyable one to those present. At the table were Messrs. Kreidler, Greene, Benton, Lewis, Hood, Badt, Beggs, Kempt, Degenhardt, Terry, and Col. Hemingray of Covington, Ky.

THE UNICYCLE ELECTRIC ELEVATED RAILWAY CO., has been organized at St. Louis to introduce a railway system invented by E. M. Turner of Fort Worth, Texas. The novel feature of the system is the use of but one rail to support the car, the wheels resting upon this, while trolley wheels extend below and bear against a second rail thus locking the car in position. A model is said to be in preparation for exhibition at the St. Louis exposition. The officers of the company are L. A. Brown, Pres.; J. H. French, Secy. and Treas.

A CONVENIENT METHOD OF CALCULATING HORSE POWER from watts or vice versa, employed by a prominent electrician, is as follows: Divide the watts by 1,000 (by properly placing the decimal point) and add one-third of the quotient. This will give the equivalent in horse power. If the horse power be given multiply by 1,000 and subtract one-fourth of the product, and you have the equivalent in watts. This enables one to make a quick mental calculation. Of course, it will be seen that the operation consists in taking 750 instead of 746 watts as the equivalent of a horse power.

WORLD'S FAIR PROGRESS.—Governor Fifer this week attached his signature to the "Enabling Act" passed by the special session of the Illinois Legislature. By the terms of this act the city of Chicago and the South Park Commissioners are authorized to provide for the use of Lake Front Park and Jackson Park by the World's Columbian Exposition, and the issuing of $500,000 worth of Park bonds is authorized. Now that no legal difficulty stands in the way the work of preparing grounds will be entered upon speedily. President Palmer, of the National Commission, has been in the city this week in conference with the directors, and has officially announced to the board that he will call the National Commission together in this city on September 15th instead of October 8th, the day to which they adjourned. Considerable discussion has been had by the officials as to plans for the grounds, and Frederick Olmsted, the engineer who laid out the South Park system here, has been sent for to confer with the board. Much preliminary work has been attended to, the organization of the bodies and committees in charge are about complete, and with the meeting of the National Commission in September, all the wheels of the great movement will soon be turning. Interest from outside does not decrease, and it is hoped to have matters in a shape for the President to issue a proclamation and invitation to foreign nations. In this connection the following cablegram, received at headquarters, is of interest: "Paris, Aug. 8th, 1890. Butterworth, Secretary Exposition, Chicago: In response to your cablegram, consuls general authorize me to assure you that they will gladly co-operate in countries of their residence to make Exposition greatest event of century. Formal letter will follow. St. Clair, Chairman."

F. M. I.

NEW YORK NOTES.

The Convention of the Edison Illuminating Companies is to be held in Minneapolis, Minn., September 16th next.

Mr. S. S. Bogart, the well-known electrical expert, is now engaged in equipping the Passenger and Belt Railway Co., of Lexington, Ky., with an electrical plant. The Sprague system has the contract.

"This Dining Room is Chilled by Electricity," is the sign on a Park Row restaurant. Electricity is not the chilling agent, however, as the uninitiated might be led to suppose, but supplies the power to drive motors and fans.

In Brooklyn a new faction in the electri-lighting of that city will assert itself. The Citizens' Electric Light Company intend to introduce incandescent lighting by the Westinghouse alternating system. Heretofore they have been supplying only arc lights.

The Interior Conduit and Insulation Company have just issued a new catalogue and price list of their goods. The system of the company is well illustrated in all its parts, and rules are given for the proper introduction and laying of the wire conduits in buildings.

During the past week Mr. Nikola Tesla has received three patents on as many forms of alternating current motors, and one on an electrical transformer. In the transformer, a laminated magnetic shield or screen is placed between the primary and secondary coils—one being inside and the other outside of the shield.

We hear nothing but, "large orders," "full of business," and like expressions now-a-days from the Okonite Company. Now that their new factory at Passaic is completed they are doing more business than ever, and the outlook for the future is most encouraging. Capt. Willard L. Candee, and Geo. T. Manson will doubtless be on hand at the Convention as usual.

The electric cars on Fourth avenue attract a great deal of attention in their brilliant colors and absence of any visible propelling power. They are perfectly controlled by the driver, who with great ease regulates the speed according to circumstances. The United Electric Traction Company are now running 5 of these cars, and more will be added as soon as they can be fitted out.

The Weston Electrical Instrument Company, manufacturers of the Weston Portable Direct-reading Standard Voltmeters and Ammeters, are now thoroughly settled in their new factory, 114 William street, Newark, N. J., and very busy. The demand for these goods is growing quite general and is due both to their general excellence and the enterprise manifested by the manufacturers.

The rapidly increasing business of the Interior Conduit and Insulation Company has necessitated the enlargement of office facilities at 16 Broad street. An additional room has been secured, adjoining the others heretofore in use by the Company, in which Mr. E. T. Greenfield, the electrician, will have his office and assistants. Ten additional machines for the manufacture of interior conduits have been ordered, and these, it is expected, will place the company in a position to fill their rapidly accumulating orders with greater dispatch.

The Crosby Electric Company, in the *Judge* Building, 5th Ave., has purchased the Eclipse Electric Co., of New York City, with its business and stock on hand, together with the patterns under which the Hussey Eclipse and the Duplex Batteries are manufactured, and hereafter the business and manufacture of the latter Company will be carried on under the management of the first named. The Crosby Electric Company carry a large stock of goods and are fully prepared to meet all demands and guarantee strict and prompt attention in filling and delivering all orders.

During the month of June the Shaver Corporation organized the following companies: Shaver Telephone Co., of Coos County, N. H., headquarters Berlin Falls, N. H.; Bristol, N. Y.; Grafton, N. H., and Merrimac County, N. H. An exchange of 50 subscribers will be erected at Berlin Falls. Littleton county proposes to start an exchange of 150 subscribers, with headquarters at Concord. The following installations have recently been made by the Shaver Corporation: New York Jockey Club, Morris Park, 11 subscribers, longest circuit 1⅛ miles; Monmouth race course, seven subscribers; Maplewood Hotel, White Mountains, 19 stations (Bank System); Albert Dickinson Co., nine telephones; Pennsylvania Railroad Shops, Altoona, Pa., 25 telephones; Arnold Shoe Factory, Northampton, Mass., (Bank System); Boston *Herald*, three stations (Bank System). The company have something over ten thousand dollars worth of orders on their books, and have had to refuse quite a number of orders for exchanges on account of the large orders in the East. R. J. G.

THE ELECTRIC LIGHT CONVENTION.—The secretaryship of the National Electric Light Association was never in the hands of a more wide-awake and efficient person than the present incumbent, Mr. Allen R. Foote. He has worked assiduously to make the coming meeting successful both in the matter of business and pleasure, and there is every promise that it will be enjoyable as well as profitable to those who attend. Mr. Foote has done everything possible to keep the members informed, up to date, of plans and preparations, and his latest effort is in the shape of a very artistic souvenir setting forth all the facts worth knowing in connection with the Cape May Convention.

CATALOGUE.—The Sawyer-Man Electric Company, of this city, have just issued an illustrated Price List of electrical appliances for incandescent electrical lighting. It shows many novelties in the line of the excellent goods produced by this company.

TELEPHONES.—Boston and Lowell are connected by six metallic telephone circuits.

MILAN CATHEDRAL.—A company has been formed in Milan for the purpose of electrically lighting the dome of the Milan cathedral by a large lamp placed on the topmost portion.

THE BERLIN-WARSAW TELEPHONE.—A telegram from St. Petersburg states that a Franco-Belgian group of financiers has asked for a concession authorizing the laying down of a telephone line between Warsaw and Berlin. The first two minutes' conversation are to be charged 2 roubles, and the following minutes 25 per cent. less. If the Russian Government approves these prices, the telephone would, on the expiration of the concession, revert to the State.

ELECTRIC LIGHT IN THE UNITED STATES.—In the United States there are 1,397 electric light stations, and the capital represented in these is $118,758,500. The number of lamps in use is 137,441 arc and 1,590,967 incandescent, and the total horse-power necessary to run these stations is 356,755.

LIGHTING IN BRESLAU.—The town committee has decided to raise a loan of $250,000 for the purpose of erecting a central station. It is probable that the tender of Messrs. Siemens and Halske will be accepted. This project comprises the immediate erection of a station of 8,000 lamps capacity, with a view to an extension to a total of 30,000 lights. Continuous currents will be used in conjunction with accumulators.

AVILES.—An installation of electric light is being arranged at the thriving town of Aviles. A rich inhabitant (the Marquis of Pinaz del Rio) is going to present the town with a complete central electric lighting station. The town is favorably situated for coal, so that altogether the cost per unit to the inhabitants will be remarkably small. The plant has been ordered in the United States.

NEW CENTRAL STATION IN BERLIN.—The Kurfürstendamm Gesellschaft, in Berlin, will shortly commence operations at their new central station, which will supply currents to light up the district of Grunewald. The glow lamps, for street lighting, will be arranged two in series. The total cost of the station, including plant and buildings, is estimated at $75,000.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED AUG. 5TH, 1890.

433,445. Registering System for Telephone Exchanges. Joel C. Clark, Morristown, N. J. Filed May 25, 1889.

433,451. Thermo-Electric Element. Edward N. Dickerson, New York, N. Y. Filed Feb. 27, 1890.

433,485. Municipal Signal System. Bernice J. Noyes, Boston, Mass. Filed Sept. 23, 1889.

433,486. Municipal Signal Apparatus. Bernice J. Noyes, Boston, Mass. Filed Sept. 23, 1889.

433,504. Municipal Signal Apparatus. John C. Wilson and Bernice J. Noyes, Boston, Mass., assignors to the Municipal Signal Company, Portland, Me. Filed Sept. 9, 1887.

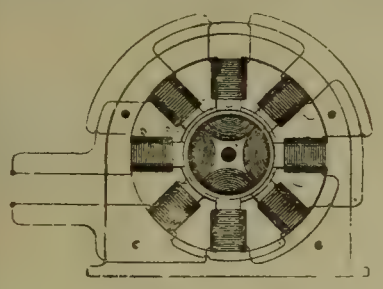
433,505. Light Signal System. John C. Wilson, Boston, Mass., assignor to the Municipal Signal Company, Portland, Me. Filed Nov. 24, 1888.

433,523. Commutator for Dynamos. James W. Easton, New York, N. Y., assignor to P. Minturn Smith, Plainfield, N. J., and William D. Perry, Brooklyn, N. Y. Filed Nov. 16, 1889.

433,544. Electric Railway. Abraham A. Shobe and William Embley, Jerseyville, Ill. Filed Apr. 7, 1890.

433,554. Electric Release for Target-Traps. Lorenzo L. True, Bismarck (Dak. Ter.), N. D. Filed Aug. 19, 1889.

433,557. Dynamo-Electric Machine. Chas. F. Winkleo, Troy, N. Y. Filed May 9, 1890.



NO. 433,701—ALTERNATING CURRENT MOTOR.

433,560. Electric Alarm Letter Box. William B. Detwiller, Randor, Ohio. Filed Feb. 28, 1890.

433,561. Cleat for Electric Wires. Lawrence Furlong, Hartford, Conn., assignor to Fredrick C. Rockwell, same place. Filed Feb. 18, 1889. Renewed July 9, 1890.

433,584. Electric Fire Alarm and Night Call. Charles J. Vining, Cleveland, Ohio, assignor to Lewis C. Merrifield and Henry J. Farwell, both of same place. Filed Dec. 2, 1889.

433,611. Trolley for Electric Motor Cars. Forée Bain, Chicago, Ill. Filed Feb. 17, 1890.

433,612. Mining Machine. Forée Bain, Chicago, Ill. Filed Feb. 17, 1890.

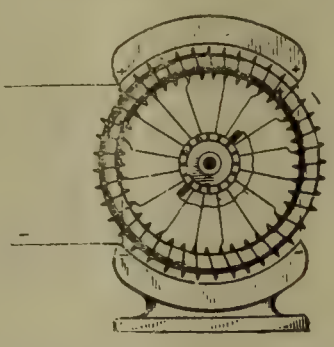
433,619. Electrical Communication. James L. Cutler, Piketon, assignor to Joseph A. Sullivan, Frank O. Loveland, and Guy Mallon, Cincinnati, Ohio. Filed Mar. 8, 1889.

433,636. Multiple Switch Board System. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Jan. 31, 1887.

433,637. Electrical Measuring Instrument. Edward Weston, Newark, N. J. Filed Jan. 18, 1890.

433,671. Electric Soldering Iron. Charles E. Carpenter, Minneapolis, Minn., assignor to the Carpenter-Nevens Electro-Heating Company, same place. Filed May 10, 1890.

433,682. Fusible Cut-Out. William J. Jenks, Nyack, N. Y. Filed Feb. 17, 1890.



NO. 433,834—INDUCTION MOTOR.

433,687. Electrolier. Everett W. Little, New York, and James T. Robb, Mount Vernon, N. Y. Filed Aug. 10, 1889.

433,698. Incandescent Lamp Socket. Thomas G. Roebuck, Jersey City, N. J., assignor to the Insulite Manufacturing Company, New York, N. Y. Filed Oct. 3, 1889.

433,700. Alternating Current Electro-Magnet Motor. Nikola Tesla, New York, N. Y., assignor to to the Tesla Electric Company, same place. Filed Mar. 26, 1890.

433,701. Alternating Current Motor. Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Company, same place. Filed Mar. 26, 1890.

433,702. Electrical Transformer or Induction Device. Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Company, same place. Filed Mar. 26, 1890.

433,703. Electro Magnetic Motor. Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Company, same place. Filed Apr. 4, 1890.

433,706. Electric Circuit Coupling for Railway Trains. Watson P. Widdifield, Uxbridge, Ontario, Canada, and Alexander H. Bowman, Allentown, Pa., assignors by mesne assignments, to the Westinghouse Air Brake Company, Pittsburg, Pa. Filed Mar. 8, 1889. Renewed Feb. 4, 1890. Patented in Canada and in Italy.

433,738. Galvanic Battery. Samuel W. Maquay, Fulham, County of Middlesex, England. Filed Sept. 30, 1889. Patented in England, France, Germany, Austria-Hungary and in Belgium.

433,744. Electric-Current Controller. Milton O. Sargent, Malden, Mass., assignor of three-fourth to James N. George, Plaistow, N. H., Charles A. Stearns, Watertown, and Charles L. Bly, Bradford, Mass. Filed May 20, 1890.

433,754. Motor-Support for Railway Cars. William Wharton, Jr., Philadelphia, Pa. Filed Feb. 9, 1888.

433,758. Current Converting Apparatus. Carl Zipernowsky and Maximilian Déri, Buda-Pesth, Austria-Hungary. Filed Nov. 1, 1888.

433,834. Induction-Motor. Charles J. Van Depoele, Lynn, Mass. Filed Apr. 23, 1889.

433,835. Telegraph Key. John B. Van Deusen, Saratoga, N. Y. Filed May 7, 1890.

433,839. Trolley for Electric Street Cars. Franklin C. Wheeler, St. Joseph, Mo., assignor of one-half to Henry Corbett, same place. Filed Apr. 18, 1890.

433,893. Insulating Material. John Fottrell, Philadelphia, Pa. Filed Dec. 23, 1889.

433,896. Support for Electric Wires. Albert L. Hallbauer and Edward L. Hiller, Lynn, Mass. Filed Nov. 30, 1889.

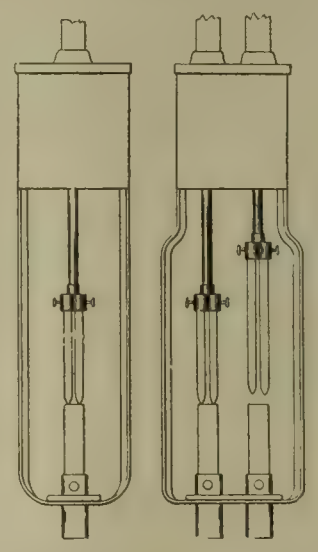
433,903. Electric Motor Mechanism. Samuel E. Mower, New Haven, Conn,, assignor to Henry G. Thompson & Sons, same place. Filed Nov. 9, 1889.

433,904. Electric Motor Mechanism. Samuel E. Mower, and George J. Spencer, New Haven, Conn., assignors to Henry G. Thompson & Sons, same place. Filed Feb. 14, 1890.

433,908. Electric Arc Lamp. Samuel P. Parmly, Chicago, Ill. Filed May 6, 1890.

433,910. Thermostat for Incubators. Frank Saumenig, Springfield, Ohio. Filed Nov, 23, 1888.

433,917. Method of Manufacturing Electric Conductors. Ernest P. Warner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Feb. 2, 1889.



NO. 433,908—ELECTRIC ARC LAMP.

433,920. Joint for Electric Conductors. George L. Wiley, Arlington, N. J., and Edward G. Acheson, Pittsburg, Pa., assignor to the Standard Underground Cable Company, Pittsburg, Pa. Filed Mar. 27, 1890.

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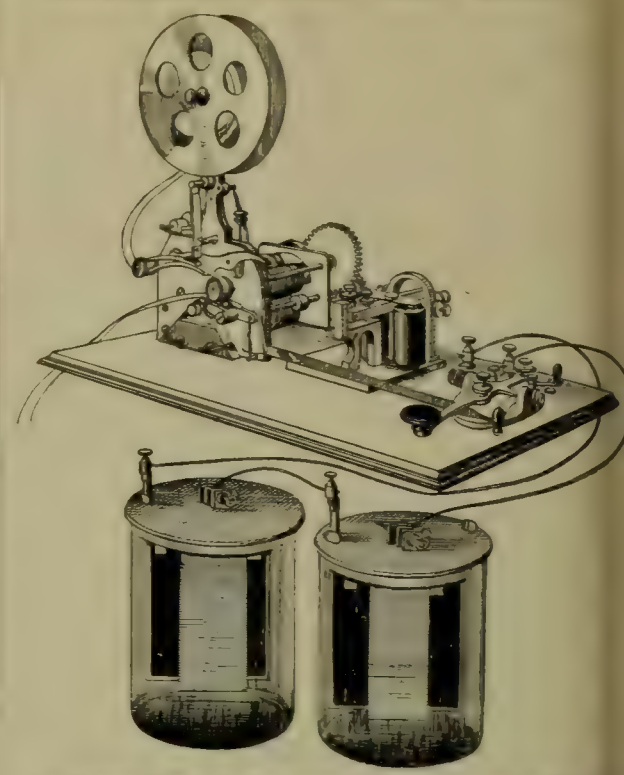
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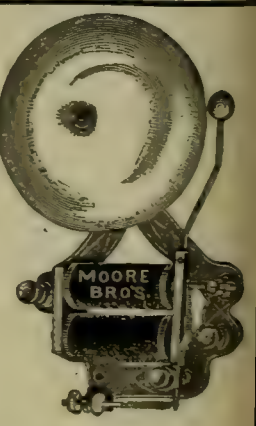
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NEW YORK, AUGUST 23, 1890.

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THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

OFFICIAL PROGRAMME OF PROCEEDINGS OF THE CAPE MAY CONVENTION.

OFFICERS OF THE ASSOCIATION.

Marsden J. Perry, President.
E. A. Maher, First Vice-President.
C. L. Edgar, Second Vice-President.
Allen R. Foote, Secretary and Treasurer.

EXECUTIVE COMMITTEE.

C. R. Huntley, Chairman. J. J. Burleigh, M. J. Francisco, John A. Seely, E. R. Weeks, James English, A. F. Mason, H. K. Thurber, C. H. Wilmerding.

COMMITTEE ON ENTERTAINMENT.

F. Theo. Walton, Chairman. A. J. DeCamp, J. J. Burleigh, John A. Seely, Allen R. Foote.

The Committee on papers have selected the following topics and have invited the persons named to prepare a paper or open the discussion on the subject assigned him.

1. Electrical Industries and the World's Columbian Fair, J. P. Barrett, Chicago.
2. Electric Light as Supplied to Steam Railroads, W. H. Markland, Altoona, Pa.
3. Standards of Economy in the Generation of Power and Steam under best Condition, Mr. H. M. Swetland, Editor of *Power-Steam*, N. Y.
4. Triple Expansion High Speed Engines for Central Station work, Mr. Williams, Beloit, Wis.
5. The Model Boiler-room and the Duties of a Fireman, Jarvis B. Edson, New York.
6. Ferranti Station at London, England, Caryl Haskings, Lynn, Mass.
7. The Proper Care and Management of Alternating Currents, T. Carpenter Smith, Philadelphia.
8. Distribution of Energy by Alternating Currents and Transformers and the Proper Method of Proportioning Conductors, A. L. Rohrer, Lynn, Mass.
9. The proper basis for determining Electric Motor Rates, H. L. Lufkin, New York.
10. Actual cost of furnishing Arc Lighting (1,200 C. P. and 2,000 C. P. Lamps) under the best possible conditions, J. C. Ayer, St. Louis.
11. Municipal Ownership of Electric Lighting Plants, M. J. Francisco, Rutland, Vt.
12. Accidents in Electric Lighting Stations and Plants, Prof. Charles R. Cross, Boston.
13. Care and Labor in Electric Light Stations and its value, A. J. DeCamp, Philadelphia.
14. How can the National Electric Light Association best serve the interests of Central Station Companies, C. R. Huntley, Buffalo, N. Y.

REPORTS TO BE CONSIDERED.

1. Committee on National Insurance Rules, George Cutter, Chairman.
2. Committee on Electrical Data, A. J. DeCamp, Chairman.
3. Committee on Copper Tariff, Charles A. Brown, Chairman.
4. Committee on Underground Conduits and Conductors, Joseph E. Lockwood, Chairman.
5. Committee on Revision of Constitution, M. J. Francisco, Chairman.
6. National Committee on Legislation, Allen R. Foote, Chairman.
7. Committee on Relations between Manufacturing and Central Station Companies, Marsden J. Perry, Chairman.
8. Executive Committee, C. R. Huntley, Chairman.
9. Finance Committee, John A. Seely, Chairman.
10. Secretary and Treasurer's Report, Allen R. Foote.

At each session of the Convention a call will be made for the proposal of questions to be discussed at a subsequent session, and for the introduction of resolutions to be considered at a subsequent session when reported by the committee on resolutions for action.

Members desiring to take part in the discussion of any subject stated or proposed, who send their names to the secretary previous to the time appointed for its consideration, will be called upon by the president and be given time before the subject is opened to the Convention. By this means every member can secure recognition and time to express his views fully on any subject that may come before the Convention. It is not expected that those to read papers or open the discussions will monopolize all the time that can be given to, or exhaust, the subject. The best results from discussions can be obtained only when every member who has an idea to explain, a suggestion to offer, or a bit of experience to relate regarding any subject before the convention, will avail himself of the regulation, stated above, to secure recognition and time that will give him an opportunity to make his contribution to the common stock of information.

An announcement of an order of proceedings will be made for each day on the preceding day. The subjects and reports will be taken up in the order there named, and will be held under consideration until finished. Each afternoon session will be prolonged until the calendar for the day has been cleared.

The last session will be an executive session, to be attended by active members only. The business to be brought before this session will be—

1. Secretary and Treasurer's Report.
2. Report of Finance Committee.
3. Report of Executive Committee.
4. Action on Report of Committee on Revision of Constitution.
5. Election of Executive Committee.
6. Selection of next place of meeting.

THE WAY THE TIME WILL BE SPENT THERE.

Breakfast from 6 to 10:30.
Morning session of Convention, from 10 to 12.
Bathing from 12 to 1.
Dinner from 2 to 4.
Afternoon session of Convention, from 4 to 7.
Supper 7 to 9.
Orchestral Concert and Hop, from 9 to 11.

The Convention will meet in the large ballroom of the Stockton Hotel, capable of seating 800. This room has been placed at the disposal of the Association, by the proprietor, without charge.

During the dinner hours, an Orchestral Concert will be given in the parlor adjoining the dining room.

For the evening Concert or Hop, the Orchestra and arrangements will be under the management of the Reception Committee. The services of an Orchestra of 10 pieces, Mr. B. L. Faeder, Director, will be furnished by the proprietor of the Hotel without expense to the Association.

If you have any interest in a Central Station Company, either as a stockholder, Officer, Manager or Superintendent, you should attend the Convention, and there meet those who are similiarly interested, in all parts of the United States. Through comparing experiences, taking part in the discussion of questions before the Convention, and doing your share to make the meeting profitable to others, it will be sure to be profitable to you.

If you are interested in the manufacture of any of the long list of supplies used by the Central Station men, you can meet more of your customers at this Convention in one day, than you could in a week of travel.

APPROPRIATION FOR THE ELECTRICAL CENSUS.—The memorial to Congress, favoring the authorization of an appropriation of $50,000 for a special census investigation and report on electrical industry was presented to the Senate, by Senator Hale, on August 5th. The case is very ably presented and we hope our national legislators sufficiently appreciate the importance of the subject to readily assent to the appropriation. Here is an industry that is unexampled in history for rapid development, and as yet no reliable data pertaining thereto is obtainable. There is an urgent and wide-spread demand for such information, and the appropriation which is asked is for the purpose of collecting this valuable data. When it is remembered that there is in this country alone upwards of $300,000,000 invested in electric lighting and power industries, the importance and value of such information for the public cannot be overestimated, and we voice the sentiments of every individual and collection of individuals engaged in the electrical field of industry when we say that this is a matter of public necessity and should receive the early and favorable consideration of Congress.

THE NEXT ELECTRIC LIGHT CONVENTION.—One of the duties of the Cape May Convention will be to select a place for the next meeting of the association. There will, no doubt, be warm advocates on the floor for various cities, and the advantages of each of these places will be fully set forth. The extreme East has the convention this year. The next convention should go to the West or Southwest. St. Louis, we think, would be a fitting place for the next one. It is centrally located and is within the borders of the Southwest. By holding it there a large delegation from the South and Southwest would be certain to attend, and, taking all things into consideration, St. Louis seems to be the most available place. A large attendance could be secured at a central point much easier than in a place situated at one extreme or the other of the country where members living at the other extreme are compelled to make a long journey. The long trips deter a good many from attending, and a central location will naturally catch a good many who would not otherwise go.

THE WESTINGHOUSE COMPANY IN ENGLAND.—The Westinghouse Electric Company has been awarded a contract to light a portion of the borough at Barnsley, England, at a cost of $89,000.

A COMPLETE ELECTRIC WIRE FACTORY.

The new electric wire mill of the John A. Roebling's Sons & Co., at Trenton, N. J., has just been completed. The dimensions of the building are 250 x 80 feet, and four stories high, and it is an addition to the already extensive and completely equipped shops devoted to the manufacture of electrical wires and cables for all purposes.

One of the features of the new mill is a hydraulic lead-coating machine, of the latest and best pattern, which is capable of exerting a pressure of 6,000 pounds per square inch. The machine renders it possible to manufacture on the premises lead covered cables of the largest size. All of the apparatus in the cabling department, besides the machines just mentioned, is entirely of new design and insures the production of electric cables of the very highest efficiency. These machines include the taping machines, winding machines, juting machines and braiding machines, all of which represent the latest development in the manufacture of electric wires and cables. In order to be better able to fill with greater dispatch the continually increasing and large orders for underground cables, the company constructed the new mill with this end in view, and the result of their effort is that the factory is now capable of an output largely in excess of the former plant.

The laboratory and testing department is one of the most important of the entire plant, for on this department rests the responsibility for the efficiency of the goods manufactured. In this department chemical as well as electrical tests are constantly carried on. The electrical testing apparatus is of the most sensitive and complete that can be made, and was furnished by Messrs. Elliot of London, whose goods have a world-wide reputation for accuracy and efficiency. The electrical tests at the Roebling laboratory are conducted with the utmost thoroughness, care and precision, and when the company's goods are turned on to the market they may be depended on as being in every way reliable and of high grade. This is the reputation the company has.

In the old works the magnet wire department is located. Here machines of special design and of high efficiency are used for the manufacture of this class of wire. This work requires great care and skill. The heavier sizes of magnet wire are produced with as much care, and as is well known, these wires have a reputation in the market for softness of material and uniform insulation which stands unrivalled. In the magnet wire department alone over 150 skilled hands are constantly employed.

In the line-wire department the machinery has a productive capacity of a carload of wire per day. The machines used in this work are of the latest and complete make, and the sizes of wire turned out from the smallest single wires to the heaviest stranded cables of one million circular mils of area.

All of the copper used in this extensive establishment is rolled in the rolling mills which comprise part of the plant. The metal comes directly from the Lake Superior Copper Mines in bars, the weight of a single piece being 200 pounds. The great advantage derived in using these large ingots is that it is possible to make a very long length of wire therefrom free from joints or splices.

Through the extensive connections the Roebling Company has had with cable roads they have naturally been brought into contact with electric railway managers. The result is the company is now extensively engaged in the manufacture of electric railway supplies, and has made a record of executing the largest contracts ever given for electric railway work.

PERSONAL.—Mr. A. A. Knudson, a well-known electrician, formerly of New York, is now the Electrician for the Eastern Electric Company, of St. Johns, N. B.

ELECTRIC LIGHTING FOR BEGINNERS*

BY THE EDITOR.

Part V.—Series-Wound Dynamos.

102—Name the different classes of direct current dynamos?

Series wound, shunt wound, compound wound and separately excited dynamos.

103—What is a series wound dynamo?

A series wound dynamo is one in which the entire current generated in the armature passes through the wire of the field magnets thence to the external circuit.

104—Why is this class of dynamo called series wound?

It is called series wound because the field magnets are connected in series with the external circuit.

105—Why is the current generated in the armature caused to pass through the wire of the field magnets?

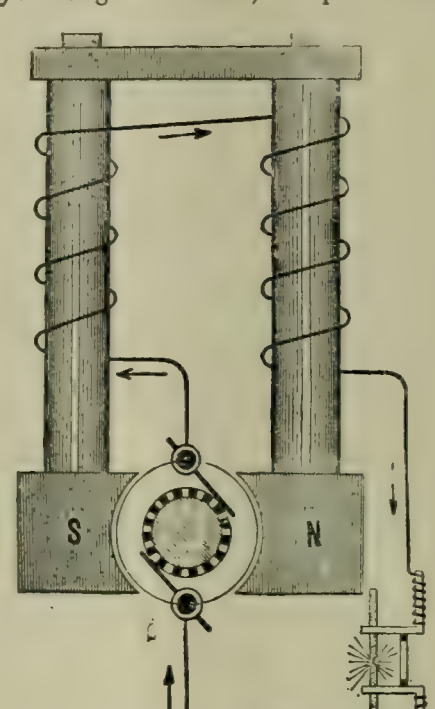
In order to produce the magnetic field.

106—Does not the generation of a current in the armature depend upon a magnetic field?

Yes.

107—Then how is it that in a series wound dynamo the generation of the current in the armature precedes the production of the magnetic field?

In self-exciting dynamos, of which class the machine now under consideration is one, there is always enough "residual," or permanent mag-



SERIES WOUND DYNAMO.

netism in the cores of the field magnets to produce a magnetic field sufficient to generate a slight current when the armature is first revolved.

108—What takes place when the armature of a series wound dynamo is first started?

The feeble current generated by the first turns of the armature, as explained in the preceding answer, passes around the field magnets. This increases the magnetism of the cores and consequently produces a denser magnetic field around the armature, which in turn increases the strength of the current generated in the armature. This accumulative action goes on until the maximum strength of current and magnetic field is reached.

109—Does all the current generated in the armature pass around the field magnets of series wound machines?

Yes; there is no other way for it to go.

110—What are the limitations to the increase of current and magnetization in series wound machines?

The limit is defined by the saturation point of the field cores and the power available to maintain the rotation of the armature.

111—What is the saturation point in the field cores?

The saturation point means the maximum magnetization which can be imparted to the cores.

112—What would be the effect of increasing the current circulating around the field cores of a series wound machine after the cores have reached the saturation point?

It would be a simple waste of energy, as we would not get a corresponding increase of magnetism after the cores had become saturated.

113—Does any variation in the resistance of the external circuit affect the production of current in series wound machines, if so, how?

Yes; a decrease in the external resistance increases the current, and conversely, an increase in the resistance decreases the strength of the current, the speed of the armature being unchanged.

114—Is the series wound machine as efficient for electric lighting as any?

No.

115—Why not?

Because of the liability to fluctuations of current due to varying resistance in the external circuit, in the cutting in and out of lamps, for instance.

116—It is practicable to use series wound machines for lighting purposes?

Yes, but special regulation is required.

117—How is this regulation usually effected?

By maintaining the resistance of the lamp circuit at a normal point, by means of compensating resistance inserted when the lamps are cut out of circuit.

118—Would a break in the circuit of a series wound machine affect the other portions of the circuit?

Yes; a break at any point would affect the entire system, as the current would cease to flow.

119—Does the term "series wound" mean that such a machine is necessarily self exciting?

Yes; although some series wound machines also receive additional excitation of the field magnets from some external independent source.

(To be continued.)

---

* *Copyrighted.*

NEW ELECTRICAL DIRECTORY.

Whipple's National Electrical Directory for 1890 is out, and is the most complete work of the character ever issued. The index shows its contents to be: Associations; Central Stations (by States); Gas Companies (by States); Isolated Plants (by States); Insurance; General Trades; Street Railroads (by States); and Telephones. The addresses and titles of all officers and persons of prominence connected with these various associations and branches of electric industry are given, and altogether the book is most complete to date. It will be a most valuable work of reference for every one connected with the electrical trade, and those who are not directly in the trade but who have business relations with concerns or individuals who are will find it equally valuable.

Mr. Fred. H. Whipple, of Detroit, Mich. is the author of this valuable work, and it is safe to say that the fruit of his labors will be received with a hearty welcome among all who are engaged in the electrical trade. There is a great demand for a work of this kind, and no doubt it will find a rapid sale.

ELECTRIC SHOCKS.—A lineman employed by the Jersey City Fire Department received a shock of 1,000 volts by coming in contact with a dead wire which was presumably crossed with an electric light wire. He lived to tell the tale. An electric light employé in Washington, while changing carbons in one of the lamps, a few days ago, received a 2,000 volt current through his body. He was rendered insensible but recovered.

ORKING EFFICIENCY OF SECONDARY CELLS.

W. E. AYRTON, C. G. LAMB, E. W. SMITH AND M. W. WOODS—READ AT MEETING OF INSTITUTE OF ELECTRICAL ENGINEERS, EDINBURGH, JULY 16TH.

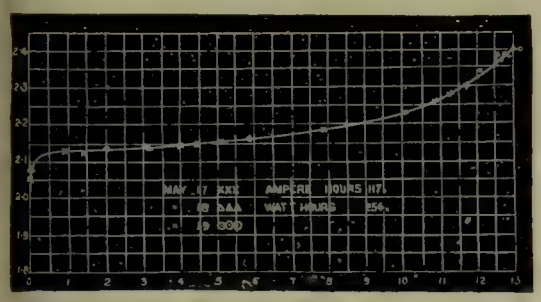
(*Continued from page 9, issue of Aug. 16.*)

..—*Results obtained with Automatic Apparatus.* Many preliminary experiments having been ade with the automatic apparatus, we suc-eded in making it work quite satisfactorily by e beginning of May, 1889, and it was adjusted charge five accumulators, A (Fig. 5), with a eady current of 9 ampéres until the potential fference reached 2.4 volts per cell, and to dis-arge them with a steady current of 10 am-res until the potential difference fell to 1.6 lts per cell. After 12 days and nights had en spent in continuous charging and discharg-g, the cells reached a normal state, the time e of potential difference in charging and the ne fall in discharging being at length repeated er and over again, so that when the time rves were drawn for the successive charges ey exactly coincided, and so for the discharge rves. The areas of these curves—reckoned, course, from the zero of potential difference, hich is much below the figure as here show—ay thus be said to give the "working watt-urs" for charge and for discharge when the arge and discharge are effected between limits 1.6 and 2.4 volts per cell. Fig. 6 shows the scharge curves obtained on May 16th, 17th, th and 19th, the points for each of the dis-arges being indicated by points differently arked as stated on the figure; and Fig. 7 ows the intermediate charge curves obtained May 17th, 18th and 19th Integrating these rves, we find—

	Discharge.	Charge.	Percentage working efficiency.
mpere hours	115	117	....
att hours per cell.....	221.8	256.2	....
antity.....	....	....	98.3
ergy.....	....	....	86.5

Soon after this very concordant set of results as obtained, the time of charging, which had mained steadily at 13 hours from the com-encement of May, began to increase to 15½ urs, while the time of discharge only increas-l half an hour—that is, to about 12 hours. At st we thought that we had been trying to arge the cells too much, so we stopped the charg-g when the potential difference per cell rose to 35 volts; but the time of charging still con-

Working potential difference per cell, charging with 9 amperes.



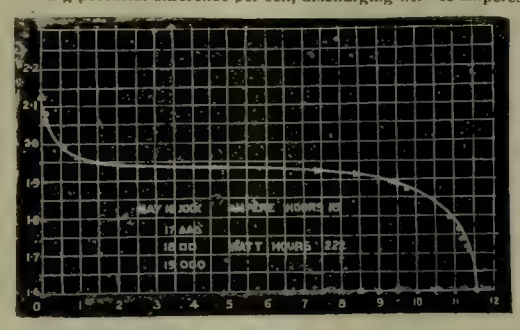
Time in hours from beginning of charge.

FIG. 6.

nued to increase, until at last it rose to 24 hours, e time of discharge still remaining about 12 urs. On again reducing the potential differ-nce limit on charging, the potential difference er cell now refusing to rise to 2.35 volts, both e times of charging and discharging became ery irregular, and at length the time of charg-g suddenly fell to 10 hours and the time of dis-harging to 6. On carefully examining the ates, they were found to have badly scaled, and have suddenly become partially short-circuited; ey were therefore carefully scraped, and the ud allowed to settle at the bottom, where, in onsequence of the special construction of the 388 cell, it could remain without short-circuit-g the plates. Only a few plugs fell out in this peration. This sediment was afterwards eighed and analyzed, showing a composition at will be referred to in section VIII., on the emical Action.

We now concluded that we had been running the cells too low; and we therefore decided to stop the discharge when the potential difference per cell fell to 1.8 volts, retaining the higher limit of 2.4 volts per cell to limit the charge. It is interesting to notice that Dr. Louis Duncan and Mr. H. Wiegand, in their paper on "The Inherent Defects of Lead Batteries," read before the American Institute of Electrical Engineers, and which we saw for the first time at the end of June, 1889, reprinted in the *Electrical World*, come to exactly the same conclusion—that the discharge should be terminated at 1.8 volts per cell, otherwise there is a formation of white lead sulphate, and a rapid depreciation of the cell. From what we have since seen, we think that the discharge should be stopped even still sooner —when the potential difference per cell has reached 1.9, or 1.85 volts at the lowest.

Working potential difference per cell, discharging with 10 amperes.



Time in hours from beginning of discharge.

FIG. 6.

We therefore adjusted the automatic interrupter to stop the discharge when the potential difference per cell was 1.8 volts, and the immediate result of this was to bring the time of charging up to 12½ hours, and to bring up the time of discharging to 10½ hours. After continuing the charging and discharging continuously day and night for 13 days, the cells reached a perfectly steady state. Curve 8 shows the time curve of potential difference per cell in the discharges finished in the early morning of June 19th, recommenced on the night of June 19th, and again commenced late on June 20th, all the three discharges being so precisely similar that they can be represented by one curve; and, similiarly, curve 9 shows the intermediate charging curves on June 18th, 19th and 20th, which were also exactly the same. The times of the three discharges and of the three charges were, respectively, in hours and minutes—

TIMES OF SUCCESSIVE.

Discharges.	Charges.
10 h. 10 m.	11 h. 38 m.
10 h. 10 m.	11 h. 37 m.
10 h. 11 m.	11 h. 37 m.

showing to what an absolutely definite state cells arrive after a definite cycle of charge and discharge between fixed limits has been repeated continuously without interruption for some weeks.

Integrating these curves, we find—

	Discharge.	Charge.	Percentage working efficiency.
Ampere hours.....	101.9	104.5	....
Watt hours per cell.....	201.7	230.7	....
Quantity.....	....	....	97.2
Energy.....	....	....	87.4

The numbers contained in this last table may probably be considered as giving the steady working values for this size and type of cell. 230.7 watt-hours are equivalent to 612,200 foot-lbs., and as the positive and negative plates of one cell weigh 28 lbs. 10 oz., the *working* storage capacity is 21,380 foot-lbs. per lb. of plate.

VII.—*Effect of Rest.*

We next tried the effect produced on the capacity and efficiency of accumulators by prolonged rests. The five cells used in the experiments stood on porcelain insulators containing resin-oil; and as the insulators, which were specially made for the Central Institution, were taller than those commonly employed to support accumulators, and as all connecting wires were removed from the cells while they were allowed to rest, it is certain that any change in the cells must have been caused by internal action, and could not have been due to external leakage.

The cells, having been fully charged on June 22, were allowed to rest, insulated as above described, until July 2nd—that is, for 10 days. The first few curves of discharge and charge after the rest showed a considerable diminution in the capacity and efficiency; but after one week's continuous charging day and night, a steady cycle was reached, the following being the times of successive discharges and charges, the limiting potential differences, as before, being 1.8 and 2.4 volts:—

TIMES OF SUCCESSIVE

Discharges.	Charges.
10 h. 1 m.	11 h. 35 m.
9 h. 59 m.	11 h. 30 m.
9 h. 58 m.	11 h. 32 m.
9 h. 57 m.	11 h. 33 m.

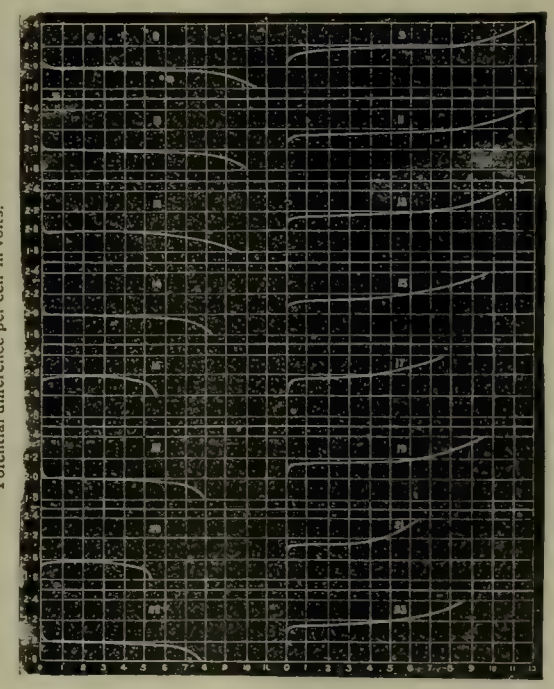
Curves 10 and 11 show the variation of the potential difference per cell; and on integrating these curves we obtain:

	Discharge.	Charge.	Percentage working efficiency.
Ampere-hours.....	100	103.8	....
Watt-hours per cell....	198	228.2	....
Quantity.....	....	....	96.4
Energy.....	....	....	85.8

Rest, then, of an accumulator, although left well insulated and fully charged at the commencement, alters the accumulator so that for the first few charges and discharges after the rest it is a much less valuable instrument than before. A week's continuous charging and discharging day and night, however, removes this effect to a great extent; the efficiency, however, still remains somewhat lower than before the rest.

Next, the cells were allowed to rest for 12 days, until August 1st. The first discharge at the end of the rest gave a quantity efficiency of only 80 per cent., so that 20 per cent. of the charge was lost. After a week's continued charging and discharging between the former limits of

Discharges with 10 amperes. Charges with 9 amperes.



Time in hours from beginning of discharge.
Time in hours from beginning of charge.

FIG. 8.

volts, the cells regained a steady state, but the time of charge and of discharge is now less than before this second rest. The times after the week's charging and discharging were:

TIMES OF SUCCESSIVE

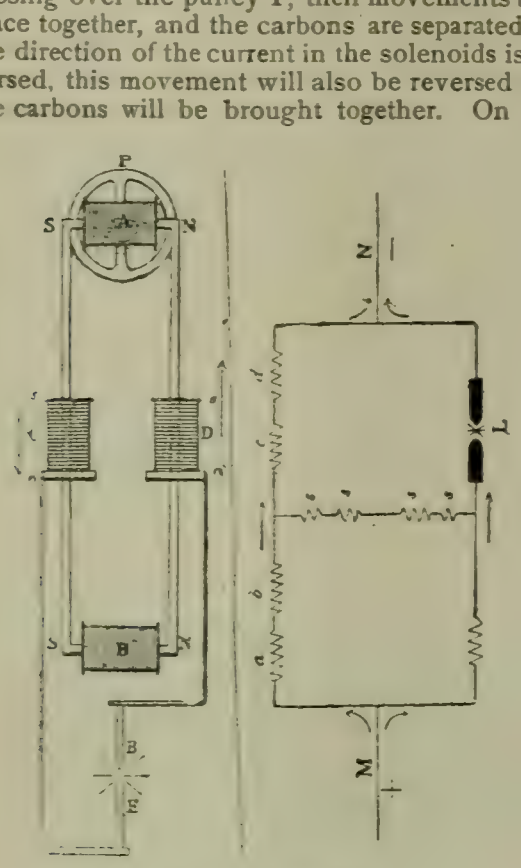
Discharges.	Charges.
9 h. 3 m.	10 h. 41 m.
9 h. 2 m.	10 h. 44 m.
9 h. 10 m.	10 h. 51 m.

(*To be Continued*).

THE DOUBRAVA ARC LAMP.*

The principle of this lamp is shown by Fig. 1. A and B are fixed electro-magnets, placed one at the top and the other at the bottom of a parallelogram consisting of rods of soft iron, which constitute their cores. C and D are movable solenoids, each sliding on one of the vertical portions of the parallelogram, which at the same time form cores for the solenoids. P is a pulley over which passes a cord, from the ends of which the solenoids C and D are suspended: below these are fixed the carbon holders E and F. When a current traverses the electro-magnets A and B the cores become magnetized, and their poles NN SS arrange themselves as shown. In a like manner, when a current passes through the solenoids C and D, two poles NN SS are formed; so that in the solenoid C the pole N is attracted by the pole S of the parallelogram and *vice versa*. A downward motion, indicated by the arrow, will thus be imparted to the solenoid C.

In the same way it is obvious that the solenoid D will have an upward motion imparted to it. These two solenoids being connected by a cord passing over the pulley P, their movements take place together, and the carbons are separated. If the direction of the current in the solenoids is reversed, this movement will also be reversed and the carbons will be brought together. On this



FIGS. 1 AND 2.

principle Dr. Doubrava has constructed two lamps, one designed to work in parallel and the other in series.

The connections of the lamp for parallel working are shown diagrammatically in Fig. 2. The electro-magnets *a*, *b*, *c* and *d* have a resistance that balances that of the arc L and the resistance *r*. S S S and S are four solenoids, which, when the arc is of normal length, should have no current passing through them. When the arc becomes too long a portion of the current goes through the solenoids in the direction M *r s c d* N, and the carbons are brought together. When, on the other hand, the arc is too short, the path is M *a b s* L N, and a portion of the current goes through the solenoids in an opposite direction to that which it formerly did, and the carbons are separated.

Fig. 3. gives diagrammatically the principal connections in the series type of lamp, as constructed by Steinlen and Co., Mulhouse. A and B are the + and – terminals respectively. E E are the upper and lower electric magnets, S S are the thick wire solenoid coils forming part of the circuit, and *s s* are fine wire coils arranged as a shunt to the arc. These

*From the *Révue Internationale de l'Electricité*

two coils are, it will be seen by the figure, arranged to act differentially. This lamp also possesses a cut-out, which introduces such a resistance into the circuit as to compensate for that of the arc. These additions as well as other modifications, made with the object of perfecting the primary apparatus, are due to M. Schlick, the engineer of the firm of Steinlen and Co.

The annexed diagram (Fig. 4) shows all the connections in detail of the type of lamp which worked at the Paris Exhibition. The current enters by the + terminal and passes in succession through the four electro-magnets. When it

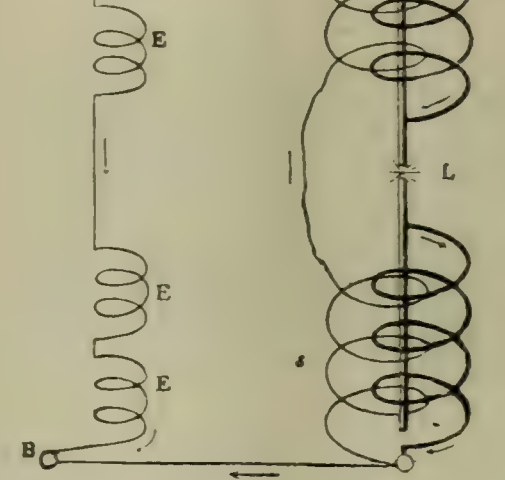


FIG. 3.

arrives at the point O it is divided into two portions, the most important of which passes through the resistance R, and the armature *a* of the cut-out C, which is now attracted by the electro-magnet. The current then leaves the lamp of the terminal. The other portion of the current passes through the fine wire of the solenoid, and the thick wire of the cut-out. It is sufficient to actuate the solenoids, and bring the carbons in contact, and thus open a new path of small resistance for the current. The current then

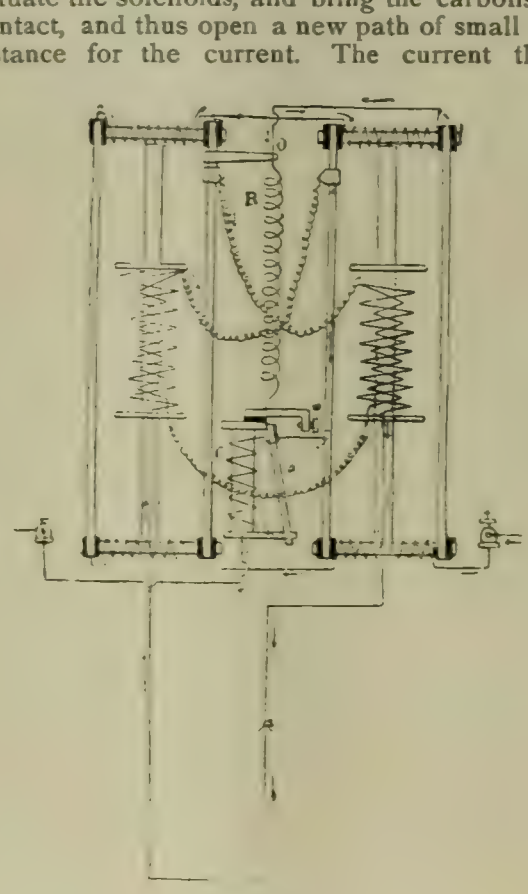


FIG. 4.

passes along the thick wire solenoids, and strikes the arc, the cut-out also attracts its armature, cutting the resistance out of circuit. The feeding of the arc is effected in the manner we have mentioned above. When the carbons are burnt out the armature *a* is brought into contact with *v*, and the resistance R is substituted for that of the arc.

This lamp is extremely simple. The only piece of mechanism it requires is a little catch to prevent the carbons from moving too far apart when the arc is struck. For this purpose the pulley over which the cord passes from which the solenoids are suspended, is provided with ratchet teeth, which come in contact with the catch in question, when the carbons move apart. This catch has, however, a certain amount of play, and the teeth when pressing against it push it by just the amount sufficient to produce an arc of the required length.

ELECTRIC WIRES AND CABLES.—The description of the wire manufacturing plant of The Roebling Sons & Co., at Trenton, N. J., will be read with considerable interest by electrical people, particularly those who handle cables. The process of covering underground cables with lead by the use of improved machinery is an interesting one, and the facts given concerning this feature of the business are worth knowing. This company is probably better known in the electric wire trade than any other like manufacturing concern. A very large percentage of the telegraph wire used in this country came out of their mills, and the fine grades of copper wire, such as is used for magnet winding have a reputation for uniformity and excellence of quality. The electric light and electric railway trade is constantly drawing on the capacity of these mills, for supplies, and so greatly has the business increased that it has become necessary for the company to build a large addition to their plant, as described.

TWO SAW BUCKS.—When Secretary Foote displays his insignia of office, i. e., two saw bucks festooned with ribbons of all colors of the rainbow, it will mean that the time is at hand when the transfer of two X bills from the pockets of individual members to the association's pocket shall take place. The bright hued ribbons may be construed to indicate cheerfulness in the performance of the duty.

FRIGHTENED NEGROES.—Blacksburg, S. C., recently celebrated the introduction of the electric light in that place. The colored portion of the population did not see much cause for rejoicing. They took to the woods when the lights were turned out, evidently thinking that Gabriel had arrived and the last day was at hand.

FRENCH ELECTRIC TRAMWAYS.—In another column will be found some interesting facts and figures concerning the operation of a tram car on a Parisian line by secondary batteries, showing that some of our French friends are believers in the future of storage batteries. The figures show very good results.

OUR CONVENTION ISSUE.—Every word in this issue will be found interesting to the members of the Electric Light Convention. It contains a good deal of "light" reading which will be appropriate during the sojourn of our friends at Cape May, and we hope they will read it and profit thereby.

CORN PALACE.—The Corn Palace at Sioux City, Iowa, will be lighted by 3,000 incandescent lamps and several arc lights. The light, no doubt, will be a revelation to many of the farmers who will attend the exhibition.

UNDERGROUND TELEPHONE WIRES.—In Toronto, Ontario, the telephone company is putting its wires under ground. Ducts of wood, thoroughly creosoted and three inches in diameter are used.

EDISON'S FIRST ELECTRIC LIGHT EXPERIMENT. It seems a good deal longer since but it was September, 1878, that Mr. T. A. Edison began his first experiments in electric lighting. In his early lamps he used platinum in place of the carbon filament now in use. He abandoned platinum for carbon in November, 1879.

CARBON WORKS.—A new electric light carbon works has been established in Sandusky, O.

THE OKONITE COMPANY, NEW YORK—LONDON.

The recent organization of the International Okonite Company and their purchase of the interests of the Okonite Company, New York City and Messrs. Shaw & Connelly, extensive wire manufacturers of Manchester, England, for the extended manufacture of Okonite insulated wires and cables, marks another step forward in the brief but highly successful career of the Okonite Company. The history of this enterprising concern has been several times brought to the notice of our readers and it is unnecessary therefore for us to refer to it at length. That Okonite jumped at once into popularity upon its introduction only a few years ago, is a fact; that it has continued to grow in public favor ever since, is also indisputable, and that it will become even more popular, is very probable. The demand for this famous insulation compound has far exceeded the manufacturers' facilities for its production. They have repeatedly enlarged their works only to find greater accommodations still imperative. Some months ago the Okonite Company commenced work on a new factory which is now completed and very commodious. It is located, as was their former establishment, at Passaic, N. J., and passes into the hands of the International Okonite Company, a model establishment of its kind. As this concern has also acquired the business of Messrs. Shaw & Connelly, at Manchester, England, it will not be long before Okonite will be manufactured abroad, in fact this will be done as soon as necessary machinery and appliances are installed.

The consolidation of these two firms, if it may so be called, will doubtless prove a profitable business and bring Okonite within the reach of all, in every section of the civilized world. Through the courtesy of Capt. Willard L. Candee, one of the directors in America of the International Okonite Co., we are enabled to present in this issue a view of the company's new works at Passaic. The factory at Passaic is a three story brick building, 380 x 80 feet, with wing, 50 x 120 feet, and engine and boiler room, 80 x 50 feet, adjoining. There are also carpenter, machine and blacksmiths shops on the premises. The entire group of buildings and plant cover an area of about 6 acres. Four hundred or more hands are employed, turning out on the average of 60 miles of insulated wire per day. Water power is used for driving the machinery. It is furnished by the Dundee Canal on which the factory is situated, but in case it should not be available from any cause, an engine of 250 H.P. capacity proves an efficient substitute. In the engine room is also a 50 H.P. Thomson dynamo, used in connection with incandescent lights with which the factory is equipped. The establishment is under the supervision of F. Cazenove Jones, Superintendent, with Chris. Klotzbach, Assistant Superintendent. The process of covering copper wire with Okonite insulation is very interesting, it being accomplished in a most thorough and ingenious manner. Any size wire can be covered by these machines. The cabling machine has already been brought to a high state of simplicity and efficiency by Superintendent Jones, and resembles very little the original machine used for this purpose. By a rotating movement it combines any number of wires into a solid well insulated cable. If this cable is intended for submarine use it passes to the armoring machine where it is armored and so finished. Fig. 2 shows over one hundred and seventy-five braiding machines which, under the deft manipulation of female operators, cover the okonite insulated wire with silk braid or cord, when it is to be used for inside incandescent lighting. Fig. 3 will give the reader a good idea of the appearance of the testing room. Here one electrical expert and four assistants are continually at work testing all Okonite Wire, by the aid of very fine Thompson galvanometers, before it is shipped from the factory. There are other views of this factory quite as interesting as those we have selected for illustration.



FIG. 1.—THE OKONITE COMPANY'S FACTORY AT PASSAIC, N. J.

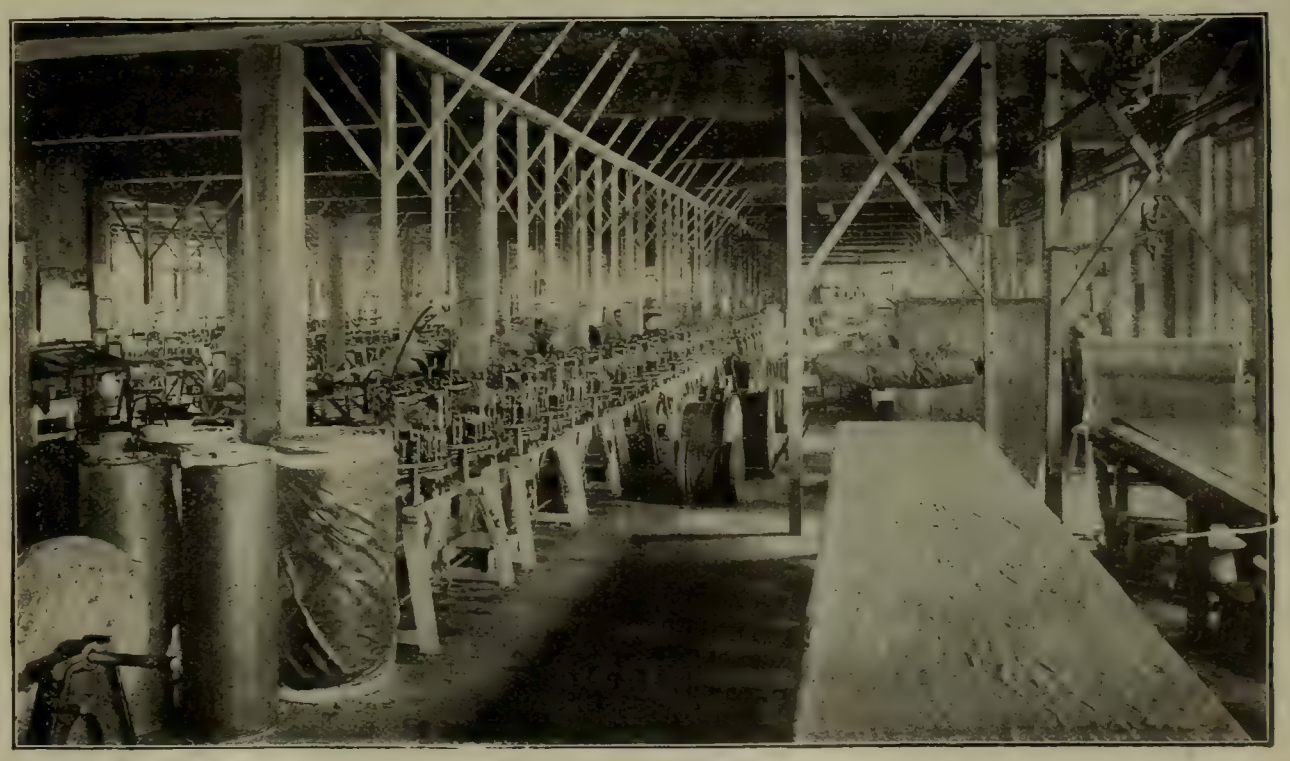


FIG. 2.—THE OKONITE COMPANY.—BRAIDING MACHINES.

ELECTRIC RAILWAY AT NEUSTADT.—The Neustadt Cement Works, which already are lighted by electricity, have now built an extension of the railway from the terminus to their works, a distance of 1,700 metres. An electric locomotive draws three trucks each carrying three tons, the journey being peformed in ten minutes.

THE LONDON AND PARIS TELEPHONE CABLE.

Telephonic communication between London and Paris, says the London *Electrician*, is now merely awaiting the consent of the French Government. Mr. Preece stated at the Newcastle meeting of the British Association that experiments had been made to ascertain under what circumstances such communication was possible; and in February, 1887, he communicated to the Royal Society a Paper in which it was stated that, taking the resistance of a conductor in ohms, and its capacity in microfarads, telephonic communication is good, when the product of these is 4,000; when it is 10,000 talking is just possible, and the limit is reached at 15,000, when no articulation is audible. Experiments have been made with telephones on the cables between Dover and Calais, between Holyhead and Dublin, between South Wales and Wexford; and from the results of these, the officials of the Post Office are perfectly satisfied that they can build a line between the capitals of the two countries through which telephonic communication will be not only possible, but highly satisfactory.

The present cable between Dover and Calais is quite unsuitable for the purpose, both on account of its high resistance and its capacity. The requisite details of the new cable and the land lines have been worked out, and the results of the calculation have been compared with the tests recently made upon a line from Baldock in Hertfordshire, through London to Worcester. In this experiment, which was conducted with a view of determining the constants of the proposed line to Paris, two copper wires were employed, and no less than 27 miles of the circuit was through the underground system of the postal telegraphs in London. The communication through this line by telephone was very good, and confirmed the calculations which have been made. The telegraphic communication between London and Paris has increased very considerably during the past few years; and as it is necessary to make some extensions, it has been considered that the new line should be one through which telephony could be carried on.

The land line will consist of four copper wires. The route of the new cable will be between Sangatte, near Calais, and Folkestone.

As the French government are fully alive both to the importance and practicability of the matter, it is not likely that any obstacles will arise, and it may be expected that the line will be ready before the end of the year.

DRY BATTERY.

The dry battery manufactured by Himmer & Anderson, No. 20 Vesey street, gives a remarkably large and powerful current for so compact a cell. While the battery is designed for open circuit work, it is capable of application to special work for short periods of time on closed circuits. An ingenious and quite valuable application of these cells is for electric lighting in the shape of a portable outfit. We know of a case where four of Himmer & Anderson's small cells were fitted into a neat box, on the front of which was properly placed a small two candle power incandescent lamp, and under the carrying handle on the top of the box was placed a small push button. The cells, lamp, and push button, were connected up in series, and in carrying the box around pressure on the push button closed the circuit and the little lamp flashed a brilliant light. The value of such an outfit is in its portability, and, while the time during which the lamp will remain lighted is limited, it is useful for such purposes as going into dark places in search of objects, etc, etc., where only a temporary light is required.

Many other uses to which this battery can be applied are suggested. For instance, a small two candle power lamp, fed by a sufficient number of cells, could be hung in front of the face of the clock, so that in case it should be desired to ascertain the time during the night, by the simple operation of pushing a button conveniently located near the bed, the clock face would be instantly illuminated.

This battery is valuable in all applications where only temporary light is required, and the compactness of the cells makes it an easy matter to get up a portable outfit. As has already been stated the battery is of the open circuit class, and it is an excellent one. It can be recharged after being exhausted, and is then as effective as when new.



THE OKONITE COMPANY—FIG. 3. TESTING ROOM.

ELECTRIC RAILWAYS

The Seventh Street Railroad line in St. Louis, Mo., is running on the Short system and its operation is giving satisfaction.

The St. Louis Suburban Railway Company proposes to build an electric line to Forest Park from its present western terminus.

The Lineff System of Electric Tramway, which is of English nativity, has been investigated by Mr. Gisbert Kapp and his report thereon is very favorable. The line was subjected to all sorts of tests of the most extreme character and it withstood them all in a remarkable degree.

NEW BOOKS.

PRACTICAL DYNAMO BUILDING FOR AMATEURS.—HOW TO WIND FOR ANY OUT-PUT. By Frederick Walker. D. Van Nostrand Company; 104 pp. Numerous illustration. Price, 50 cents.

This little work is written in plain language, and is devoid of all but the simplest mathematical calculations. It is just what amateurs want, and professionals, too, will find it valuable—and no doubt it will find a ready sale.

GAS COMPANIES.—The President of the Conference of North British Gas Managers in his address at the meeting of the Association at Perth on the 24th ult., after a passing allusion to the experiments made in Greenock of supplying a section of that town with electric light, said it was evident that the electric light could not be supplied at anything like the cost of gas. Gas was the light of all classes of consumers; but the electric light, from its excessive cost, could only be the luxury of the rich. Where gas was sold as cheaply as it was in most towns, there was no risk of the general adoption of the electric light. In his opinion the supply of electricity should be left in the hands of those companies who specially undertook such work, and gas companies should no more trouble themselves with it than they would with the supply of oil to those who prefer to burn this illuminant instead of gas, oil being a much more active competitor than electricity.

A NEW SPECIES.—A citizen of Lowell, Mass., is getting up a name for himself that may pass down through the ages yet unborn. This person has invented a man—an electric man. This man is not constructed of dust, etc., but his frame work is of iron, and his bowels consist of machinery, while his limbs are a series of toggle joints. This artificial man surpasses his prototype in strength however, he being endowed with the strength of six horses. His mission in this world is to work, and he is to be hitched to passenger vehicles, and every time a fare is deposited the six horse power man politely takes off his hat.

THE FERRANTI SYSTEM IN FRANCE.—Besides the supply stations at Nancy, Troyes and Havre, the Société Nationale d'Electricité, which is working M. Ferranti's system in France, has in hand work at Rethel, Vierzon, Nimes Sens and Amiens. They are in negotiation with the Municipal Council of Paris for a concession for lighting a portion of the left bank of the Seine, including part of the Fifth Arrondissement and the quartier of Sorbonne. The Company offered a deposit of $20.000, but the Council demand $30,000, and decline to return it.

PERSONAL.—Mr. Wm. R. Regan, Secretary and General Manager of the Minneapolis Exposition, to whom we are indebted for the facts concerning the exhibition given in our last issue, is an indefatigable worker, and through his instrumentality the exhibition is bound to be a grand success. Mr. Regan is well known in electrical circles, and he has put his heart and soul into the Exposition to make it a success.

STRIKE.—The employés of the Westinghouse Electric Company at Pittsburg struck on August 11th for shorter hours. Both plants are shut down and 1,200 men are idle. At last accounts the company was firm in its refusal to accede to the men's demands.

ELECTRIC LIGHT IN BULGARIA.—It is intended to light the town of Sofia, Bulgaria, with electricity, using the water of the Boyena as the origin of power. The cost of initial establishment is estimated at $120,000. Tenders will be invited in August.

TELEPHONE IN ITALY.—The Societa Telefonica Lombarda has had to build an iron structure, 66 feet high, in the Piazetta S. Lepoliro, Mailaud, owing to the householders having declined to allow poles to be put on their houses.

ELECTRICAL EXECUTIONS.

On January 4, 1889, the New York *World* published an article based on some experiments made by Mr. F. W. Jones, Assistant General Manager and electrician of the Postal Telegraph Company with a view to determining the electrical resistance of the human body. These experiments were conducted for the benefit of the Medico-Legal Society while the subject of electrical execution was under consideration, and Mr. Jones then called attention to the uncertainty of electricity as a death dealing power. *Apropos* of the Kemmler execution the results of Mr. Jones' investigation will be read with interest and profit by this time.

Mr. Jones found the resistance of the man he experimented on to vary from 17,000 to 80,000 ohms in a few minutes and depended entirely on the amount of electricity used to make the measurements. The Society at first recommended applying one electrode on top of the head (as it was with Kemmler) and the other to the neighborhood of the spinal cord. This second contact it was later recommended should be to the subjects feet instead of his neck.

"It is well known that Mother Nature has admirably protected the brain of man, as also that of many other of his fellow creatures, with a skull or bony case containing the seat of all the organs of sense, and this case forms a coherent mass," Mr. Jones said in reference to the Society's recommendation. He explained why it was difficult to reach a vital point through the skull with a current of electricity, owing to bone being a non-conductor and other obstructions, and continued: "It is easy to see that the greater part of the current applied between the top of the head and base of the skull would be resisted by the skull and would flow around outside through the moisture caused by respiration, and also under the epidermis through the blood vessels and tissues enveloping the skull, and any total effect would arise from a shock similar to a blow on top of the head and from a reflex action on the spinal cord through the magnum foramen at the base of the skull."

To verify this view Mr. Jones made measurements from the top of the head to the base of the skull and from the back of the skull to a point in the front of the body between the fifth and sixth ribs. These measurements proved the latter path, although three times the longest physically, to be the easiest route for the current. While the head measured from 4,500 to 31,000 ohms resistance the body only ranged from 3,200 to 26,000. From these facts it was argued that the safest and most humane way of applying the current was through the body. This would paralyze the heart and cause a painless death without danger of the body being disfigured by burning, due to too much electrical resistance.

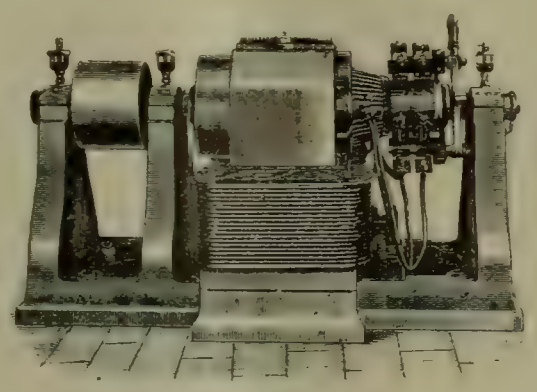
Further investigation into the subject was subsequently made by Mr. Jones and he found that the resistance of human beings varied in different persons even more widely than it did in one person under different circumstances. In measuring eleven men he found that with 1 volt of current their resistance ranged from 2,750 to 40,000 ohms; and with 20 volts, from 1,000 to 7,120 ohms. What it would be with 1,000 volts could not even be estimated, much less measured. In his report of the results he said, in conclusion. "It appears that the state authorities, are absolutely indifferent to the opinions of electricians of experience, and now that electrical execution is a law, the condemned subjects for some time to come must experimentally furnish a large amount of data that I am sure could have been furnished *a priori* by electricians, and thus have saved some probable revolting scenes, worse than those of the rope our humanitarians are striving to obviate. From beginning to end, those in charge have demonstrated their utter unfitness to advise the State upon the subject.

Had the State authorities heeded the opinions of electrical experts Kemmler's execution would not have been attended with the horrible events that occured in the Auburn jail, and the fair name of the Empire State would not have been tarnished by the revolting scene which was enacted in its name.

THE PREECE DYNAMO.*

In the Preece dynamo, of which we give an illustration below, the bed-plate and brackets are one complete casting. The plummer blocks are fitted with adjustable phosphor bronze bearings, and each bearing is fitted with a sight feed lubricator.

The magnet yoke, which is cast in one piece is let into a recess in the bed-plate, and the pole pieces are separate castings bolted to the magnet yoke. The field coils are wound upon separate shells with zinc flanges, and are interchangeable for all machines of the same output. The armature is built up with charcoal iron discs insulated from each other with a specially prepared varnish paper, and are held in position on the shaft by two insulated bolts passing through the driving end plates which are firmly keyed to the shaft. The armature core is ventilated internally by suitable divisions being left at every 2 inches between the plates. The armature is wound one layer deep, with 19/17



THE PREECE DYNAMO.

strand braided cable, and connected up to a 60-part commutator, there being one complete turn per commutator bar.

The armature on the pulley side is provided with a blower to send a current of air through the pole pieces and prevent an accumulation of dust; both ends of the armature are protected with brass shields fitted to the pole heads. The brushes are made of soft brass wire and their pressure upon the commutator is regulated by thumb screws.

At a speed of 800 revolutions per minute the E M.F. is 110 volts, and the current at full load, 250 ampères, there being no sparking. The rise of temperature after 10 hours continuous run is said to be 40 degrees on the armature conductors, and the field coils 30 degrees Fah. above the temperature of the air.

CONTINUOUS CURRENT TRANSFORMER.

The continuous current transformers used at the Draycott-place station of the Chelsea (England) Company in appearance resembles a two-pole inverted type Elwell-Parker dynamo. The armature is of the drum type, the two windings being upon the same core, and a commutator for each is arranged at opposite ends of the armature. The machine has been constructed by the Electric Construction Corporation (Limited), and has given very satisfactory results during the time it has been under test. The output for which the machine is intended is 33,500 watts, and the speed 1,000 revolutions per minute. There is obviously a necessity for extra precaution in insulating the high and low tension circuits from each other in the armature of the transformer on account of the mechanical stress.

The method adopted by the designers of the machine has been to wind up the primary into thin ebonite troughs, which are laid along on the surface of the armature. This has proved efficient so far. The insulation resistances, which have been steadily rising since the commencement of the tests, is at the time of writing as under:

Between the windings.... ....17 megohms
" the thick wire and frame of machine..7.5 "
" the thin wire and frame of machine...9 "

A test has recently been made of the performance of the transformer, the readings and the results of which are given in the table below.

	Primary.			Secondary.			
	E.M.F. at terminals.	Current.	Watts absorbed.	E.M.F. at terminals.	Current.	Watts delivered.	Commercial efficiency.
1	604	72 5	43,790	111.5	320	35,536	81.3 p'r c't
2	606	72.5	43,935	111.5	327	36,313	82.5 p'r c't
3	588	61	37,932	110.5	280	30,814	82 2 p'r c't

A NOVEL FEATURE IN INCANDESCENT SWITCHES.

Simplicity of construction, efficiency in operation and cheapness are the three main points which are looked for in any good article. These three points are combined in the new "Convention" incandescent double pole switch



INCANDESCENT SWITCH.—SECTIONAL VIEW.

which we illustrate below and which is manufactured by the Illinois Electrical Material Company, Chicago.

The sectional view shows the contact bar resting on the insulated ratchets. To close the circuit it is only necessary to turn the handle to the right and the bar will climb the grade and take a horizontal position on the brushes fixed on both sides, while a second turn gives an in-



INCANDESCENT SWITCH.—GENERAL VIEW.

stantaneous break, the bar being thrown by the force of the spring about 3-16th of an inch. The ratchets are made of insulating material as is also the block supporting the contact bars, the small slot cut sideways in the centre block aiding to throw the contact bar of the ratchet the necessary distance. To convert into a single pole switch it is only necessary to remove the outer contact brush.

* London *Electrical Review*.

ELECTRICITY IN THE CENSUS.

On the 5th inst. Senator Hale presented in the United States Senate, a memorial to Congress and statement of the National Electric Light Association, favoring the authorization of a special census investigation and report on electrical industry, and an appropriation of $50,000 to provide for the same. The memorial states that it is estimated that there is upwards of $300,000,000 employed in this section of the electrical industry. "By means of the Census Reports," continues the memorial, "it is the purpose of the Government to establish the rightful rank of the United States among the nations of the world, in point of population, wealth, education, and general progress in the industries, arts, and sciences. The development of the older nations is the resultant of the accumulations of centuries. The development of the United States is the resultant of the genius, enterprise, and intelligence of its people. * * * The proud pre-eminence of this country in these respects is most marked. There is not a nation in the world that is making use of the many practical applications of electricity without using the creations of American inventions or the products of American factories.

* * * * * * * * *

It is believed that upwards of two hundred establishments are to day engaged in the manufacture of electrical apparatus and supplies. The aggregate number of persons employed, the amount of material consumed, and the total capital engaged; are sufficient to rank this industry second to none other in importance. This is especially true when it is considered that about 80 per cent. of this industry has been brought into existence since 1880, and is engaged in the production of apparatus of a kind and for a purpose never before known in the history of the world. The single item of copper consumed annually by this industry is estimated at 50,000,000 lbs. The producers of copper are protected by a duty of 4 cents per pound. At this rate the tariff tax upon this industry for but one item amounts to $2,000,000 annually. In view of this it is clear that, from the stand-point of the manufacturers and their army of employés, the investigation sought and the appropriation therefor is not a request as for a favor to be done, but for the recognition of the Government's most liberal supporters.

* * * * * * * * *

In the department of mechanical illumination the gas industry, over fifty years old, can show but 1,043 central plants. There are to-day upwards of 1,050 electric central stations furnishing a light that was wholly unknown to commerce ten years ago.

Street cars drawn by horses were first operated fifty-eight years ago. The system now includes about 5,902 miles of track, operating 18,000 cars, and carrying 3,600,000 passengers daily. The first electric road went into use only five years ago. There are now upwards of 1,753 miles of track, operating 3,000 cars, carrying 1,200,000 passengers daily.

* * * * * * * * *

The census report should present such a statement of the inception, practical progress, and present condition of the art of applying electricity to its many uses as shall for a long time be an accepted authority in all industrial, commercial, legislative, and social discussions involving questions pertaining to this subject. All that is required to accomplish this desirable object is to have every detail truthfully described in untechnical language by a writer of unquestioned ability, to speak authoritatively upon the subject he undertakes. That this may be done, the subject must be divided into sections in a way to give equal prominence to every detail, and the Superintendent of Census, with the approval of the Secretary of the Interior, should authorize the special agent for the investigation of this industry, to associate with himself as expert, the ablest person, whose services can be secured, to write the statement for each and every section. By so doing the value of each part will be enhanced by the unquestioned value of the whole, and a work will be produced that will be a credit to the nation and a lasting benefit to its people.

THE VIADUCT MANUFACTURING COMPANY.

The name of the Viaduct Manufacturing Company, of Baltimore, is as familiar to the electrical trade as that of any of the other foremost electrical concerns that can be mentioned, and when the reliability of the company and the excellence of its goods are considered, the secret of its good name is at once apparent.

The company's works, of which we give herewith an illustration, are situated at the Relay Station, on the B. & O. R. R., near the city, and the offices and salesrooms of the company are in the city, at the corner of Charles and German streets.

The works and grounds cover an area of 25 acres and in the former 75 skilled workmen are constantly employed. The various departments are fully equipped with the latest improved tools, machinery, etc., made especially for the work required of them. The machinery is driven by four turbine wheels of 150 horse power each. The company manufactures and deals in all kinds of telegraph, telephone and electric light supplies, magneto signal bells, annunciators, district telegraph materials, burglar alarms, etc., etc.



WORKS OF THE VIADUCT MANUFACTURING CO.

The company has a well earned reputation for integrity and fair dealing, and its goods are well known throughout the civilized world for efficiency and uniform excellence.

The trade of the Viaduct Manufacturing Company extends far beyond the borders of the United States, large orders coming from Central and South America, the West Indies, Mexico, Venezuela, Chili, and Australia.

Among several important specialties manufactured by the company is a handy medical battery for the use of families and physicians, which is unequalled by any in the market.

Mr. E. G. Davis is president of the company and Mr. A. B. Davis is manager. Both gentlemen are expert electricians and are held in high esteem in the trade for their integrity and enterprise.

THE ELECTRICAL TRAMWAY IN PARIS.

From an English contemporary we learn that experiments with the working of tramways by electricity are being continued in Paris by the Northern Company on the line between Levallois and Madeleine. Four cars are practically worked, and the Société Française d'Accumulateurs Electriques (Faure-Sellon-Volckmar), who supply the motive power at the rate of 3d. per car and kilometre, are of opinion that the traffic will be permanent. The motive power is furnished by Faure-Sellon-Volckmar accumulators, with double plates. The batteries are divided in twelve boxes, each containing nine elements coupled in series, 108 cells in all, and as each element weighs 15 kilos., the total weight of the battery is 1,620 kilos.

The twelve boxes are placed in cupboards in the corners of the car—four in front and eight behind. The connections are so arranged that the elements, when the boxes are fixed in their places, become automatically ranged in groups of three by three boxes behind each other, so that there are four groups in all of twenty-seven elements ranged after each other. These four groups may be connected for work in four different ways, as at the Birmingham tramway.

The various connections are effected by the aid of a commutator, consisting of a wooden cylinder, with contacts on the surface. The cylinder is turned by a handle.

The electrical motor is of Siemens' construction, and situated below the car in front. The number of revolutions may be raised to 1,600 a minute, but under normal working it is 1,000. The power is transmitted to the wheels of the car through gearing, which reduces the speed in the proportion of twenty-six to one.

The motor is reversed by the use of a double set of brushes. They weigh 3,500 kilos., there being 1,600 kilos. of accumulators and they carry 50 persons. During ordinary speed of 11 kilometres (6.85 miles) an hour the electrical work required is as follows: On level road, 4.3 horse-power (16 ampères × 200 volts); on incline of 1 in 100, 7.8 horse-power (29 ampères × 200 volts); on incline of 1 in 50, 11 horse-power (42 ampères × 200 volts). With a speed of 9 kilometres (5⅝ miles) an hour and an incline of 1 in 33, 12.3 horse-power (46 ampères × 200 volts) are required. On an incline of 1 in 25, 15.33 horse-power (57 ampères × 200 vo'ts). Finally, with a speed of 5 kilometres (3 miles) an hour and an incline of 1 in 20 the force is 10.2 horse-power (38 ampères × 200 volts), and on an incline 1 in 18 10.75 horse power (40 ampères × 200 volts.)

Business Mention.—Queen & Co., of Philadelphia, report a steady and increasing demand for their specialties in test instruments. Their improved portable testing sets are meeting well deserved favor as new features of great value to electricians have been introduced. The sets are being made in large quanties to fill orders already received. The new "Magnetic Vane" Ammeters and Voltmeters as brought out by the same firm are much sought after and are now in use by the Edison, Brush and Mather Companies. Meters of special size and range will be made if desired. A large collection of instruments has been placed on exhibition at Cape May during the convention by Queen & Co., and all who are interested in the subject will be well repaid by a visit to their parlor where everyone will be welcomed.

No Subway Injunction.—Judge Beach, of the Supreme Court, has denied the application of the North American Underground Telegraph and Electric Company for an injunction restraining the Consolidated Telegraph and Electrical Subway Company and the New York Underground Telegraph Company from using any subway system other than the Johnstone system.

NEW YORK NOTES.

Mr. James F. Kelly, will represent the wire department of the Edison General Electric Company, at the Cape May Convention.

The demand for wire of the brands manufactured by the Edison General Electric Company, particularly of guages from No. 0000 to No. 1 is enormous, and the company is utterly unable to keep up with their orders. They are actually trying to have a $40,000 order revoked on account of the improbability of their being able to fill it in the time specified.

The goods of the Safety Insulated Wire and Cable Company, of 234 West 29th street, this city, are in great and increasing demand. The seamless rubber insulated wires and cables manufactured by this company for underground, aerial, submarine and inside use are in special favor and are giving general and uniform satisfaction wherever used. Over two hundred miles of underground cables of this company's make are now in use in the New York subways, and the largest electrical construction companies in the United States are using the inside wire. Millions of feet of it are in constant use, and the first complaint is yet to be made. The Atlas wire, made by the Safety Insulated Wire and Cable Company, is conceded to be the safest and best line wire in use

It is stated that A. L. Bogart of New York, and the Electric Gas Lighting Co., of Boston, have a monopoly on all the gas lighting apparatus on the market. These concerns have served notices on those using apparatus for that purpose against purchasing other than their goods.

All of the electrical houses in this city have received circulars from the managers of the Minneapolis Exposition, urging them to be represented at the exhibition which opens on the 27th inst. The managers agree to pay all costs from the time the goods are packed for shipment to Minneapolis, until they are returned to their owners after the exhibition is over. Hence it will cost electrical houses nothing to participate in the exhibition any more than the mere cost of packing the goods.

The Western Union Telegraph Company propose to run their dynamo and battery wires from the basement to the operating room in iron pipes placed on the outside of the building after the alterations in the latter are complete. The dynamos and batteries will be located in the basement, and there will be no more openings in the operating room floors. The system of distributing wires to the operating tables will be radically different from the old. The floors will be channeled, and in these channels or grooves the wires will be laid and led therefrom to the tables. There will be a slight incline to the wire channels so that water may be turned on in case of the breaking out of a fire among the insulated wires. The wire channels will be covered up flush with the floor.

The Interior Conduit and Insulation Company of this city have prepared for distribution, at the Cape May Convention, a pamphlet of testimonials of their conduit system, similar to the one recently issued, but more elaborate. The title page reads: "Indorsements of the Interior Conduit System by the Leading Electric Light Companies, Wiring Contractors, Boards of Fire Underwriters, Architects and Builders." The pamphlet contains a fac-simile of letters from J. Pierpont Morgan, E. H. Johnson, Thomas A. Edison and Elihu Thomson, besides the indorsements as announced on title-page. It is a very interesting book and every one visiting the Interior Conduit and Insulation Company's exhibit will be presented with a copy.

The Okonite Company will be represented at the Cape May Convention. Capt. Willard L. Candee and Geo. T. Manson will probably be in attendance.

The demand for Weston Portable Direct Reading Standard Voltmeters and Ammeters, manufactured by the Weston Electrical Instrument Company, of Newark, N. J., is growing larger every day. R. J. G.

WONDERFUL DEVELOPMENT.—Electric lighting probably presents the most marvelous development of any industry ever established. It is little more than ten years ago since it was first brought to public notice. Now every little hamlet in the country does not consider its existence complete without the electric light. Even in far off semi-civilized places in south Africa the great light is met with. It is generally known that there are a great many electric lights in this country, but it is not generally known that capital to the extent of about $300,000,000 is invested in the industry.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL BUILDING,
BOSTON, MASS., Aug. 16, 1890.

The Russell Electric Lamp Co. have brought out a new arc lamp of 1,000 candle power. It is 15 inches long, burns eight hours, with one set of carbons, and is especially designed for inside lighting. This company also manufacture lamps of 12, 18 and 24 hours capacity, on the same principle. They intend to make a fine display at the St. Louis exhibition.

The Superintendent of the Westboro Electric Light Co., Mr. R. D. Smith, has just completed the installation of 249 lights in the new Catholic church at Westboro. The work is splendidly done. Okonite wire being used throughout.

The fine new electric light station at Worcester, which has just been completed, is also wired throughout with Okonite wire, furnished by Pettengill, Andrews & Co., who report great demand for this most excellent product.

The new coal cutting machines made by the Thomson-Houston Electric Co., will be tested in a few days. All the machines thus far designed have been ordered, and it is expected that the capacity of the new factory will be taxed to its utmost.

The Tripp Manufacturing Co. are receiving large orders for the new electric car truck, which they have just placed on the market.

The Economic Electric Co., of Brocton, have finished and are testing their first dynamo. Many novel features are introduced in the make up of this machine.

The Edison Electric Illuminating Company, broke ground on Thursday for the foundation walls of the engine house for their new station on Head place.

The Wright Engineering Company has designed and installed a new station f r the Clinton Gas Co. at Clinton, Mass. The Wright Company has also installed a plant for the Derby Gas Co. who will use water part of the year and steam the rest, the machinery being so designed that it can instantly be shipped from one to the other. There are two 250 horse-power water wheels.

The Curtis Electric Company has taken an office in the Electrical "Bee Hive," 620 Atlantic avenue.

S. E. Barton, of the Electric Mutual Insurance Co., has just returned from a trip to the West. Capt. Brophy, of the same company, is able to be out again after a severe illness. W. D. Brophy, son of the captain, is doing finely in the South and West placing risks for the "Electric Mutual."

Mr. S. H. Cobb, of the Electric Safety Company has made an improvement on the "Cartwright Protector," which increases its efficiency over 200 per cent.

The Evans Friction Cone Company are about to install the power plant for the Juniata shops of the Penna. R. R. It will consist of two Westinghouse 45 light alternating arc machines. and two 17 U. S. incandescent machines of 400 lights each. The two arc machines are to be driven by a 85 H. P. compound Westinghouse engine, and each of the incandescent machines are driven by a 45 H. P. compound Westinghouse engine. Each dynamo will be driven by Evans' Friction Cones and there will not be an ordinary belt in the station. The Evans Company are getting out a special catalogue for the Cape May Convention; five large blue prints are bound in each one, showing some of the largest stations fitted. The company have installed over 1,800 H. P. since March with their system.

The "Best" trolley hanger controlled by L. T. Jordan, of the Jordan Train Lighting Company, will be found on exhibition at the convention at Cape May, also the electric light coupler controlled by the same gentleman.

Reading is to have electric lights, and a committee has been appointed by the town to look up the matter.

Among the many beautiful decorations in honor of the G. A. R. Encampment, that of the *Boston Herald* might be noted as particularly fine, a large number of tri-colored incandescent lamps adding brilliancy to the display.

Houghton & Dutton, the large dry goods firm on Tremont street, used 400 16 candle-power incandescent lamps on the outside of their building, over one hundred hundred lamps blazing out the word "Welcome," in red, white and blue.

Nothing better can be said of the efficiency of the Thomson-Houston system of electric railways than that during this week over 500,000 passengers were carried over the electric lines of the West End Railway Company, and there was not a hitch or delay arising from any fault with the system.

The New England Printing Telegraph Company of Massachusetts was chartered on Wednesday. The company proposes to construct and maintain ærial and underground telegraph lines, and transmit intelligence to be printed by machinery at the various stations on the line. The office of the company is to be in Boston, with F. B. Dole, president, and R. H. Waters, treasurer. Capital, $15.000, in shares of $100 each.

A sample of Simplex wire taken from a mine in the Lake Superior region, was shown this week which was in a perfect state of preservation, after laying for months 500 feet under ground on a floor that was so thickly impregnated with iron that it was 60 per cent. magnetic, and a stream of water running above the wire constantly. W. J. P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, ILL., Aug. 16, 1890.

MR. JAMES W. EASTON, of the Easton Electric Co., spent some days in the city this week.

MR. W. P. ADAMS, of the Western Power Construction Company, left Chicago Friday for a trip of several weeks in the East.

COL. ROBERT C. CLOWRY, vice president and general superintendent of the Western Union Telegraph Co., has been elected to the Board of Directors of the World's Columbian Exposition.

A 200 H. P. MCINTOSH & SEYMOUR ENGINE will be employed to drive the Edison dynamos which will furnish incandescent lighting at the Interstate Industrial Exposition, opening in this city, September 4th.

THE SUN ELECTRIC LIGHT COMPANY, operating the Sperry system, have secured the contract for furnishing arc lighting to the Interstate Industrial Exposition of Chicago. About 175 lights will be used. The Expositoin will open September 4th, and continue forty days.

THE EASTON ELECTRIC COMPANY, J. H. Reid western manager, have opened new offices this week at 411 & 412 Royal Insurance Building. The plant of two 35-light machines of the Easton make mentioned some weeks ago as having been sold to Hanna & Hogg of this city, was started this week and is running very satisfactorily.

THE ROCKFORD ELECTRIC MANUFACTURING COMPANY of Rockford, Ill., are equipping the West End Street Railway of that city with an electric railway system devised by Mr. Frank Mayo of the Rockford company. The road will be 4½ miles in length and will start with four cars. The new factory of the R. E. M. Co., will be ready for starting September 1st. It will be 300 x 50 feet with an engine room 40 x 48 feet, and will employ 150 men.

MR M. A. KNAPP has just returned from a ten days' absence from the city.

MARYVILLE LIGHT & POWER CO., has been formed at Maryville, Kansas; capital, $5,000; directors, Charles F. Koester, Perry Hutchinson, S. A. Fulton, George W. Parrish, A. R. Shumway.

DUQUOIN STREET RAILWAY CO., has been formed at Duquoin, Ill., capital, $10,000; incorporators, Henry Horn, P. H. Pope and P. Mifflin.

SANTE FE, N. M.—F. G. Littlehale and others have been granted a twenty years' exclusive franchise for operating an electric light plant in Sante Fe, a provision being inserted in the franchise that they shall not charge town or private persons a greater rate than the gas company now charges. The plant must be in operation within two years from August 11, 1890. A company has been organized and will shortly begin work under the franchise.

A NEW ALL NIGHT LAMP.—A recent development of the double carbon lamp litigation is the placing before the public of a new sixteen hour lamp which contains but one set of carbon holders. The novel feature of the lamp consists in the use of three carbons, two of which are the ordinary carbons held above in a clamp of peculiar design, and the third or lower, a carbon of special size and shape. The advantages claimed for this lamp are simplicity, only one mechanism and one carbon rod being used, and the fact that single lamps of any pattern can be easily converted into all night lamps by the employment of these special clamps and carbons. This lamp is the product of the Sperry Electric Company of Chicago, and has now been in use for some weeks in this city in at least one plant of thirty lights. It is claimed to give the best of results, and may be a factor in arc electric lighting in the future. Mr. Chas. E. Gregory, of the Sperry Company, is now in attendance at the National Electric Light Association, at Cape May.

AN ELECTRICIANS' BUTTON.—Messrs. Giles Bros. & Co., of Chicago, have gotten up a lapel button of unique design for the use of electricians. In the centre of the button is Ohm's Law, represented by the formula $C = \frac{E}{R}$. About this is an electric circuit containing an arc and an incandescent lamp, motor and street car. At the four corners are the initials of the Electric Light Association, and below, the date of its organization. The figures are of gold upon a white enamel background, making a very handsome button for those interested in electrical affairs.

F. M. I.

RIVER AND RAIL CAR.

A car equipped with the motor and storage battery system of the River and Rail Electric Company, of this city, is running daily between the Brooklyn city line and Fort Hamilton, at the Narrows, and is attracting a great deal of attention from electricians and other interested parties. The car can be made to run at a speed of 6 miles an hour or less, and can be speeded up to 15 miles, when occasion demands, by a novel arrangement attached to the sprocket wheel. This feature was fully covered in our article on the River and Rail companys' system in the issue of August 9th.

Large delegations from all over the country have witnessed the operation of the car, and every one, without exception, carries away a deep impression that the system is thoroughly efficient.

Mr. Geo. L. Wright, the general manager of the company, says that the longer the car runs the better the battery and motor work, and altogether the system is giving the utmost satisfaction and is fulfilling every expectation.

The company have placed contracts for the building of a number of new cars which, when equipped with motors and batteries, will be put in operation in this city.

Delegations of electric power men have investigated the system and express themselves highly pleased with its efficiency.

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THE ELECTRIC LIGHT CONVENTION.

We present in this issue a verbatim report of the proceedings of the Convention of the National Electric Light Association, held at Cape May, N. J., August 19th, 20th and 21st. Everyone interested in electric lighting, directly or indirectly, should read every word of the report carefully and thoughtfully, for it is full of valuable information and suggestions. The convention was a most important one, and the papers read were on important and timely subjects. Electric lighting is a science, pure and simple, and as such it must be treated scientifically. How far that has been done the reader of the report can see for himself; yet, the papers are not so technical but that they can be fully understood by the layman.

The entire proceedings of the convention were most ably conducted, and the results prove that the members are as skillful in debate as they are in business management. It is not an empty claim to state that electric light managers are the most clear headed, energetic and keen-visioned class of business men there is in the country today. The nature of the business they are engaged in compels them to be; if they are not, they fall behind in the rapid race of electricity. The fittest survive in the electrical field as in all others; and we cannot recall any other industry in which the combination of science and practical experience is so fully developed and so extensively applied as in the domain of electric lighting.

The Cape May Convention was characterized by general harmony and good feeling; there was no unusual friction in the proceedings, and many new ideas were developed. Any new suggestion touching electric lighting operations is always sure to be of value to some one, and the interchange of experiences and ideas in convention is one of the best methods known of improving the state of the art.

In every respect the Convention was the most important of any ever held by the National Electric Light Association, and it is very reasonable to assume that the future meetings will grow in importance as the business of electric lighting develops.

Everyone present seemed to have had a thoroughly enjoyable time both intellectually and physically, and no doubt all were by their brief stay at these ashore, greatly benefitted. An occasional rest from the labors of business life is a wise thing, and these conventions afford electric light men an opportunity to take a rest, which likely they would seldom take if it was not for the fact that many others in the same line of business were also taking a rest, and all were taking their rest at the same place.

THE ILLUMINATING POWER OF LAMPS.

It is a great satisfaction to know that when we buy a thing we are getting full measure, whether it be sugar, beans or electric light, and when a thing is sold with the understanding that it is full measure, but in reality is found wanting when compared with a standard, confidence in the seller of the goods is liable to be shaken. It is regrettable that in one respect such a state of affairs exists in electric lighting. We refer particularly to the illuminating power of incandescent lamps, and the thanks of the producer and consumer alike are due to Dr. Louis Bell for so ably bringing the matter to the attention of the Electric Light Convention. When we buy a sixteen candle power lamp we expect to get one that possesses the illuminating power of 16 standard candles, but how many measure up to the standard? Very few indeed. Some exceed the required power but more are deficient, and it is unfair alike to consumer and to the supplying company that there should be any deviation from the standard. Of course electric lighting is a comparatively new industry, and when a new thing is being introduced and developed minor details are for the time being laid aside until the essential features are fully established. The illuminating power of incandescent lamps were one of the small things that were temporarily laid aside in the development of electric lighting and now that business competition compels attention to the smallest details the subject of illuminating power is beginning to receive proper consideration. The key note has been sounded and it is hoped that proper attention will be given to this subject. When a sixteen, or a twelve, or a twenty candle power lamp is sold, be sure that it is of the illuminating power represented, and the consumer will have good feeling towards the company which supplies him with light and towards himself when he has the satisfaction of knowing that he is getting all the light he pays for.

ELECTRIC LIGHT IN JAMAICA AND HAYTI.—Mr. George S. Bowen, the "father" and first president of the Electric Light Association, is rather optimistic in his views in regard to the possibilities of electric lighting in Jamaica and Hayti. Every school boy knows what the bar to enterprise in those countries is. Their governments are too unstable. When the people learn to govern themselves, or get some other country to govern them, then it will be time for enterprise to take hold, and not before. The electric light men of this country are quite right in hesitating to invest any capital in a country that is almost continually in political turmoil. The inhabitants do not feel natural unless they have a revolution once a year or so. They have no regard or consideration for invested capital unless it is with a view to confiscation. The countries named are naturally rich, and no one questions that the people would like to have electric lights, but they will first have to learn to behave themselves, and when they can give reasonable assurance that their government can afford ample protection against lawlessness, then enterprise and capital will step in. No doubt many electric light men are looking longingly towards Jamaica and Hayti, and would like to establish stations in those countries, but what guarantee have they that the result of their efforts would not be gobbled up and destroyed in a revolutionary movement? The reason that oil is still the only illuminant in those countries is obvious.

PRESENT AT THE CONVENTION.

The following is a complete list of those who were in attendance at the convention:

ALLEGHENY, PA.
Groetzinger, A

ANSONIA, CONN.
Platt, F B

ATLANTA, GA.
Alfred, John S

BOSTON, MASS
Alexander, P H
Austin, G L
Barker, F E
Barton, S E
Brophy, Capt Wm
Burbank, A N
Burnham, Louis W
Edgar, C L
Cabot, F E
Castle, Wm W
Conant, H J
Duncan, H E
Eustis, H H
French, H M
Garratt, A V
Goddard, C M
Hart, L H
Lovejoy, J R
Mason, A F
North, E C
Shaw, A C
Ross, R F
Pettingell, F E
White, R T

BRIDGEPORT, CONN.
Bryant, W C
Orford, J M
Platt, O S
Stanley, H D

BRISTOL, PA.
Scott, Chas E

BROOKLYN, N. Y.
Peck, E F

BUFFALO, N. Y.
Abell, C Lee
Huntley, C R
McDonald, W A

CHICAGO, ILL.
Adams, W P
Barrett, J P
Blaisdell, John W
Brown, Chas A
Cavell, E V
Cutter, Geo
Dickerson, J W
Degenhardt, Fred
Eddy, Henry C
Gregory, C E
Kreidler, W A
McKinlock, Geo A
Powers, E L
Shay, J W
Young, John
Shay, J H
Small, H H
Smith, Gilbert M.
Williams, Ed F
Wilmerding, C H
Winston, H S
Wunder, F A

CAMDEN, N. J.
Armstrong, Hon E A
Burleigh, J J
Robinson, Heber C
Rodman, C L

CLEVELAND, OHIO.
Curtis, C C
Cleveland, W B
Miles, Benj F
Crouse, J B

COLORADO SPRINGS, COLO.
Wade, E C

DALLAS, TEXAS.
Clower, W M
Harris, C O

DETROIT, MICH.
Smith, Jessie M
Whipple, Fred

ELGIN, ILLS.
Bowen, G S

FITCHBURG, MASS.
Coggshell, H F

FLINT, MICH.
Bishop, A G

FT. WAYNE, IND.
Kimball, W R
Slattery, M M M

HARTFORD, CONN.
Halm, W G
Trolles, C L
Whiting, Francis P

KANSAS CITY, MO.
Bates, M E
Hart, G W
Weeks, E R
Hageman, Geo H

MONTREAL, QUE.
Corrivean, A J

NEWARK, N. J.
Baker, C O jr

NEW BEDFORD, CONN.
Brady, T H
Whitney, L C

NEW ORLEANS, LA.
Hart, S J

NEW HAVEN, CONN.
English, J
Warner, C D

NEW YORK
Ackerman, P C
Adams, F M
Barney, C H
Brown, Oliver A
Beck, L D
Bell, Dr Louis
Caldwell, Edward
Candee, Capt W L
Coles, Stephen L
Crocker, Francis B
Field, C J
Fisher, G H
Fleming, Wilfrid
Foote, A R
Gallagher, R E
Greenfield, E T
Godfrey, J W
Gray, R J
Gordon, W H
Hammer, Wm J
Hartwell, Geo H
Haines, H M
Jenks, W
Johnson, E H
Johnston, W J
Kelly, Jas F
Larbig, Theo
Laurence, A B
Little, E W
Madden, Gen E O
McQuade, J P
Bracken, Wm
Spear, C W
Swetland, H M
Magee, Frank A
Manson, Geo T
Martin, T C
Meeker, Geo H
McCoubray, T
Myerson, E
Phelps, Geo M
Prescott, Geo B, Jr
Price, C W
Ryan, R W
Stagg, J R
Seely, John A
Serrell, L W
Shainwald, Ralph L
Shippy, H L
Storke, H L
Taltavall, J B
Taber, Robert
Temple, Wm H
Van Gestel, J
Van Nuis, C S
Warder, F
Wetmore, Jean A
Western, Benj R
Wetlzer, Jos
Wheeler, Schuyler S
Wiley, G L
Williams, Harry W
Wood, E E
Wisner, F P
Young, C G
Cullen, W F
Leonard, H Ward
Stump, C E
Morrison, W E

NORTH EAST, PA
Daniels, A L

ORANGE, N. J.
Wirt, Chas

PHILADELPHIA.
Almy, Henry N
Bragg, C A
Brooks, David
Cleverly, H A
Conner, D O
Drysdale, W A
DeCamp, A J
Deacon, F H
Hood, W R
Marshall, Norman
McDevitt, W
McIntire, W C
Moore, Alfred F
Porter, Geo F
Pierce O D
Smith, H S
Smith, T C
Stadleman, W A
Shoemaker, W H
Wilbur, G A
Willyoung, Elmer G

PITTSBURG, PA.
Angloch, H L
Duncan, S A
Carrier, A E
Marsh, J W
Mead, Morris W

PLANSVILLE, CONN.
Roberts, H C

POTTSTOWN, PA.
White, Chas E

PT. HURON, MICH.
Davidson, W F

PROVIDENCE, R. I.
Perry, Marsden J
Wood, Geo H

RUTLAND, VT.
Francisco, M J

SAN FRANCISCO, CAL.
Roe, Geo H

ST. LOUIS, MO.
McMath, Robt
Moffitt, C C
Russell, D R
Parker, Russell

TOLEDO, O.
Fabin, C R

TRENTON, N J.
Perrine, F A

WATERBURY, CONN.
Young, A M

WILMINGTON, DEL.
Cobb, H B

WINDSOR, CONN.
Baird, M E
Newton, A D

WASHINGTON, D. C.
Royce, F W
Renshaw, A M

WORCESTER, MASS.
Smith, H M

TWELFTH CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

HELD AT CAPE MAY, N. J., AUGUST 19, 20, 21 AND 22, 1890.

The Association met at the Stockton House, Tuesday, August 19, 1890, and was called to order by Mr. President Perry at 10.30 A. M.

The President read the following address:

Members of the National Electric Light Association: You are to-day to erect by mutual action, another mile-stone—in the form of the volume that will be created to contain a record of your proceedings—to mark the progress of the development of the electrical industries. Short as the history of this development is, it has been so crowded and broadened by the eager enterprise that is characteristic of our people, that no records are to-day sufficiently ample and complete to give any of us a correct knowledge of the present condition of the multitude of undertakings employing electricity in some form of practical application.

To supply this deficiency a "Memorial and Statement" has been presented to Congress in the name of this Association, urging that the fullest possible investigation and report be made on the Electrical Industries by the eleventh census. This Association can do no more important work for the interests it represents than to select for the Census Reports certain points of inquiry, and adopt measures to keep them continuously written up to date. Recommendation, looking to this end, may be presented by the Committee on Data. As a general statement it may be assumed that there is to-day a central lighting and power station in operation in every town of any importance in the United States. An estimate made by and published in the August number of *Electrical Industries* makes the following showing:

Number of Stations.....	1,379
Capital invested.....	$118,758,500
Number of Arc Lights.....	127,441
Number of Incandescent Lights.....	1,590,967
Engine Capacity, Horse Power.....	356,755

Eloquent as these figures are of enterprise and progress, they tell but part of the story. One startling omission is that of the electrical transmission of power for stationary and locomotive work. The statements, however, may serve the purpose of helping the imagination to picture the results that are to be shown by the Census of the Century, in the year 1900.

It is a safe assertion that there is not a station in this country with a present capacity sufficient to satisfy one-twentieth of the demand for light and power, that exists within the area of its practical working limits. To reach the consummation of ultimately doing the entire lighting and power service that is to-day being supplied by the use of agents other than electricity, is an undertaking worthy of the united efforts of all who are interested in the Electrical Industry. The foundation for such a growth must be laid in an unquestioned demonstration that investments in central stations for supplying light and power by the use of electrical currents, are safe and profitable, that the service is in comparison with that rendered by other agents used for similiar purposes a protection to life and property, and that the service can be employed with advantages in economy, health and comfort, by all users that cannot be realized by the use of any other agent.

Those who know best what is required to meet all issues and to establish a business involving the complex factors and conditions assembled in undertakings for central station work, are those who have invested their money in it and are employed daily in its management. To them and their interests, which includes that of all who manufacture apparatus and supplies, as surely as the greater comprehends the lesser, this Association is pledged for well-considered and effective work.

In your deliberations and dissensions, you have an opportunity to show your thorough knowledge of the subjects in which you are interested. By your actions, you can prove yourselves masters of the factors that include progress and invariably lead to successful issues.

The Twelfth Convention of The National Electric Light Association, is now open for the consideration of such subjects and business as may come before it.

The Secretary read the following announcement of the order of business:

For the purpose of securing orderly and prompt action for those attending the Twelfth Convention, the Executive Committee has appointed a Committee on Credentials, the members of which are: Edwin R. Weeks, Chairman, M. J. Francisco and John A. Seely.

The Committee recommends the appointment of a Committee on Resolutions to consist of three members.

The Executive Committee believes that many questions that can be discussed with great profit to members of this Association do not come to the surface in set papers, nor in the reports of Committees. That every such question may be considered, a call for "Topics to be Discussed," will be made at each session except the last. All topics so proposed will be referred to the Committee on Resolutions, and if approved, a place will be found for the topic in the order of business.

That members desiring to speak on an announced subject may secure the opportunity without confusion, each one is requested to hand his name to the Secretary before the subject is called. When the subject is before the Convention the Chair will call such members to take part in the debate before it is opened to the Convention. It is hoped that members will take full advantage of this invitation.

MR. FABEN, of Toledo—I move that the recommendation just read by the Secretary be approved, and that the Chair appoint a committee of three on resolutions.

The President—You have heard the motion made by Mr. Faben. What is your pleasure?

The motion was seconded and carried.

The President appointed on such committee A. F. Mason, C. H. Walderming and C. R. Huntley.

The President—The next thing in the order of exercises will be the reading of the paper on "Electrical Industries and the World's Columbian Fair," by Professor J. P. Barrett, of Chicago.

Mr. Barrett—With the permission of the Association I will thank our associate member, Mr. Blaisdell, to read this paper.

Mr. Barrett's paper will be found on another page.

Mr. Faben—There certainly will be no one enterprise presented at the World's Fair that will interest central station men as much as will the electrical department. The amount of detail required to develop a proper exhibition of the appliances presented there, and to induce manufacturers to present those features of their business that will be not only of interest to themselves, but to central station people as well, and the amount of work involved in the undertaking, demands that action should be taken by this Association now. This being a central station association, the central station people ought to go to work very promptly to lay plans for securing a proper exhibition at that time. For that purpose I would like to present a motion as follows:

"That a committee of five be appointed, of which number the President of the Association shall be ex-officio one, the other four members to be appointed by the Chair, to meet the authorities of the Columbian Exposition, and secure suitable facilities for the proper exposition of electrical manufactures and appliances, and in general to work for the interests here represented, and to offer to the authorities of the Exposition the co-operation of the National Electric Light Association to aid in making the Exposition a success.

"That the committee request the selection by the authorities of the Columbian Exposition, of Mr. John P. Barrett, of Chicago, to have the practical charge and control of the electrical department of the World's Columbian Exhibition."

Mr. Phelps—I have great pleasure in seconding the resolution which Mr. Faben has offered, and of both features of it. That is, the appointment of a committee to secure suitable facilities, and tendering the co-operation of this body with the authorities of the Fair, and also recommending for appointment Mr. John P. Barrett. The paper which has been read to us this morning is about as good evidence as we might need perhaps of the fitness of Mr. Barrett for that work, although doubtless the most of us knew that well enough before. A further reason is that Mr. Barrett has already been commended to the World's Fair Commissioners by the signatures of very many of the most prominent electrical people, electricians, electrical engineers, manufacturers and users of light and power. I think it would be eminently fit and proper for this Association to take such action at this time as has been proposed. The sooner such action can be had the better it will be for the exhibition. I presume that there is no doubt in the mind of any member of this Association of the entire fitness of Mr. Barrett for the position. I therefore second the motion.

MR. ARMSTRONG, of New Jersey—I am most heartily in favor of all of the resolution except that part of it which recommends the appointment of some particular individual. I think that this Association would make a serious mistake if it did that thing. I have myself recommended the appointment of Prof. Barret, and personally I am heartily in favor of his appointment and personally am willing to do everything possible to secure that appointment; but it seems to me that the Association would be making a serious mistake if it lent itself to a recommendation of any individual for any appointment. (Applause). I should be very sorry to see this Association join in recommending anything where there is a possibllity of there being, with merit, some competition against it; and I believe that every member of the Association would join with me in deprecating the recommendation of anything no matter how good it might be, if, with merit, some competition could be brought against it. We want to be in the position beyond any question or any cavil of disinterestedly and impartially standing here as representing all and everything connected with the industry with which we are associated. We do not want to have the slightest possible suspicion that we are biased in any direction. Therefore I am very glad to vote for this resolution if we may have that part of it omitted. I may say to the gentlemen who have moved and seconded the resolution that I am willing to join with them, individually, in doing everything possible to have the gentleman who has presented such an interesting paper to us appointed to the position they desire to see him appointed to; but do not let this Association adopt such a resulation. It would be weakening to us, and I think it would be weakening to him. (Applause).

MR. ALEXANDER, New York—This morning I received a copy of the electrical journal of the West—*The Western Electrician*—and its first editorial speaks about mistakes having been made by the Association here at a former meeting at which the Association voted to have the World's Fair held in New York instead of in Chicago. (Laughter); and especially recommends that we take no action whatever, and do not commit ourselves further in any way whatever, without first having due deliberation. Now the resolution offered by Mr. Faben, and seconded by Mr. Phelps, coming immediately after the paper by Prof. Barrett was read, puts Prof. Barrett himself in rather a delicate position. His paper speaks particularly of the advantages that could be derived by the proper arrangement of electrical exhibits at the Chicago Exhibition; and I do not think that he himself would like the resolution to come up now, at least not in that form. If notice had been given by these gentlemen that such a resolution would be brought up in the course of the session it would have given opportunity to gentlemen who are interested in the subject to confer with each other regarding a proper appointment. I therefore move that that resolution be tabled.

MR. DEGENHARDT, Chicago.—I would be untrue to the city of Chicago and to my friend Professor Barrett, if I did not raise my voice in support of his appointment. As I understand it, the resolution has for its object the successful operation of the World's Fair. In the appointment of a neutral man like Pofessor Barrett we have in him all the qualifications set forth in the resolution, and I would like to add that the very support which has been granted to him by signatures throughout the United States is a sufficient guarantee of the feeling which must exist. Of course we Westerners recognize the fact that you are dying hard back here, and the World's Fair seems to be the red flag that excites the bull, so to speak. Prof. Barrett is known throughout the United States as an absolutely neutral man. I think that he is free and untrammelled. He has no affiliations that we know of, and is therefore a man qualified for the position. I think that this association owes the city of Chicago, as a debt, the adoption of this resolution.

MR. DUNCAN, Pittsburgh.—At a former stage of the proceedings of this body this morning, as I understood it, we adopted as the report of the Executive Committee, a resolution to the effect that a committee be appointed by the chair to whom topics presented for discussion should be referred; and the chair appoint such a committee. Am I right?

The President. There has been no action taken under that resolution, and any member would have a right to originate business and the Convention would have a right to consider it unless it was ordered to be referred to that committee.

Mr. Duncan. I arose for information more than anything else—to ascertain definitely what the import of our previous action was; whether it was to refer to this committee absolutely every resolution which came up in the order of business before discussion, or whether this body will discuss the resolutions first, and then refer them to that committee. As a substitute for the pending motion I move to refer these resolutions to the committee already appointed by the chair.

MR. DECAMP, Philadelphia.—I think, Mr. President, that if we undertake to do that we will never do any business. Resolutions are offered, nine-tenths of which it is perfectly competent for us to discuss in this connection, and, if I understand Mr. Duncan rightly, these resolutions are discussed (if that is the arrangement) and are afterwards referred to the committee.

Mr. Duncan.—Will you allow me to explain? You have appointed a committee to report upon resolutions. It is usual and customary to refer your resolutions to that committee. That committee considers them and reports the resolutions back to the body, making a definite report one way or the other. That then brings up the whole subject matter, and then you can amend or do as you please with the resolution, and we can proceed with the orderly conduct of business. But, if it is the decision of this body to discuss this resolution first, then I am ready now for the discussion. That is all that I am trying to get at. In order to test the sense of this body, and to ascertain what our understanding might be in the appointment of a committee on resolutions it was to ascertain the feeling of the body on that, that I made that motion. Now, if this discussion is to go on, then let us finish the subject matter up now and we will not need to send it to the Committee on Resolutions. Otherwise it would properly go to the Committee on Resolutions, be reported back, fully discussed and then decided. That is my purpose, not to cut off debate but simply to come to an understanding.

Mr. DeCamp—Do I understand that these resolutions are to go to the committee?

The President—The question now is on referring the original motion to the Committee on Resolutions.

Mr. DeCamp—With what object?

The President—That is for the convention to say. The speaker who made the motion will probably explain it.

Mr. Duncan—I understand that we have adopted here an order of business which says that all resolutions shall go to a committee.

The President—No; it does not.

Mr. Duncan—I so understood it; and that you had appointed a committee under that resolution.

The President—No; there has been a Committee on Resolutions appointed, and they are to consider any resolutions which the convention may see fit to refer to that committee, and under that you, Mr. Duncan, have made a motion, as I understand it to refer to that committee the original motion that the association endorse Professor Barrett as the appointee to have charge of the electrical exhibition of the World's Fair. This was the original motion. A motion was made to table it. You offered a substitute motion, which is now under consideration, to refer it to the Committee on Resolutions, and the question is now as to the reference to the Committee on Resolutions.

Mr. Duncan—My understanding being that all resolutions introduced into this body would naturally go to this committee and that they would, perhaps, put it in better shape and form and separate the two matters which are contained in this resolution—the two distinct subjects—and that they will then come back to the body, suppose that we recommend the first resolution only, and in order that the business may be orderly, that we disconnect the latter part, as to the appointment or recommendation of an individual for this position, and that we separate that from the other resolution for the reason that we do not want to have the two things conflict, because there might be a difference of opinion on that as to whether the appointment was expedient or not. They can sift that, separate it, and report two separate resolutions and then the whole subject matter can come before this body. That is my understanding of the orderly way of doing business; but if you want to take the other way I am satisfied.

The President—I understand you now to move as a substitute to refer the original question to the Committee on Resolutions.

Mr. Duncan—Yes; the whole subject, as offered by my friend on my left, Mr. Faben.

Mr. Faben—As the mover of that resolution I will say that I offered the resolution as I considered in the interest of the electric light associations. I have not had the pleasure of knowing Mr. Barrett so well as many members here, but the knowledge I had of the man from the say-so of the members, and my judgment of the matter, led me to believe that he was a suitable person for that position. The gentlemen seem to lose themselves a little here in considering this as an appointment. The National Electric Light Association cannot appoint a man to fill that position, but they certainly can pass their judgment on who the choice will be.

The President—The question is not as to the original resolution, but as to its reference.

Mr. Faben—If I am out of order I will submit.

The President—We simply want to get the thing in order.

Mr. Alexander—On the question of referring this matter I have made a motion, not thinking at the time of the vote passed by which a Committee on Resolutions was appointed. I made a motion to lay the matter on the table in order to give us time to consider it. Mr. Duncan's motion not only covers that point well, but refers this matter to the committee of three gentlemen whom we all know as good and level-headed men, as men who can digest the matter and report back to the Association, and then will be the time for discussion. By that time the members themselves will have been informed of this resolution, and will be more apt to judge rightly and to act rightly in the matter. I want to say that my motion is not at all a reflection upon Professor Barrett's ability; but I think that as we have made similar mistakes, and they have been pointed out to us, we ought now to be a little more deliberate in our action.

Mr. Brown—In case these resolutions are referred to the Committee on Resolutions, I would like to ask whether they will be referred back by the Committee on Resolutions to an executive session, in which no associate members are permitted to take part.

The President—I should suppose not. I should suppose that any business originated in open session would be referred back in open session for action. That would be an act of fairness the other an act of unfairness. I do not believe the gentlemen I have appointed on that committee are capable of that sort of thing.

Mr. Duncan—I wanted to get this business in straight form. We have appointed a Committee on Resolutions. If we are going to introduce resolutions *seriatim* on any subject of business

ss that comes up, what is the use of your Committee on Reso-ions. If you want a particular time to report, amend my otion by making them report at a particular time.

Mr. Brown—I am in favor of facilitating business as much as ssible, and it seems to me that the way to facilitate business ould be to take action on this resolution now. I do not know y we are not as well prepared to take action on this question after the Committee on Resolutions have reported it back.

The President—You have understood the ruling of the Chair, course, that that is competent matter for the Convention to termine.

Mr. Brown—If it is the sense of the Convention that it will cilitate business to have them report to the Committee on esolutions, well and good, but it seems to me that now is the ne to dispose of questions of this sort, and there is certainly thing adverse to the action already taken by the Convention appointing the Committee on Resolutions, if we do take action this matter at the present time.

Mr. Armstrong—I understand that there are two resolutions dorsing the paper and certain recommendations, and another commending Professor Barrett for an appointment. If that true, I call for such a division of the resolution as will permit at subsequent resolution to be treated by itself.

The President—The question is as to reference to com-ittee.

Mr. Armstrong—If that be the ruling of the Chair I move to nend that by referring simply the recommendation for an ap-intment to the Committee—well, I withdraw the motion.

The President—The question is as to the reference of the ori-nal motion to the Committee on Resolutions. I will have it ad so that the members will know what they are voting on—at is, to refer it to the Committee on Resolutions to report it ck with such alterations as they may see fit to make.

Secretary Foote—The resolution offered by Mr. Fabian and conded by Mr. Phelps, is, that a committee of five of which mber the President of the Association shall be, ex-officio, one, e other four members to be appointed by the Chair, to meet e authorities of the Columbian Exposition to secure suitable cilities for the proper exhibition of electrical manufactures and pliances and, in general, to work for the interests here repre-nted and to offer the authorities of the Exposition the co-eration of the National Electric Light Association to aid in aking the Exposition a success; that the Committee request e selection by the authorities of the Columbian Exhibition of r. John P. Barrett to have practical charge and control of the ectrical department of the World's Columbian Exhibition.

The President—The question is as to reference to the Com-ittee on Resolutions for consideration and report to this body. l who are in favor of this reference will manifest it by saying e—opposed, No.

The motion was carried.

The President—The next order of business is the report of the mmittee on Copper Tariff, by Mr. Charles A. Brown of icago.

Mr. Brown—We had expected that by this time Congress uld have passed a tariff bill and that thus there would be me definite result with reference to the duty on copper in curing which the Committee could claim some part. But you know what the present situation regarding the tariff bill

The original bill introduced by the Committee on Ways and eans provided for a reduction of fifty per cent. of the duty on rious forms of copper. This provision of the bill as intro-ced into the House was not changed in the House. In the nate the clause relating to the duty on copper was amended by rther reducing the duty to one-half cent per pound on ores and e and one quarter cents per pound on ingots, bars, plates, and g, being a reduction of 70 per cent. in one case and 80 per cent. the other form the present schedule of duties. It is reasonably re that if the tariff bill becomes a law at the present session of ongress the duty on copper will be reduced at least fifty per cent. our Committee has secured something over five hundred signa-res to a petition addressed to the Committee on Ways and Means questing the abolition of the duty on copper. We have mailed mething over a thousand circular letters and have made in ad-tion to that a good many personal solicitations. Mr. Phelps the Committee, personally went to Washington with the gnatures to this petition and presented them to the Committee n Ways and Means with a brief but forcible argument in favor the petition. As no appropriation was made by the Associa-on to meet these expenses the members of the Committee emselves advanced the necessary money for postage, traveling penses, express, etc., to the amount of $110, in carrying out hat seemed to them to be the spirit of the instruction contained the resolution appointing this Committee.

The President—Gentlemen, you hear the report. What is our pleasure?

Mr. DeCamp—I move that the report be accepted and the mmittee continued. I would like the committee in its next port to give us some idea of whether the manufacturer will get at reduction or whether we will get it.

The motion was carried.

Mr. Alexander—I also move in connection with that, that the reasurer be instructed to reimburse the committee for its out-ays. Is that proper at the present time?

The President—That is a matter that would ordinarily go to e Committee on Finance.

Mr. DeCamp—I will second the motion.

The President—It is moved and seconded that the Committee n Copper Tariff be reimbursed the amount of their expendi-ures—not to exceed $110.

The motion was carried.

The President—The order of business of the morning session ppears to be exhausted. The Reception Committee meet in arlor C, at 2 P. M. I believe that comprises all the newspaper entlemen.

The Committee on Resolutions want to meet immediately fter the close of this session and consider and report any busi-ess. The Secretary says that you can have the use of the xecutive committee room—parlor 28. Is any further business o come before the session? Have any members any topics that ey would like to have discussed at some future session?

Mr. DeCamp—I want to give notice of my intention to offer a esolution to reconsider the action taken by the Committee on esolutions. My reason for offering that, is this: while the lan proposed is a most admirable way of presenting the busi-ess for a body that has unlimited time to discuss and get rough with its business, I think if that resolution prevails that e will do very little business in the three days in which we eet to transact our business. I think it is too cumbersome or this Association.

Mr. Fabian—I do not think I understood the announcement as a majority of the house seems to understand it and for the information of the members I would ask that the announcement be read again relative to the appointment of a Committee on Resolutions.

Secretary Foote—The Executive Committee recommend the appointment of a Committee on Resolutions to consist of three members, and as a subsequent item in the topics proposed for discussion it was proposed that all topics be referred to the Committee on Resolutions, and if approved that a place be found for them in the order of business. We did not know how many topics might be proposed and what the character of them might be. Some of them would want more space on the order of business than others, and it was proposed to let all these matters go to the committee so that they might be placed in due order an the calendar.

Mr. De Camp—That was my understanding of the resolution—that is, that it does not apply to any resolution that might be offered here on the floor.

Secretary Foote—Unless referred by order of the Convention.

Mr. Alexander—I move you, sir, that we now adjourn until the afternoon session.

The President—I wish to make an announcement here. The following topic has been proposed for discussion: "The Proper Classification of the Lighting Power of Incandescent Lamps." Mr. Louis Bell, editor of the *Electrical World*, will open the question. We will make place for that. The announcement is made in advance so that all who desire may have an opportunity to be present and take part in the discussion. I think it is important——

(Mr. Seely here rose to speak.)

Mr. Alexander—My motion was seconded, sir.

The President—A motion to adjourn has been made and seconded. Those in favor will manifest by saying aye.

The motion to adjourn was carried.

AFTERNOON SESSION.

Called to order at 4 P. M.

The President—I have received this telegram:

DENVER, COLO., August 19, 1890.

TO MARSDEN J. PERRY, President:

Denver, Colo., sends greeting to the Twelfth Convention of the National Electric Light Association. May the owl be wise and the spring chicken not devoured. The commutator brush should not be allowed to spark, and may you all see the rising sun without the pendant saw buck. I regret not being able to be with you. M. D. LAW.

The President—The first thing on the opening of this session will be a five minutes' talk by Mr. Brooks, of Philadelphia, on the use of liquid insulation for underground conductors.

Mr. Brooks—It is rather embarrassing, Mr. President, to come before so large an audience. The five minutes that I take will be a brief reference to the advantage of a liquid insulation for underground conductors carrying currents of high voltage. Gentlemen, since electric lighting came into use, it has been found that the ordinary tests for insulation do not apply; that is, a test with a galvanometer and a voltaic battery of say one to five hundred cells. That has become apparent, and they have adopted other means in Paris and in London for testing the insulation of conductors that have to carry very high intensity currents. We have seen this noticed in many periodicals. Mr. William Maver, Jr., in an article published in the New York *Electrical World*, March 1st, of the present year, states that a cable measuring twenty thousand megohms per mile, for insulation in the factory, broke down by a dynamo current of six hundred volts after being drawn into a conduit. Now, in the ordinary test, if a person should go and measure the insulation of an electric light cable, and he found that it was twenty thousand megohms per mile, and he took another system of insulation and found that it was only half a megohm per mile, as a general result he would take that which stood twenty thousand megohms to a mile; but, if you apply to it a current of high voltage from an induction coil or a Holtz machine, you can prove that the one with the twenty thousand megohms insulation per mile was broken down by from five to ten thousand volts. Now, you take the same No. 4 conductor and insulate it in oil for twenty feet, just as an experiment, and raise the temperature to 200 Fahrenheit and apply the galvanometer, and it is not a half a megohm per mile—just about the one-fortieth part of the one that Mr. Maver speaks of; but when you come to apply the induction coil or the Holtz machine and test it to produce what is sometimes called the break-down or a disruption, it can be broken with ten thousand volts when the other cannot be broken with five hundred thousand volts. There is the difference between the testing of the insulation of a cable, or an insulator, or a dialectric, if you please, testing it with the ordinary delicate galvanometer, static galvanometer, and testing it for standing a current of high voltage. Now, if the current applied to a conductor tests half a megohm per mile, the temperature of the insulation being 212 Fahrenheit, that would not show much; no one on first sight would buy it; but if you are going to purchase a cabel and test it as they do in England, or give the guarantee as they do now in England, there would be five parts of current going through the insulation, to five hundred thousand and five parts going through the conductor; and the small proportion that goes through the insulation is a mere bagatelle, but it stands the current. These are experiments that I have made in Philadelphia, and I would do it here with a Holtz machine, but the atmosphere in the summer, and especially on the seashore, is very unfavorable to the use of a Holtz machine.

I will incorporate the rest of my remarks in the record.

ON THE ADVANTAGE OF A LIQUID INSULATION FOR UNDERGROUND CONDUCTORS CARRYING CURRENTS OF HIGH VOLTAGE.

Mr. Wm. Maver, Jr., in an article published in the New York *Electrical World*, March 1st of the present year, states that a cable measuring twenty thousand megohms per mile, for insulation in the factory, broke down by a dynamo current of six hundred volts after being drawn into a conduit.

Twenty feet of that cable would give the proportional insulation of over five million megohms, yet it is broken down with the tension of less than a thousand volts.

Now, if we take the same copper conductor and insulate it with cotton or other textile covering to one-eighth of an inch thickness and immersed in oil, we do not get so high insulation measured with the galvanometer, but it is not punctured or disrupted with a Holtz machine or induction coil by the application of a current of five hundred thousand volts.

I show a rough sketch here to illustrate how much more difficult it is to pass a spark through oil than through the air. We twist together two small copper wires, each covered with one thin layer of cotton, the ends of the wire are separated below the twist and the twisted portion immersed in oil, the upper ends each being attached to one of the rods of the Holtz machine. After the discs are set in motion sparks will pass between the two balls until they are separated an inch to an inch and a half, or until the spark passes from wire to wire in the twisted portion. The distance between the knobs as they are gradually separated is the length of spark and corresponding electro-motive force required to rupture the insulation between the two wires. If an inch, it is by the authorities, twenty-three thousand four hundred volts. So long as the current is applied, it passes from wire to wire through the insulation after once ruptured, but stopping the current and the insulation is soon restored.

Bearing upon this feature of restoration of insulation, it is the fact that of the fifty-three conductors laid for the Pennsylvania R. R. Co. three years since, not one of them has for a moment been interrupted by lightning or any other cause, nor have they cost one cent for maintenance.

The total length of conductors is something over seventy miles.

Taking Chief Walker's report of the total number of miles of overhead wires in Philadelphia, as compared with the number of linemen employed in their maintenance, I find there are two linemen or more for every seventy miles of overhead wires, and, at the rate of two dollars and a half per day, there has been a saving of forty-five hundred dollars in maintenance as compared with overhead wires during the past three years.

In connection with the fact that oil is so little affected by currents of high voltage, it is well to bear in mind the yearly expense caused by interruption of river cabies by atmospheric discharges. Again, a fault in ordinary insulation is developed into a perfect ground by currents of high tension.

Referring to the jar again, if the insulation is punctured, it is restored at once by agitating the liquid. In iron pipes the liquid is continually moving, owing to contraction and an expansion of the oil, from changes of temperature and no chance for the current, through a fault or weak spot, to develop into a perfect ground.

This system of liquid insulation is as cheap first cost as overhead systems, all things considered.

And how about conduits or subways? I learn from official statements that they charge a thousand dollars per mile per annum for the use of a duct in Chicago and in New York, and further, that an electric light conductor carrying a thousand volts, cost a thousand dollars per mile or more, for maintenance. Two thousand dollars is the interest on thirty-three thousand dollars and over, at six per cent. Can arc lights be furnished under those conditions at a living profit?

I shall not go into the cost, inconvenience and dangers of subways. Those that have used them, and otherwise not interested, can tell all about them.

Last summer I went to Europe and started the business of laying electric light mains. My patents were put in the hands of Johnston & Phillips, London, and they have been very successful, having laid many installations without a single failure or interruption. Their guarantee is that not one thousandth part of the current per mile is lost. (Applause).

Underground conductors and underground systems are not popular on account of cost. As before stated they are as cheap by this system as overhead wires and cost comparatively nothing for maintenance. When electric light companies see their way clear to put their conductors underground I shall be happy to assist them. I will lead the horse to water, and hold the bucket for him to drink. and if he doesn't choose to drink he can let it alone. I have been asked and summoned as an expert before Legislatures and counsels to prove the feasibility of putting wires underground—the whole amount of that business has been to help them to get a better price. It was walk up to the Captain's office and settle. I shall not enlist in the service of those patriots any more.

The President—The next thing in the order of business of the afternoon session is a paper on "Dangers from Electricity," by Professor Henry Morton of Stevens Institute of Technology, Hoboken, New Jersey, and will be read by Mr. Alexander.

At the conclusion of the reading of the paper Mr. W. W. Freeley, of Boston, opened the discussion.

Mr. Freeley—In my observations on Professor Morton's paper I should have liked to avoid, if possible, all reference to the company that I represent, because it might be said that my company, like a great many individuals connected with the business, has its own axe to grind. Well, my company has. But my company has another object in view which I think will commend itself to you, and that is to bring about a better condition of things than exists at the present time in connection with the instructions to employés of electric light companies with regard to the dangers which surround them in carrying on their daily operations. When my company started in business here a few years ago they found that in consequence of its being the first one to introduce what is known as employers' liability insurance, in the United States, that they had really no experience to guide them upon which they could found rates of premium for the various electrical risks; they, therefore, had to refer to their experience in England. But there they found themselves somewhat in the same difficulty, as electrical lighting was in its infancy, and very little or no attention had been paid to the collection of statistics with regard to accidents to electric light employés. They, therefore, laid down this basis of charging a rate to the electric light companies: To consider an electric light company in the nature of an ordinary producer of any article, and to add to that a certain percentage for the known or unknown risks which might be incidental to their business. They therefore established what they considered to be a fairly reasonable rate to charge the electric lighting employers in order to protect them with regard to their legal liability for accidents to employés. But, in the course of a short time, they found that the rate was inadequate. They found that several serious accidents occurred amongst their policy holders, and what was of greater importance to them in carrying on their business, they found that the prejudice of the public, which was aroused by the press from time to time, whenever an accident occurred, for instance, similar to those which occurred in New York—they found that the prejudice which existed in the mind of the public was so great that when a suit was brought against a company for an accident which had occurred to an electric light employé, and he demanded compensation or damages from his employer for his injuries, it was utterly impossible to carry that case before a jury on account of the prejudice which

existed in the minds of most people against electric light companies—I mean, for instance, that electric light companies were carrying on their work regardless of the dangers by which their men might be surrounded. As these cases went on accumulating we were compelled as business men to consider what was next to be done. First of all we had to protect ourselves from loss, and the result was that we were compelled to increase our rates of premium by nearly one hundred per cent. We then set ourselves to try to find out whether we could do something to bring about a better state of things with regard to the employees of electric light companies, and, if we could do so, whether it was not possible to reduce the rate of premium charged to electric light companies. We accordingly issued a circular to electric light builders we had a great many throughout the United States asking them to send us copies of their regulations for the guidance of employés in carrying on their work, for our consideration; and we told them that we contemplated submitting those regulations to an eminent electrical authority with a view of his considering the same, and from them formulating a set of simple regulations which might have the effect of minimizing the dangers surrounding the operations of electric light men. We received many replies from companies which stated that they had no regulations of the kind at all. Others sent us their regulations, but we found that they did not cover the whole ground. Others sent us on some very nice regulations. The result was that we found that there was no general kind of action existing among electric light companies on this subject. Therefore it was with a great deal of confidence and hope that we submitted all these regulations, and the matter generally, to Professor Morton for his consideration. He has drawn up the set of regulations which have been read; and we consider them very good. We also requested him to write a paper for the consideration of this Convention. Our reason for doing that was this: That we thought there would exist at this Convention what might be called the concentrated essence of the wisdom of the electric light companies; and we felt perfectly sure that everyone connected with electric light companies had the matter of protecting their workmen fully at their hearts, and that if it was pointed out to them that by adopting a few simple regulations they could prevent human suffering and prevent the sacrifice of lives, there was no doubt that they would readily join with us in this matter. Now, as Professor Morton says, possibly these regulations are not complete; but thinks that among you gentlemen you may be able to suggest amendments or alterations which will make them thorough and complete in every respect. I therefore ask you on behalf of my company if you will kindly take those regulations into your best consideration and if you can aid us, either individually, or as an association to complete those regulations, we shall think it a great favor, and you may rely upon it that when they are adopted and brought into use we shall take very close watch of the result of them; and if the result is what we anticipate it will be, there is no doubt it will be followed up by a reduction of premium. (Applause).

The President—The subject is now open for general discussion.

Mr. Francisco—I would like to ask Mr. Freeley for some information with reference to the prices that he charges electric light companies, and how he classifies the workmen. In what class do you put electric light men at the present time? How do you class them—as ordinary, extra hazardous, or special?

Mr. Freeley—We have no classification of that kind. As I stated, we started out to fix a rate, but in consequence of the cost of taking care of the cases that occurred, we have been compelled to increase that charge by nearly one hundred per cent.

Mr. Francisco—Suppose that I want to insure my men to day, what would be your price for insuring my dynamo men?

Mr. Freeley—You do not quite understand the system of insurance. We do not insure the workmen of electric light companies.

Mr. Francisco—You simply insure the employer?

Mr. Freeley—We insure the employer.

Mr. Francisco—You spoke as though you would charge the workmen a certain price.

Mr. Freeley—I think I did not say a word about the workmen.

Mr. Francisco—That is why I could not quite get the drift of your remarks. Now, on the employers basis, how do you classify those?

Mr. Freeley—We do not classify them at all. We simply charge a rate.

Mr. Francisco—How do you compare that rate with the rate for other manufacturers?

Mr. Freeley—The rate is high, and we consider that it is higher than it ought to be.

Mr. Francisco—Suppose that I insure my own company with a view to protecting the company against any claim which can be brought for accidents to workmen. What would be your price as you stand now?

Mr. Freeley—The premium is based upon the wages or upon the payments. We should charge one dollar and a half per cent.

Mr. Francisco—As I understand this electric light insurance business (I having been in the business for some time, and have spent twenty-five years in the insurance business), I find from his statement that he charges a dollar and a half to insure me against any claim that my employés may make. I have been running a station where for five years we have not had an accident of any description. Why should we pay for protecting ourselves against the claims of these men nearly double what other manufacturers would pay for the same privilege? That is what I would like to have explained. It is a fact that I can insure a quarry company, employing a thousand workmen, for less than half what you say you would be obliged to charge me for protecting the employés of an electric light company. In the quarry the men are certainly exposed to very great dangers, and several of the quarry men have been killed during the very time that our station has been running with no accidents at all. I claim that if a station is properly prepared, and the lines are properly run, there is no more danger of running an electric light station than there is in any other ordinary business—that is in any business where you would classify them as an ordinary risk. Why, therefore, should electric light men and electric light stations be called upon to pay additional premiums, just as they were by insurance companies on account of extra hazards, when really, if things are properly arranged there is no such hazard? There is no danger of that kind if the wiring, and everything else, is properly done—any more danger than there is in any other business. Of course accidents will happen in every kind of business, but I am speaking now of the general risks. He says in this report that about sixteen and one half per cent. out of the 91 cases were caused by accidents. Why should electric light men pay for 91 per cent, when there is only 16 per cent needed by their occurrence? Why should we charge the whole liability off to the electric light department instead of giving them the benefit of low rates? I am practically interested in this matter, because I have men employed there that come under this very point, and if it is such a dangerous piece of business I am liable to be called upon any day to put up for injuries received by the men, and not only that, but I am under contract at my place to protect that place absolutely from all dangers of every description occasioned by my works, whether to the men, or to the department. As a matter of course if we have to do that we want to protect ourselves by insurance, and we feel that we ought to have a rate commmensurate with the risk, and which would give us the same benefit which others derive from the business. (Applause.)

Mr. Alexander—I offer this resolution:

Resolved, That it is the sense of this association that a copy of the rules prepared by Professor Morton, as embodied in the paper read before the meeting to-day, ought to be conspicuously posted in every electric light station.

The resolution was seconded and unanimously adopted.

The President—Are there any further remarks on that subject?

Mr. E. A. Armstrong—Inasmuch as my company has insurance for its employés I was interested in the statement that was made, and particularly interested in the statistics that were given in the paper read before us. I don't know whether it is at all possible for us to make such reports to this association as will assist the various companies giving employers assurance or not; but if it is I think we ought to do it. For over five years we have operated our station and have had no accident of any kind, with but one single exception. I believe that a door of the boiler-room fell down on one of our employés and hurt him somewhat, but you would hardly charge that against the electric light station. The company insuring us told us last week, when our policy expired, that they would require double the amount of premium that we had paid, being an advance of one hundred per cent.; but so far as I have been able to see there has been no warrant for that increase in the accidents which actually have occurred; and the report made in this paper fully justifies the conclusion that I reached. A representative of the company says, however, that because of the ignorance and the prejudice concerning this very subject the companies have been compelled to pay largely in excess of what they ought to pay. Now, it strikes me that on such grounds there can be very little justification raising the rate as it has been raised upon us; but still the rate is raised. We who wish to be assured must pay that rate. If, by the observance of these rules, the sixteen and one-half per cent. can be further reduced, then it is well; if, however, by a careful examination by the officers of this association, it can be shown that the accidents in electric light stations are less, proportionately, than in other stations, merely because the men are more careful, dealing as they do with dangerous things, merely because the men are more watchful, having, as they do have, graver responsibilities, then we ought to have the full benefit that other companies get in their insurance. The quarry men that Mr. Francisco speaks of are certainly in much greater danger than are the men employed in electric light stations. I think that every man connected with an electric light company will claim that, and can successfully maintain it. Therefore it seems to me that if by any suggestions that can be made here—how it shall be done I cannot now suggest—but if by anything that we can do we can give full and accurate reports of every accident and of every difficulty that occurs in all our stations, so as to convince these assurance companies that there is very little danger to employés, we can in that way do a great thing and a good thing for our companies. I would be glad to see a proper committee take that matter in charge and devise some proper means for carrying this into effect; and I presume that within the range of what the secretary can do he will gladly do, with such assistance as the members of the association can render.

The President—It will be entirely competent and within the scope of the duty of a standing committee which we have, the Committee on Data, to inquire into this matter and report at the next convention if the convention choose to order it done.

Mr. Armstrong—That being the case, Mr. President, I move that the Committee on Data be requested to examine into and report all accidents happening in electric light stations, and to what they may be attributed. Let the Secretary put that in proper language. The motion was carried.

The President—Are there any further remarks?

Mr. Seely—Mr. President, before you close the subject of Professor Morton's paper, I move that a vote of thanks be extended to Professor Morton for his valuable paper and that the Secretary be instructed to print the same in the proceedings. The motion was seconded and carried.

The President—Of course the Secretary is instructed to present a copy of the vote to Professor Morton.

Mr. Cutter of Chicago will now present the report of the Committee on National Insurance Rules. (Applause.)

Mr. Cutter read the report as follows:

REPORT OF COMMITTEE ON NATIONAL INSURANCE RULES.

Mr. President—Gentlemen: Your committee have, at this session simply to report progress, as the object for which it considers itself appointed has not been completed, viz., the codification of a set of rules regarding electric light and power installations which shall become national in character, and be used instead of the many sets put forth by the different insurance associations throughout the country.

We have written the following letter to many insurance associations throughout the United States.

CHICAGO, ILL., April 8, 1890.

Dear Sir: At the last meeting of the National Electric Light Association, in Kansas City, a committee was appointed to select delegates or representatives from the different insurance associations in the country, and also from the electric light companies, to a national electric insurance committee. This committee will probably consist of eleven or thirteen members, the majority to be insurance men. They are to devise a set of insurance rules concerning electric light installation, which shall be enforced all over the country. It is found at present that different rules are in force now in different parts of the country, and in many places two sets of rules more or less conflicting, cover the same territory. We hope to remedy the evil of this by devising one set and have this set supported by insurance men throughout the United States.

In order to have these rules the best for the purpose, they should represent the average opinion of the various men who have had experience in this particular line, and also who represent the different interests involved. It is our aim to get a committee thoroughly well balanced as to the conflicting interests, so that the resultant opinion of them all will be so strong an expression of the best methods for electric work as to meet the support of all the insurance people and the electric light people also.

We wish you would name your choice as a representative upon this committee. We are already accumulating a great deal of information on insurance rules all over the world, so that when this committee hold their meeting they will have the work so far advanced that a good set of rules can be arranged without very much delay.

As there are many electric light inspectors who have had valuable experience and understand the subject pretty well, whom we expect to have upon this committee, we feel that such committee will be a great benefit both to insurance and electric light interests. It is our ambition to have this committee so carefully selected that it will become a body of referees to settle all important questions arising in relation to proper electric work. We trust you will realize the importance of this, and give it prompt and careful attention, and be prepared to support the decision of such a committee.

Hoping to hear from you soon, and to have your support in this valuable work, we remain,

Very respectfully yours,

GEO. CUTTER,
Chairman Ins. Com. N. E. L. A.

The answers to these letters were almost universally favorable, and contained many expressions of appreciation on the part of the insurance people of the efforts made by this Association to work in harmony with them in devising these rules and in advancing information leading towards good and safe construction.

You can, of course, readily understand that it has occupied much time and correspondence to determine just what associations to approach, and how to approach them, and get them to fully understand our object in order that they should send a representative to act upon this committee. As a result of this work we have the pleasure of informing you that the following gentlemen have come to Cape May as representatives of the various associations and companies named:

COMMITTEE ON NATIONAL INSURANCE RULES.

GEORGE CUTTER, Chairman.

Company	Representative.
Edison	W. Jenks.
Thomson-Houston	J. R. Lovejoy.
Westinghouse	P. H. Alexander.
Engineering Firms	T. Carpenter Smith.
Electrical Supplies	George Cutter.
Philadelphia Bd. of Fire Underwriters	Wm. McDevitt.
New York Bd. of Fire Underwriters	Wm. Dol Boughton.
Underwriters Ass'n. of the Middle Dept.	H. O. Kline
National Bd. of Fire Underwriters N. Y.	A. A. Anderson.
Associated Factory Mutual Ins. Co., Boston	Capt. Brophy.
Boston Board of Fire Underwriters	F. C. Cabot.
Western Union Fire Underwriters Ass'n	C. E. Bliven.
Cleveland & Chicago Boards	John P. Barrett.
St. Louis Board	Robert H. McMath.
Central Station Insurance	S. E. Barton.
New England Ins. Exchange	C. M. Goddard. —— North.
Southeastern Tariff Association	Jno. S. Alfred.
Underwriters Association of N. Y. State	—— Babcock.

These gentlemen have been in session most of the time for several days discussing the different rules, and laboring to outline a frame-work, so to speak, or what they term generic rules. It was the general feeling that these rules should be made concise, and as few as possible, and still cover the basic principles of good work.

Your committee have the pleasure of stating to you that the insurance representatives were quite generally agreed with a feeling of good will toward electric light and power installation, and they do not feel afraid of them.

The deliberations upon this set of rules have been referred to a sub-committee for further study, both to eliminate any mistaken positions, and also to frame them in proper wording.

They have also taken the necessary steps to communicate with one another for the purpose of arranging these rules so they can meet the approval of the different representatives and be adopted in place of the rules now in force. It is the opinion of these gentlemen that this work will be accomplished, and that they will enable your committee to report to the next meeting of this Association the uniform set of rules that you have wished for, and also that they will be supported by the various insurance associations.

It was voted at the last meeeting that we should express to you their appreciation of your efforts to work in harmony with them in this direction and assure you of their good will and reciprocity of feeling in the same line.

Your committee have also corresponded with various European authorities to learn their methods of inspection, and also to secure copies of the rules they have in force, and we have in our possession various sets of rules from England, France, Germany and Italy, and these sets of rules with their accompanying information will probably influence, to a considerable extent, the rules which we will adopt. The force of this can be especially appreciated by quoting part of the report of the Committee on Lighting, Heating and Patents, appointed by the National Board of Fire Underwriters, which report was presented to the National Board last winter.

"The great problem before us to-day, however, is the management of the various systems of electric lighting, so as to insure safety from fire. When such lights were first introduced, underwriters congratulated themselves that at last the long sought means of illumination without danger had been found. No matches, no kerosene explosions, no swinging gas brackets would hereafter vex them, but a steady, safe and brilliant light, which could do no possible harm, had come among us and all were happy.

It did not take many months, however, to discover that the

electric light was not the harmless thing we had imagined, but that it was a prolific source of danger, and its introduction has cost the insurance companies more than any method of lighting hereiofore in use. It has come to stay, and some time it will probably be as safe as any light in use, but our knowledge of its properties and of its management must be vastly increased before that time appears. We see the danger but as yet are too ignorant to point out the remedy. What yesterday seemed a safe method of installation, to-day proves dangerous, and what we regard as safe to-day is likely to develop danger to-morrow. We can only wait and study."

For a number of years the National Board has followed the action of the New York Board in the matter of rules of regulating electric light equipments. These rules were revised and reissued by that Board, January 15, 1890, and it is recommended that they be adopted by this body as thus revised, and promulgated to members.

In this connection it is proper to say that the National Electric Light Association, in a letter appended to this report, asks the National Board to nominate a representative upon a committee to be drawn from bodies of underwriters and electrical experts in different parts of the country, to devise and recommend rules for electric light installations, which shall be uniform throughout the land, and tend to throw safeguards about the use of such lights. Your committee recommends that the invitation be accepted and a representative appointed. Certainly, nothing but good can come out of the deliberations of such committee, and it is necessary that we should in every way increase our knowledge of what has become so important a factor in our business, and, if possible, remove some of the dangers now attending it.

Precisely what is expected of this committee in regard to the third topic named in the report, viz: "Patents," they are unable to say, but nothing in this department has been brought before them which seems to require any report.

And then to show the opposite opinion held by insurance companies in Europe as well as many in this country. The Phœnix Fire Office rules of London were issued in 1882, and their edition of 1889 contains the following statement, viz: "Notwithstanding the number of years that these rules have been in force not a single fire has yet occurred from any electric installation that has been placed up in compliance with them. The electric light is the safest of all illuminants, and is preferable to any other when the installation has been thoroughly well put up."

The electric light and power interests are of great importance in Italy, and the only rules in force in that country are those established by the government to protect its telegraph and telephone circuits. There are no insurance rules in Italy, and no insurance inspection of electrical installations, and places lighted by electric lights have a benefit or a diminished rate.

In conclusion, gentlemen, your committee respectfully ask for more time to complete their work.

On motion the report was ordered received and filed and the Committee continued.

Mr. Duncan—Mr. Chairman, before we pass that subject—is that paper open for discussion?

The President—The report of the Committee?

Mr. Duncan—There is a statement made in that report to which I desire to call the attention of the Chairman of that Committee: that the Committee place themselves on record as making the statement to this Association that electric lighting up to the present time is the most dangerous illuminant in this country; and in the latter part of the same report, since 1882, in England, they make the statement that it is the safest illuminant in the country? Is that correct?

Mr. Armstrong—That is a quotation.

Mr. Duncan—Where is the quotation from? That is what I am trying to get at.

Mr. Armstrong—The National Board of Underwriters.

Mr. Duncan—That is the insurance standpoint. The last statement made is based upon what?

Mr. Cutter—That is a quotation from the last edition of the Phoenix Fire Office Rules.

Mr. Duncan—In other words, the two statements upon which the Committee's report stands are from two standard authorities upon insurance matters, one diametrically opposite to the other. That is the point that I want to bring out before this body to show you that while we are organizing a committee, as I understand by that report, the majority of whom shall be constituted of insurance men, to consider rules which shall be favored and referred to this body for adoption, yet upon their own statement in different countries they present diametrically opposite views. I hope therefore that this Committee in its pursuit of facts and in its pursuit of knowledge will so sift the insurance statements that when they come before this body again they will be able to say from their own standpoint what are facts and what are not.

The President—Are there any further remarks on this subject?

Mr. Alexander—Mr. President, perhaps the reason why the Phœnix rules show such good results is because on the very first page is printed a very terse sentence and very much to the point. It says: "In examining your tenders for work from different electric companies be careful not to accept the lowest tender until you have thoroughly examined all, and find that the work will be done just as good, at the lowest figure, as the highest given." This short sentence, or one using similar language, is printed on the first page, and owing to that, perhaps, they have had such good results with their rules. (Applause.)

Mr. Barton—Mr. President, there seems to be a little bit of misunderstanding on the part of my friend, Mr. Duncan in relation to the quotations in that paper. It has become to my mind so chestnutty that it is hardly worth replying to. The report of the National Board of Underwriters which was quoted in the the paper is the most assinine conglomerate mass of stuff that I ever read. (Laughter). I have taken the trouble to express myself upon the subject and those who can read have had an opportunity to read. My friend Mr. Foote has done the same. The whole basis for the statement made in that report was founded upon the supposition, upon the assumption, that the one great fire in Boston, last November, was due to electrical causes; and, Mr. Chairman, there is not a shadow of foundation for that assumption (applause), not a shadow; and I make the statement boldly and challenge any refutation of it. That fire cost the insurance companies something like three and a half or four millions of dollars. It swelled the loss in a certain statistical paper that was published here in this country as to fire losses—it swelled the losses of those tables chargeable to electric lighting more than five hundred per cent.; still it was only one fire, only one incident, and that one incident was without any foundation of authority. Those are the facts. The number of fires which occurred last year was only seventy-three; the number of reported fires I would say, from electrical causes, was only seventy-three, as compared, I believe, with one hundred and nineteen the previous year for the whole United States. The number of fires actually twenty-five or forty per cent. less; the amount of loss attributed to fires five hundred per cent. greater. And as I have repeatedly made the statement, if that kind of reckoning is fair and is right, why, then you may fairly say that a cow and a lantern is the most prolific source of danger that is known, because they burned up the city of Chicago with two hundred millions of dollars. (Laughter and applause.) I do not think it necessary to say anything further. The whole subject of the report of the National Board of Fire Underwriters of New York is not worth talking about. I am ashamed of my profession that ever such a report should have emanated from it. (Applause.)

Mr. Mason—Mr. President, this seems to be a case where, more than any of which I have had knowledge, the doctors disagree. It does seem to us as if the insurance people had not much confidence in each other's judgments. (Laughter). An insurance man characterizes the report of the largest insurance organization perhaps in America as "assinine," and we are all cheering him; and, if it will be taken in the pleasant way in which I speak of it, I rather think it is a fact that insurance men enjoy hugely disagreeing with each other. I rather think that our good friends, the gentlemen who represent the insurance companies who have been making rules for us, think each other to be considerably long-eared; at least I have had a suspicion that they did, and I have sort of pitied my good friend, the chairman of this committee, who has had to sit while these fellows have been around that committee which he has called together. I have wished that I might have been in and seen what sort of a menagerie it was. I looked in the door but I was frightened and got out. (Laughter). Now Mr. President, I have this thought coming over me. We appointed a committee last year, the committee of which Mr. Cutter, the chairman, has just made a report. We had a more or less definite thought in our minds as to the scope of that committee's work. They have done a work undoubtedly valuable and one that must live and must go on. Yet I have been questioning whether this Association does not want to do something itself and of itself; whether it does not consider itself perfectly competent to do that work; and I have thought of formulating something like this, for instance, taking it for granted, if I may, that this body desires to express itself on this matter of rules: Resolved, that this committee be instructed, having heard from—I cannot call it a sub-committee, but this large committee which is to consider rules—having heard from them, that our committee be instructed to give us independently a set of rules which it recommends, whether they be the same that shall be adopted, or whether they be changed less or more—that they give us a set of rules which they can recommend, and we will consider them here. I offer that as a resolution. I will put it in writing, if you please, afterwards.

Mr. Alexander—Mr. President, in the interest of fair play, I want to say that there are several gentlemen here who have come many miles, insurance men, who do not consider that they have a right to the floor, being merely here on complimentary tickets. The gentleman who has spoken, Mr. Barton, is a member of the Association. I think it would be merely fair play to permit these gentlemen to express their ideas. The Secretary of the National Board unfortunately has gone off this afternoon, before this report was read, and is not present. I see other gentlemen present, insurance men, who are well able to take care of his side of the question. But before you call upon them I want to say that I have found these gentlemen, not as Dr. Mason has described them, when I sat with them three long days, but rather inclined, many of them, I will say, inclined to do the best they can in our favor. In fact, one inspector said this—and he is an inspector well known, Mr. Goddard of Boston—"If you and Mr. Jenks and Mr. Lovejoy say that my rules are wrong I will consider that they are wrong unless I can present an argument and convince you that I am right, because you have had experience in the business which I have not had." I think that is a very fair statement. I have heard two or three other gentlemen express a similar statement. They said, "We want to do the best we can." Some of them were electricians; some were inspectors; but the inspectors that were there always all of them were perfectly willing to abide by any fair rules made by a good body of men. I did not intend to speak on the question when the report came up. I have sat with them and in justice to those who are absent now I think I ought to make that statement; and I hope the President will give the floor to the gentlemen who are present representing insurance interests and who have came a long distance. I see a gentleman here from Alabama and one from St. Louis, who have come here for that purpose.

The President—The motion now before the house, made by Dr. Mason, is that our Committee be instructed and directed to report at the next Convention a set of rules which will be, if found proper, adopted by the National Association, and by the National Association recommended to the insurance interests of this country and to all who are installing and using electric light. Does that express the sense of your motion?

Mr. Mason—Yes, sir. I don't want what this Committee may do. This Committee that has been proposed is certainly not in any way responsible to this body; we have a Committee that is; and I wanted to relieve our Committee from any embarrassment they might be under. Whatever this large Committee may develop (and let us suppose it will be the wisest thing) we want the wisdom of our Committee after that Committee has got all the help it can get; and I want them to make a report for which they will be responsible and report to us and we will act upon it. I will ask also, for the enlightenment of the body, that the Secretary will give us the names of the gentlemen of this Association associated with Mr. Cutter on this Committee, that we may know who the Committee is.

Mr. Seely—Mr. President, I offer an amendment.

Mr. Mason—May we have the information that I call for? I call for the information so that we may speak intelligently.

The President—Mr. Seely.

Mr Seely—I move, sir, that the Chair appoint a new Committee to formulate rules and regulations governing the installation of electric light and that the members of that Committee shall be active members of this Association.

The President—Dr. Mason, there is an amendment offered to your resolution. Will you accept the amendment?

Mr. Mason—I beg the gentleman's pardon. I was writing and did not hear it.

The President—Mr. Seely offers as an amendment to your resolution that the Chair appoint a new Committee who shall formulate a set of rules to be reported to this Association and by them adopted if found proper.

Mr. Mason—If the Chair will allow me I would like to suggest through you to Mr. Seely that we ought to know who this Committee is. Perhaps it is the very choicest sort of a Committee. I don't know the names of the Committee, except the Chairman.

Mr. Seely—I offered my resolution before those names are read.

Mr. Mason—You want to hear the names?

Mr Seely—That is why I made my motion.

Mr. Mason—Because you did not want to know?

Mr. Seely—I do know.

Mr. Mason—If Mr. Seely proposes the amendment we will vote upon it. There is no need of my accepting it or rejecting it.

Mr. Storke—Mr. President, before the appointment of a new Committee a motion for the discharge of the old Committee would be in order.

Mr. Cutter—Mr. President, as Chairman of that Committee I would like to say a word in relation to that resolution. Do I understand that Dr. Mason's resolution is now before the house?

The President—No, Mr. Seely's amendment.

Mr. Mason—I did not accept the amendment.

The President—I asked if you accepted it.

Mr. Mason—I did not, simply for the reason that it is independent of my motion and may stand by itself.

Mr. Storke—Mr. President, I call for a ruling on a point of order. As I understand the resolution adopted a few moments ago the report was accepted and the old Committee continued. Before the appointment of any new Committee a motion, to be in order, should be for the discharge of the old Committee.

Mr. Duncan—I beg pardon of the Association for raising this issue, but I was trying to get at a question of fact and I did not see any other way; I did not know whether that was the final disposition of it or not.

The President—The Chair will sustain the gentleman's point of order.

Mr. Duncan—Then having voted in the affirmative I make a motion to reconsider the action on that.

The President—There is a motion now before the house. Dr. Mason's motion is now before the house.

Mr. Seely—May I ask if Dr. Mason's motion is now prevailing before the house?

The President—He is putting it in writing now.

Mr. Mason—I beg pardon. I shall not change the phraseology at all.

The President—Dr. Mason's motion is made, and I think I heard the second. The question is on Dr. Mason's motion to instruct our Committee to report a set of rules which they would recommend this Association to adopt, which this Association in turn will consider if satisfied with the rules, and will pass them and recommend them to the insurance and electric light interests of the country. Any remarks on that motion are in order.

Mr. Cutter—Mr. Chairman, I will first undertake to explain to one gentleman who has asked about the contradictory statements. That arose because (it was largely personal) the Chairman considered the report before the National Board as unfair; therefore, a careful consideration of my report will show that I have embodied the statement that the insurance men here have expressed themselves in a different tone, and that insurance men abroad have expressed themselves in a different tone; and our only object in embodying it in our report was simply to put the two statements side by side for consideration (applause); in reality, Mr. Chairman, to show the absurdity of the position taken by the Committee of the National Board; that that opinion is not sustained by the insurance people in this country; and I intended to so word my report as to convey to this Association the idea, the fact, that the insurance people that we have met here have given us to understand that they do not concur in that view of the case. That was why we embodied that in the report, and I hope it answers the gentleman's criticism.

Now in relation to instructing us to devise an independent set of rules to present to this Association, I would like to state that we are not active members of this Association, none of us. It is a labor of love. We do not care very much about how your rules are; we simply want good work; and I for one am willing to do what I can towards bringing about that good work. In doing that we have brought insurance people here, twelve or thirteen of them from different parts of the United States All told, it represents considerable expense and time lost; and for what? If you tell us to devise a new set of rules and present them to this Association, you thereby tell those insurance people that you do not care for them to continue their work towards devising a uniform set of rules which they support. If you appoint a separate Committee, whether they be active members or not, you take practically the same position, and you put us in a very embarrassing one, because the insurance representatives have most of them gone home. We have taken the necessary steps to reach them. We have appointed a Sub-Committee to enlarge and perfect the in-

structions we have given them, and in harmony with what they supposed to be the wishes of the National Electrical Light Association. Your Committee, to speak candidly, felt itself towards the last of the deliberations in a very embarrassing situation, working here and not being members of the Association, and not knowing whether they would be supported or not. We could not complete our labor; therefore, in order not to block the work, we made our arrangements with the National Electric Insurance Company, so called, to hold itself together—and your Committee of five are upon it—to work out this set of rules; and in my report I have said that we hope to present them to the next meeting of this Association for your approval, to do as you please with them; and also with it a statement that these rules will meet with the support of the insurance people. When they come before you at the next meeting we believe you will not have to refer them again to the different insurance people for their approval. Therefore, if I have made myself understood, I hope this Association will appreciate the fact that it is a labor of love on our part, and we only ask you to let us stand over and we will do the work.

Mr. Mason—Mr. President, I wish I might be permitted the courtesy to ask a word in addition to what I have said. I think there is not a member of this Association but appreciates the work not only of Mr. Cutter but of those who are joined with him. They have done a grand work and it must result in good; but one point I make is this. I hope the pleasantry in which I indulged regarding insurance people will not be taken as serious. It may go for what it is worth, it is not worth much. But this I am very serious upon. Here is a Committee which is not responsible to us, and which will do doubtless a very valuable work; a work which may or may not live; I trust it will live. One thing is sure: this Association appointed a Committee because it wanted to adopt certain rules, and it is competent to do it. Whether insurance people like the rules afterwards or not is a secondary question. Now my resolution looks simply to this: that our Committee shall, if they believe that the rules that shall be formulated by this large body are the best possible, present them to us; if not, they will make such changes as their independent wisdom suggests; but that finally we shall have a report to us of our Committee of rules which the Electric Light Association may consider and upon which they may pronounce, absolutely independently of any and all other organizations. That, I am very sure, is what the Association intended, and my impression is that is what it wants; and that my resolution looks to certainly. I hope no disrespect will be assumed towards the Chairman of this Committee or the gentlemen who have acted with him.

Mr. Barre.t—Mr. Chairman, I have had the honor of representing the Board of Underwriters of Chicago at this meeting, and I found there some of the ablest men in the profession of inspectors in this country or any other (applause) willing to work and co-operate with the Association for the purpose of the common good. One of the great difficulties with which we contend in this country is the various rules set down in different parts of the country; and the great purpose of this meeting, as I understood it, was to harmonize these rules, and to get a set of rules for inspection and installation. I understand that this report, when finally made, was to come to this Association and receive its approval or rejection. They have arranged to receive reports from all parts of the country, and I would be sorry to have this arrangement disturbed until the next meeting of the Association, so that we may have an opportunity to lay something before them.

Mr. Alexander—Mr. President, I have a few words to say on this, because I am very much interested in this insurance subject and I have for years past worked on it very hard. All those gentlemen interested in it I know will stay here and listen. Now we have discussed it three days from early morning to late at night; we have discussed it at the dinner table and on the beach, while walking and while bathing, and for days before you came here we had nothing under consideration but this important matter. I hoped myself that we would bring in here a set of rules. What I want to find out here is just the question that Dr. Mason asked, who are that Committee? I find in the printed report of the Kansas City Convention no mention made of any Committee being appointed, but simply a resolution to appoint; and that resolution is to appoint a Committee of five, which in turn shall appoint three electric light men as a Committee of conference. Even if it had been forgotten—if the President had forgotten to appoint such a Committe (I don't know how it is now); I don't believe candidly that there is anybody on that Committee to-day but the Chairman. And then, gentlemen, where do we stand? Let us understand this, and let us settle it right here who are on the Committee As I say there is a Committee of five, that in turn may appoint three men, and those three men may concur. Those three men and the insurance men are the standing Committee, whatever you may call it; and the National Electric Light Association has nothing whatever to do with them; and that has been expressed by the gentlemen who have met. It is an entirely outside affair; and therefore I should like to see Mr. Seely's motion go through recommending the appointment of a Committee of the National Electric Light Association. (Applause).

Mr. Duncan—Mr. Chairman, my tendency to stir up the insurance people has created a great deal of fire. We are getting information here this afternoon that is valuable. We were on the eve of passing a report creating a bureau outside of this body which should not be responsible to us, and creating it as a Committee the majority of whom are outside of us, to throttle either us or somebody else; and by an intuitive sense which came to me I asked the question for information whether this report before us now was being cared for by any organized body of our own. From the statement made by the gentleman who has just preceded me we have arrived at the conclusion that for an hour and a half we have discussed a report which was never authorized by or belonged to to this Association, if that statement is correct. I take the statement as being absolutely true, that there is such Committee on the record. If the Secretary knows differently, it is his duty as an officer to get up and say so. Silence gives consent, and we are therefore discussing.

Mr. Cutter—I will explain about that Committee if you will allow me. I can perhaps save the Secretary some trouble in finding the record of it. The resolution was passed at the last moment of the meeting at Kansas City. The Committee was not appointed at that time; the President had not the time, and therefore it was appointed by the President later on, and we received our announcements afterwards; and if the report has been published without the names of the Committee, that is not an explanation of it. The Committee consists of Mr. C. J. Field, Mr. T. Carpenter Smith, Mr. S. E. Barton, Mr. H. Ward Leonard and Mr. Charles Cutter.

Mr. Mason—That is good. That clears up that.

Mr. Storke—May I ask what the question is?

The President—The question under consideration is the resolution of Dr. Mason that our Committee, a committee of this Association, which has joined itself to certain other parties outside of the Association, by authority, that is to say, has got authority to confer with them and arrange certain rules—that our Committee be directed and instructed to report to us independently a set of rules for our consideration, which we will pass and then recommend to users of electric apparatus throughout the country and to insurance people. That is the substance of Dr. Mason's motion.

Mr. Storke—I call for the question.

Mr. Duncan—I gave way to the gentleman on my right Mr. Cutter) to answer a question.

The President—Mr. Duncan has the floor.

Mr. Duncan—I am very glad to know that we have a Committee and that the Committee has performed its work, and I believe they have done it well (applause), and while I thank that Committee for working so disinterestedly, not having any standing in this Association, at the same time I cannot refrain from remarking that it seems rather remarkable that on an issue which is so important to electric lighting and central stations, and in which such a large amount of capital is invested, that the Committee should report and yet have no standing practically in this body. It is for that reason, this discussion having gone on from one point to another and having brought that out, that I shall support the motion of Dr. Mason to put this in the hands of a Committee of this body, so that we shall be responsible for it and approve it or we will not. Is that Mr. Seely's amendment? As I understand it that is for the anpointment of a Committee of this Association who shall make independent rules and submit them to us for approval or disapproval.

The President—Mr. Seeley's amendment was to create a new Committee and direct them to report. The point of order was raised that it would be necessary to move a discharge of the old Committee first. The Chair sustained that point of order. The motion now is to instruct those gentlemen who are named as our Committee, to report to us at the next Convention, a set of rules.

Mr. Alexander—I want to say to the President that the old Committee, under the resolution is a Committee for harmonizing the electrical and insurance interests; and the amendment is for a new Committee to form rules.

The President—The one is the title of the Committee; the other is the substance of the resolution. The substance of that resolution was that you should report a set of rules. I have it right here. The substance of that resolution was rules, all the way through; that is the one thing.

Mr. George Cutter, of Chicago, presented the following resolutions, which were unanimously adopted:

"WHEREAS, It seems desirable that underwriters' rules governing the installation of electrical apparatus for light and power, should be the same throughout the country, and that they should be as plain and concise as would be consistent with their efficiency, and

"WHEREAS, In order to secure the formulation and adoption of such rules, it seems necessary that the authority be vested in a Committee composed of representatives of all parties interested; therefore, be it

"*Resolved*, That the Chair select and appoint a Committee of five members of the National Electrical Light Association, who shall have power to chose three representative electrical men to act on a Committee for the purpose of devising and adopting national insurance rules and considering any other matters affecting the joint interests of Insurance and Electrical Companies; and be it further

"*Resolved*, That the Committee of five be requested and authorized to negotiate with the various general insurance organizations throughout the country, with a view to securing the appointment by them of representatives on a national electrical committee, and that the Committee of five report the result of its deliberations and actions at the next meeting of this Association."

I think there can be no question about the authority of this Association to control that Committee.

Mr. Barton—Mr. President, I think I know something about that resolution that was passed, and if this Committee which Mr. Cutter is the Chairman of has not fulfilled its duty and made its report to the Convention, then I don't know what the fulfilling of a duty of a Committee is. I don't think you will find, Mr. Chairman, in that resolution anything requesting or directing that Committee to bring in a set of rules. It was authorized to confer with the representative insurance men with a view to negotiating or agreeing upon a set of rules that should be unanimous and should be operative throughout the country. I have had the pleasure, and perhaps I may say the discomfort of serving on that Committee for the last three days, including Sunday, and I know that we have accomplished excellent work. We have had an excellent representation of insurance men. Mr. Cutter has called about him an excellent representation of electrical men, covering all of the interests. That Committee has gone to work; it has labored day and night, and far into the night, on questions of rules without any lack of harmony whatever; it has been perfectly harmonious from beginning to end. It has almost completed its labors. If we could be allowed two or three days more, if the insurance and other representatives could have stayed here, we could have had rules reported to you. My idea is that we have no right to report rules here. I should be dead opposed to reporting any set of rules to this Convention. What can this Convention do with a set of rules? I think you will all agree with me that it is not a comfortable position to be in the soup, but I am free to say we would be there if we brought a set of electrical insurance rules into this Convention. Who would know where we stood? We would be a great deal worse than Pandemonium or Bedlam, or anything else.

Mr. Cutter—Would we not have to refer those rules to the same insurance that have met us?

Mr. Barton—I will speak on that a little later on. My friend, Dr. Mason, is level-headed. I agree with him in almost everything that he says. The only reason that he makes a mistake now is because he don't thoroughly understand; because he has not been in session with this Committee all these days; if he had he would agree with us.

Mr. Mason—I am sorry for myself.

Mr. Barton—I am glad for you and sorry for myself. I believe in independence as much as anybody else. I believe if the electric lighting interests had had it in their power in the beginning to have made their own rules, to have abided by their own rules, to have gone on doing good work in accordance with good rules, irrespective of the insurance interests, absolutely ignoring them, it would have been far better for them; but they did not do it in the beginning. I further say that this National Electric Light Association can never enforce any rules. If it had representatives from all of the people who are installing electric lighting apparatus; if every local company, every central station in the United States, or a large majority of them even, were represented in this National Electric Light Association, firm believers in it and supporters of it, then I would say with Dr. Mason, have your own rules and let the insurance companies do what they please; make rules that are right and fair and safe, and such rules as you want, and enforce them, and you will be all right. But unfortunately that is not the condition of affairs If you make rules how much of them can you enforce? When it comes down to a matter of fact, the only way you can enforce rules, in the competition that is so fierce all over the country, is by the pressure brought to bear from the insurance interests, and no other. It is the only way that any set of rules, any set of requirements or restrictions can be enforced; it is through the pressure that is brought to bear by the insurance interests; and why? Simply because their interests are identical, and are brought right in; not because it is a work of love on their part, or charity, but because it is dollars and cents with them. I am free to confess it is not so serious a question as some of them believe, because I myself am not a believer in the danger of electric lighting, even with poor work, as some people are; but it still remains that no rules can be enforced without the support of the insurance interests. Now then, this Committee that Mr. Cutter represents is nothing but the outgrowth, the continuation of a Committee formed because there was a threatened disruption between the insurance and electrical interests; and that Committee's name signifies that it was a Committee for harmonizing insurance and electric interests. My friend, Alexander was the Chairman of it, and he did noble work and harmonized the interests. In perpetuation of that thing, in carrying it on, and in order to do better work, another Committee was appointed, of which Mr. Cutter was Chairman, and that Committee has gone on disinterestedly and has equally done good work. It has gotten together, as I said before, these insurance men; and as Professor Barrett has said, it has brought inspectors that have a national reputation, inspectors that are not influenced either one way or the other, except by the one desire to see good work done; and the result will be a perfect set of rules, and those rules will be in operation before your next Convention comes, and you will be feeling the good results of them; they will be offered to you then and you will be asked to adopt them; and I venture the statement that you will do it without any objection.

The President—Do I understand the speaker to say that they propose to have them in force before they present them to the Association at all?

Mr. Barton—They will be worked upon; there isn't any doubt about that. Any good rules will be worked upon; and this Association and no other association can prevent it if they are good rules. If they are right they are bound to be adhered to by those in the business who are determined to do good work. It does not matter whether they get approval or disapproval; if they are right and proper rules they are going to have the support not only of the insurance men but of the electrical interests; and they are going right on. And then, I am sorry to disagree with my friend Dr. Mason and also with my friend Mr. Seely. It will be a mis-

take if you appoint any other Committee; if you set about to form any rules of your own, after having appointed a Committee for the very purpose, and that Committee having done its work faithfully and fairly, and reported to you its progress and asked you for more time—not unreasonable things at all; it has done everything that it was asked to do, namely, to report what it had done at your next meeting; not to report rules; you can find nothing in that resolution asking them to report rules to you. I had something to do with the drawing of the resolution and I don't think I ever have suggested reporting any rules to the Convention, because a Convention like this is no place to consider rules of insurance.

Mr. Mason—Do you say they will be presented to us at the next meeting?

Mr. Barton—Yes, they will be presented, and you will be asked to receive them and adopt them. As I have said before, I venture the prediction that you will adopt them. I think the whole thing is stirred up without any necessity at all. The Committee has done its work, has done it well, and you can ask no more; and I trust Mr. Seely will withdraw his motion and that Dr. Mason will do the same.

Mr. Mason—I think the whole object of my resolution has been achieved and I think I shall voice the sense of the whole meeting if I simply do what I now propose to do. I move that this whole subject be laid upon the table. I think we understand each other and I think everything will move on as we want it to now. I move that the whole matter lay on the table.

Mr. Storke—I understand that will be accomplished by the withdrawal of the motion.

Mr. Mason—I cannot withdraw it without unanimous leave. If I move to lay it on the table the matter is not debatable, and it will be seconded I understand.

The motion to lay on the table, being duly seconded, was carried.

The President—The next thing in the order of business will be the consideration of the subject of the proper classification of the lighting power of incandescent lamps; and the discussion will be opened by Dr. Louis Bell, of New York.

Dr. Bell—I have raised this question for the consideration of the National Electric Light Association because it seemed to me a very curious thing that the whole subject of the classification of electric lights has not been more thoroughly gone into at previous meetings, and that there is now no general accord either in the classification of incandescent lamps as regards their light giving power, or the methods in which that light giving power shall be measured. It is rather a singular thing that light should be one of the most difficult things to measure absolutely that we have—not difficult to measure relatively, except in certain cases which we are unfortunately too familiar; but it is exceedingly hard to find anything like an absolute standard of light. The last desperate effort of the Convention in this direction only resulted in perhaps as impracticable a standard as was ever brought before the consideration of a scientific body. The question of classifying electric lamps is coming to be rather an interesting one, and one that is of importance to those who supply the lamps. We have various sizes and sorts of incandescent lamps, of all sorts of nominal incandescent candle powers, the most usual in this country being the sixteen candle power lamps, but is there any common accord as to what is meant by a sixteen candle power lamp? I think not. And when the matter comes to be tested we find that it is not so. Of the various lamps which are now in use, rated at sixteen candle power nominally, some of them give the full candle power called for by their names, others give ten, twelve, fourteen or fifteen; and some of them give more than the rated candle power, while others give more or less than sixteen candle power according as to the method of measuring which is used. We do not know at first sight whether it is fair to say that a lamp is sixteen candle power when its mean horizontal intensity reaches that figure, or when its spherical intensity reaches that figure, or when its hemispherical intensity reaches that figure. That whole question is open, and certainly ought to come under consideration by this body. Then again, suppose we take one of those particular candle powers to be the standard; for instance, suppose that we take the horizontal candle power, which is perhaps the easiest to measure. Are we then in any better position? It might seem so at first, but a moment's consideration will show that the size, or rather the shape of the carbon filament has a very important bearing on the distribution of the light, and that consequently a light which gives in any one direction sixteen candle power may give considerable less in any other direction. Again, if we attempt to fix a standard direction, as for instance a direction normal to the plane of the filament for measuring the candle power we again get into trouble, for the reason that while the filament of a circular section gives a nearly equal distribution of light, a rectangular filament necessarily, theoretically and practically, gives an unequal distribution, the maximum intensity being at forty-five degrees off of the plane of the filament, or thereabouts. So that looking at it in any way we like we find that when we are speaking of a sixteen candle power lamp, we may or may not mean the same thing.

With the arc lamp we unfortunately know that the case is even worse, for instead of having an approximately equal intensity throughout an equal range around the lamp, we have a maximum in a zone perhaps twenty degrees wide, and deflected forty-five degrees below the horizontal plane of the arc. Furthermore, we know only too well that the normal candle powers of arc lamps are quite different from the real. The whole subject is in a tangle which at first seems almost hopeless. Heretofore it has not been specially important in the early stages of electric lighting, because people did not look so closely then into the exact conditions under which the light which they purchased shall be given; but as the electric lighting business comes more and more down to close competition and hard commercial lines it becomes more and more necessary to look after those things, and to define just what we mean by the lights which we contract to furnish, and to arrange some way by which there shall be general consent as to the meaning of the terms which we use. I am happy to say that, as most of you know, the practice abroad tends towards something quite different from the candle power measurement. It tends towards the selling of electric energy by watts even when it is furnished as light—the kilo-watt hour being the British Board of Trade unit—and it is a question which I think we should take up, whether it is not perhaps advisable to classify by watts, a quantity which can be measured with the greatest ease, instead of by candle power, a quantity which is only measured with extreme difficulty. I pass over for the time being the difficulties in actual photometric measurement depending upon the difference in color, as they are subsidiary; but the great question seems to be to find some one definite thing which we can all agree to call a lamp of a certain size, whether it be sixteen candle power or sixteen watts, or whatever you please to call it. Of course certain objections to the watt classification instantly arise, and among them is the possibility that it may tend to develop a type of lamp which will not be quite as efficient as those which are now generally used. That, of course, is simply a possibility, but it is one of the things that we want to bear in mind, for, objectionable as candle power may be, it is not well for us to be blind to the difficulties that come up with any other form of measurement. I desire to bring this subject prominently before the National Electric Light Association, because it is one in which I have felt a great deal of interest, and which I have had occasion to study somewhat, although perhaps more from the scientific side, in the matter of photometry. I believe it is a subject which calls for action on the part of the Association as a body, because I think the time is coming, and is in fact now here, when some such definite standard of measurement is needed and should be had; and this is the only body that has the power to make and to enforce any classification of light which may seem desirable after a consideration of the whole subject. I think that it is a case for action by the Association, and that it should take measures that shall lift us out of the very puzzling difficulty into which we have fallen simply through negligence, and through no fault or intent to deceive, but simply because the whole matter has been allowed to slide, and everybody has gone on in his own particular way instead of having, as we must soon have, something definite, something exact, something perhaps not scientific, but something which shall be at least emphatically definite. (Applause.)

Mr. Garratt—It must be a matter of pleasure to all of us to have this subject brought before the convention. There certainly is no one thing which has caused so much aggravation to the soul of the average electrician as the effort to find some basis on which you can talk about the candle power of lamps. The trouble with trying to establish in America a practice similar to that of the Board of Trade in London is the fact, which we might as well recognize, that the National Electric Light Association cannot enforce anything. Some years ago I made no less than five hundred thousand figures for this Association to enable it (I was requested so to do) to measure wires I made enough figures to reach from the City of Boston to the City of Providence. But, after having made these figures, and after they had met the approval of a majority of the members, we found that we were totally incapable of making anybody use them. Now, there certainly can be nothing better—or at least it is the opinion in England, and I think it is of the majority of men in America—there is certainly nothing better for the unit of incandescent lamps than the kilo-watt hour, provided there is proper precaution taken that the makers be not led to turn out a lamp which may possibly not be as efficient as the customer ought to have. Taking the kilo-watt hour as the unit of energy for each lamp, and fixing the length of the light of the lamp, seem to tie up our friends, the lamp makers, pretty tight with regard to what we should call a ten, a sixteen, or a twenty candle power lamp. It is quite impossible to make the purchaser of the lamp, the householder, ever talk about kilo-watt hours. They will purchase what they know as a candle power lamp. But this Association might very properly suggest to the manufacturers of lamps that a sixteen candle power lamp, or a twenty candle power lamp should absorb so many watts; and the unit of charge to the customer might be based upon watts as against hours. That might perhaps be best brought before us in proper form by the action of a small committee who could bring the subject before the next meeting of this Association in a paper, and if it is satisfactory to the body it might then be recommended to the lamp manufacturers. It is a thing which I do not think the general public will do very much with; and I do not see that it is a thing which the National Association can very well enforce. But I am positive that the kilo-watt hour would meet the approval of all the electric light fraternity in the country.

Mr. Alexander—Not many years ago I attended a lecture given by a gentleman on incandescent lamps. He was a very learned man indeed. He told us all about incandescent lamps; and in fact he made one statement—and it is that particular statement that I want to allude to—that in order to give a certain efficiency to a lamp the carbon should be of a certain structure, the carbon filament should be of a certain structure, and should be .9188 of a millimetre in thickness. I was talking about it with a gentleman who was very much interested in the subject; and he illustrated several facts with a great many equations, like $Y Z = D^2 \times X$; and he had it all printed for the edification of his hearers, and I had it in my hand, and looked at it hopelessly and put it in my pocket. I commenced to say that when he mentioned that the carbon filament should be .9188 of a millimetre in thickness I was reminded of my youthful days, when a man was pointed out to me who was quite a genius; and that gentleman had a grease spot on his coat, and he immediately went to studying chemistry to see by what means he could get that grease spot out of that coat without injuring the texture of the fabric; and he studied day and night for two years, until he finally got it; but when he got it the coat was all to pieces, and he could not wear it. It is not a scientific lamp or a laboratory lamp that you want; it is a commercial lamp for every day use. When Dr. Bell brought up this subject (which is certainly a very interesting one) I thought at first, why don't you speak about the candle power efficiency of the arc lamp? There is certainly much more variation between the so-called two thousand candle power arc lamp, and its actual power, than there is of the incandescent. I recollect a measurement made three or four years ago by which it appeared that a two thousand candle power arc lamp varied from 134 to 1,386 candles, according to the measurements made then; but still they were all called 2,000 candle power lamps.

The President—I shall have to call the gentleman's attention to the fact that we are discussing incandescent lamps.

Mr Alexander—I am coming to that directly.

The President—I hope you will come to that at once. and stay there.

Mr. Alexander—I only want to ask why you do not measure your arc lamp by watts, and why you measure your incandescent lamp by watts. The efficiency of the lamp to the consumer is of the greatest value only in some cases. If I have a water power to run my central station, as the power does not amount to anything, I do not want an efficient lamp, but I want a long lived lamp; but when I use coal at five dollars per ton I want a very efficient lamp. It is a fact that I have had from one railroad company a letter in which they asked for a very efficient lamp, because it cost them more to move their storage battery in and out of the car than the breaking of the lamp amount to. They have, by figures, furnished by their electrician, shown that a very short lived lamp, say a lamp that lasts them but one hundred hours, is cheaper than one which lasts them six hundred hours but needs a great deal of current.

In measuring lamps, Dr. Bell has no idea but that we can measure a lamp very carefully and nicely, and then put it in as an actual sixteen candle-power lamp, but when he will consider that in manufacturing, three little girls who are paid from four to seven and a half dollars per week, have to measure from two thousand to twenty-five hundred lamps on a photometer per day, he will see that a commercial lamp has to be made at a price that the central station would not want to pay if every lamp was figured right down to the one-hundredth or one-tenth of a candle-power. It is impossible to do it. In the lamp with the twisted filament, as you know, the light can be measured upright, and you get an equal diffusion of light; while in another lamp you would have to make of course two measurements; and the mean measurement of those two ought to be sufficient, and come near enough to the actual measurement of the other lamp with the twisted filament to off-set any commercial destruction. This matter having been brought up in this way I thought that I ought to explain the difference between the laboratory lamp and the commercial lamp with some care.

Mr. Bell—I am not speaking of the laboratory lamp at all. I am speaking of the practical commercial lamp with which we are to deal I am not asking Mr. Alexander nor any one else to make a lamp which shall have exactly one hundred candle power; I only wish to have our incandescent lamps certainly classified within twenty-five per cent. of their proper value. We do not have to see far to find lamps put out on the market as sixteen candle lamps which do not give efficiently thirteen candle power. That is the kind of inefficiency I am talking about, and not about any question of measuring the hundredths of candle-power. What do we care about hundredths of candle power, or what do we care about a difference of one-half a candle-power in different directions? If the difference rises, as it sometimes does, to be four or five candle-power in different directions, then it is something that we ought to take cognizance of. I am not speaking of laboratory tests, or of laboratory lamps; I am speaking only of practical commercial incandescent lamps. The question of arc lamps I felt tempted not to touch upon for the reason that we have not been in the habit of measuring those any where in the world by the watt. The incandescent lamp is supplied frequently by metre, and that is what brings the matter of classification into special importance. We all know very well that the arc lamp is a great sinner in the matter of the distribution of light, and in the difference between theoretical and practical efficiency; but at the same time we ordinarily do not measure the power supplied to arc lamps, in watts, as is getting to be somewhat the custom as to incandescent lamps. I should certainly be in favor of including the arc lamp in any action which the association might take on this question. I am not here to malign the incandescent lamp. I think it is a matter of wonder that the incandescent lamp is as generally efficient and successful as it is; but I think the time is coming when we ought to come to some definite conclusion as to what we mean when we say that a lamp is a sixteen candle-power lamp,

and sell it for such, knowing, as I do, that the lamps now in the market known as sixteen candle power vary rather more largely than even the conditions of commercial service make desirable.

Mr. Alexander—May I just say that I consider that when a lamp is sold as a sixteen candle power light and gives but thirteen candles, it is a dishonest thing; as to the other question about selling efficient lamps, that is your business. I saw in New York City the other day bills which were made out of watts, which I considered a very proper thing to do.

The President—I was in conference with a young man representing a lamp concern, and the question came up as to the price and efficiency of lamps, and he said: "It is altogether a question for us whether you sell by metre or by contract. If you are going to sell by metre and your customer pays for the lamp, we will give you an inefficient lamp so that the bill will pile right up on him; but if you are going to sell by contract, we will give you a very much more efficient lamp, and you can furnish a lamp that will be much more efficient and you can make the same money." That shows that the young man who represented the lamp understood how to meet the demands of business.

Mr. Storke—Will not that be a matter for the executive session? (Laughter.)

The President—In making a test of the lamps of six different makers I found that the variation in sixteen candle power incandescent lamps is much more extreme than would be called a fair ordinary commercial average. I found that in two lamps the variation was from 17.25 candles to as low as 6.42 candles; and the watts per candle varied from 3.13 to 8.2 watts per candle.

Mr. Garratt—Were these all new lamps?

The President—They were all new lamps.

Mr. Alexander—That is a subject that I am interested in; and I want to say that a lamp that will measure at the start twelve or thirteen candle power, after two hundred hours will likely give more light than a lamp which measures seventeen candle power at the start. All these matters have to be considered. If I desired to measure and to make an actual test I would measure the lamp after fifteen hours burning, and then I would get a good result.

The President— We are now going through with tests and measuring every twenty-five hours. I will say, however, that a lamp which gave 17.25 candles was the lamp which at the end of 1,000 hours showed the least blackening of any lamp we had, but unfortunately it was not as efficient as I would like to have them.

Mr Garratt—Yes; but it is simply to consider the best methods by which we shall talk to our customers, so that when they say, "What do you mean when you talk about a sixteen candle power lamp?" we shall be prepared to answer them. I do not think that we are prepared to answer that question now

Mr. DeCamp—Do you mean that is the best method of determining what a sixteen candle power lamp is?

Mr. Garratt—No; I am not going into the subject of photometry at all; that is not my intention.

Mr. DeCamp—What is the best method of determining what constitutes a sixteen candle power lamp? Is that your intention?

After some further discussion it was moved and seconded that a Committee be appointed by the Chair to report at the next meeting of the Convention the result of their investigations and their conclusions as to the proper classification of the lighting power of incandescent lamps.

The motion was carried, and the President stated that he would name the Committee later.

The Secretary then on behalf of the Reception Committee announced the programme of entertainment during the hours of leisure, after which the meeting adjourned until Wednesday, August 20th, at 10 A. M.

THIRD SESSION.

The Association met pursuant to adjournment, Wednesday, August 20th, 1890, at 10 A. M.

The President—The first matter to be considered this morning in the order of business is the report of the Committee on Patent Legislation, of which Mr. Arthur Stewart is Chairman.

Mr. Wilmerding—There does not seem to be any member of the Committee here, and I move that the Committee be discharged. They have not made a report for two or three meetings, as I understand, and I think we might as well give it np.

The motion was carried.

The President—Next is the report of the Committee on Legislation, Mr. C. H. Wilmerding, Chairman.

Mr. Wilmerding read the following report:

REPORT OF THE NATIONAL COMMITTEE ON LEGISLATION, TWELFTH CONVENTION.

MEMBERS OF THE COMMITTEE.

ALLEN R. FOOTE, Chairman.

Alabama.	
Arkansas.	
California.	George H. Roe.
Colorado.	C. H. Smith.
Connecticut.	John C. English.
Delaware.	
District of Columbia.	George C. Maynard.
Florida.	
Georgia.	H. E. W. Palmer.
Illinois.	C. H. Wilmerding.
Indiana.	John Caven.
Iowa.	
Kansas.	L. A. Beebe.
Kentucky.	A. H. Barret.
Louisana.	
Maine.	William R. Wood.
Maryland.	J. F. Morrison.
Massachusetts.	F. A. Gilbert.
Michigan.	J. E. Lockwood.
Minnesota.	
Mississippi.	
Missouri.	Joseph A. Corby.
Montana.	
Nebraska.	
Nevada.	
New Hampshire.	Alonzo Elliott.
New Jersey.	Henry W. Pope.
New York.	E. A. Maher.
North Carolina.	D. A. Tompkins.
North Dakota.	Vincent S. Stone.
Ohio.	Charles R. Faben, Jr.
Oregon.	P. F. Morey.
Pennsylvania.	A. J. De Camp.
Rhode Island.	Marsden J. Perry.
South Carolina.	George B. Edwards.
South Dakota.	
Tennessee.	
Texas.	
Vermont.	M. J. Francisco.
Virginia.	
West Virginia.	John B. Carden.
Wisconsin.	S. S. Badger.
Washington.	

At the Eleventh Convention this committee was instructed "to report for the action of the next convention, such changes in the Constitution as will, in its opinion, best provide for the membership and representation of State Associations in the National Association" (Volume VIII., page 249).

After this action had been taken, the Convention raised a special committee charged with the duty of making a general revision of the Constitution of this Association. In view of this, this committee has considered itself discharged from further consideration of the subject.

By action of the Eleventh Convention, this committee was instructed "to co-operate with the New York State Association in securing such an amendment to the Execution Law of that State as to require a special apparatus to be devised for that purpose, that shall generate a current of not less than 10,000 volts" (Volume VIII., Page 248).

No request has been received from the New York State Association for such co-operation, and so far as this committee is informed, no effort was made during the last session of the Legislature of that State to so amend the law. In the light of the reports made regarding the experimental execution that has since taken place in that State, it is now probably as clear to the public as it has been to this committee, that if executions are to be made by the use of electric currents, the amendment to the execution law recommended by this Association at its Eleventh Convention is demanded by every humane and equitable consideration.

(a) To give practical effect to the "Memorial and Statement" presented to Congress in the name of this Association, by its President, which was presented in the United States Senate, by Senator Hale, on August 15th, and was referred to the Committee on the Census, and ordered printed. A member of this committee has prepared a bill, which was introduced in the Senate of the United States, August 15th, by Senator Hale. It was read twice and referred to the Committee on the Census.

This bill is as follows. Your committee recommend that the Association endorse this bill and urge its enactment, and that a resolution of thanks be tendered Senator Hale for his courteous and prompt action regarding this subject.

51st Congress—1st session, S. 4,329.

IN THE SENATE OF THE UNITED STATES.

August 15, 1890.

Mr. Hale (by request) introduced the following bill, which was read twice and referred to the Committee on Census.

A BILL

To amend an Act entitled "An Act to provide for taking the eleventh and subsequent censuses," approved March first, eighteen hundred and eighty-nine.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled.

That, for the purpose of rendering the investigation of the electrical industries by the eleventh census thorough and complete in every detail, the Superintendent of Census, under the direction of the Secretary of the Interior, is hereby authorized and directed to make such sub-divisions of the subject as may seem to him advisable, and to associate with the special agent now commissioned to investigate the manufacture of electrical apparatus and supplies and their uses, as special expert, the ablest person whose services can be secured to write the statement for each sub-division so made, subject to the supervision of said special agent; and the sum of fifty thousand dollars or so much thereof as may be necessary, is hereby appropriated, out of any money in the treasury not otherwise appropriated.

During the legislative season of 1889-1890, comparatively few State Legislatures were in session. During the coming Legislative season 1890-1891, a large number of State Legislatures will be in session.

If legislation touching electrical interests proves as attractive to the coming legislatures as it was to those that have recently been in session there will exist an exciting cause, cause sufficiently urgent to fuse all central station companies in every State into a compact organization for the protection of their mutual interests.

That ill-advised legislation will be met with in every State admits of no doubt. So long as would-be law-creators think it a factor of popularity to show in their legislative records that they introduce bills or advocated measures that are intended to be, or are in fact, antagonistic to the practical development of the electrical industries, such things will be done; or, so long as persons interested in patented apparatus and systems, think they can gain a commercial advantage for such interests through legislative enactments, they will seek to secure such enactments regardless of their effect on electrical interests in general.

That those interested in the electrical industries in each state will be thoroughly organized and equipped to meet the emergencies that will be thrust upon them, is very much in doubt. There is no sense of security equal to ignorance of danger. For those who are ignorant of a danger it has no existence. This we fear is the condition of most central station companies in this country, regarding impending dangers from legislation. In view of this, the greatest service that may now be performed is to so state the threatening dangers that they can no longer remain in ignorance of them. To do this then is no need to speak of unreal things that are but creations of imagination. Sufficient material for the purpose is found in the record of things that are.

To show the tendency and animus of thought of those intrusted with the responsibility of legislating for the good of the people, a critical analysis is asked for the following brief reports on the work done by the Legislatures of a number of States during the last season:

Connecticut.—(Senate Bill No. 4.) Chapter IX. An Act relating to Attachments and Judgment Liens.

Massachusetts.

No better presentation can be made of the subject for the State of Massachusetts than to present in full the following Report of the Counsel of Massachusetts Electric Lighting Association, made at its first annual meeting under date of July 8, 1890.

(For copy report see appendix. Also copy bills and reports.)

New Jersey.—February 12, 1890, a substitute for "Assembly, 113" was introduced by Committee on Municipal Corporations, "An act relating to electric telephone and telegraph wires and creating boards of electrical control in cities of the first and second class."

February 14, 1890, Assembly, No. 6. Introduced by Mr. Smith and referred to Committee on Corporations:

"An Act in relation to telegraph, telephonic and electric companies in cities of this State."

(For copies of these bills see appendix.)

New York.—January 21, 1890. In Assembly, No. 160. Introduced by Mr. Whipple, read once and referred to the Committee on Ways and Means:

"An Act to create a board of electrical commissioners and to define and regulate its powers and duties."

February 20, 1890. In Assembly, No. 598. Introduced by Mr. J. H. Stevens (by request) read once and referred to the Committee on Electricity, Gas and Water Supply:

"An Act authorizing water companies to manufacture and use electricity for the lighting of streets, public places and private buildings in cities, villages and towns within this State."

February 21, 1890. In Assembly, No. 629. Introduced by Mr. Whipple, read once and referred to the Committee on Electricity, Gas and Water Supply.

"An Act to protect life and prevent accidents in the use of high tension electric currents."

April 4, 1890. In Assembly, No. 1887. Introduced by Mr. Molan, read once and referred to the Committee on Electricity, Gas and Water Supply:

"An Act to create a State board of commissioners of electrica control and to define and regulate its powers and duties."

April 18, 1890, in Senate, No. 618. Introduced by Mr. Erwin, read twice and by unanimous consent ordered printed and when printed committed to the Committee on General Laws:

"An act to create a board of Electrical Commissioners and to define and regulate its powers and duties."

April 18, 1890, in Senate, No. 634. Introduced by Mr. Erwin, read twice and by unanimous consent ordered printed and when printed to be committed to the Committee on General Laws:—reported favorably from said Committee, with amendments, and committed to the Committee of the Whole:

"An act to create a State Board of Electrical Control and to define and regulate its power and duties."

(For copies of these bills, see appendix.)

In transmitting copies of these bills to the Chairman of this Committee, J. W. Eaton, Jr., Atty., of Albany. N. Y., writes as follows:

"None of these bills have become laws. I am of the opinion that an attempt will be made next year to rush through the Legislature a bill, combining most of the principal features of those sent you, unless some determined opposition develops in the meantime. I believe there is also a movement in favor of adding an electrical expert to the present railroad commission and putting the matter under their charge. There was no law of general interest affecting electric lighting passed this session."

Ohio.—The Legislature of this State was urged to action by the following highly electrified paragraph in the Inaugural Address of Governor Campbell:—(See reports in Daily Press, January 13, 1890.)

"The application of electricity is rapidly opening up new fields of legislation. Unless something be done to prevent the sacrifices of life daily resulting from the effect of electrical wires, the companies which put up and control them will have grown so rich and powerful that the passage and enforcement of proper laws will be difficult. Municipalities have attempted to enforce regulations for protection from such dangers, but without satisfactory results. The duty of investigating the generation and distribution of electrical currents is one which presses upon you. The investigation should be prompt and thorough; the result thereof made public; and such action taken as may, in your judgment, throttle this evil in its infancy."

The following bills were introduced into the Ohio Legislature at the last session:

"A bill concerning electric wires and circuits dangerous to life and property."

"A bill to authorize the construction of subways and underground conduits in which to place electric wire cables and other electrical conductors in cities, towns and villages of this State."

"A bill to regulate electric light companies so as to protect the public from accident and damage from the same."

"A bill relating to electrical conductors for electric lighting in cities of the first grade of the first class, and the removal of overhead wires."

Virginia.—Senate Bill No. 238. A bill for the prevention of danger from electric currents. Patron—Mr. Lovenstein. Referred to the Committee on General Laws.

While this report does not completely cover the ground, owing to difficulty experienced by this Committee in obtaining copies of bills and definite information regarding action taken on them, the showing is sufficient to demand attention from every one interested in the electrical industries, and will enable them to form some idea of the legislative work that is near at hand during the season of 1890-1891, when the Legislatures of some thirty-seven States will be in session.

This committee desires to call attention to the fact that all legislation is directed to the regulation of the use of the electrical apparatus, not to its manufacture and sale. This use includes all forms of apparatus, the telegraph and telephone, as well as the generation and transmission of electric currents for light

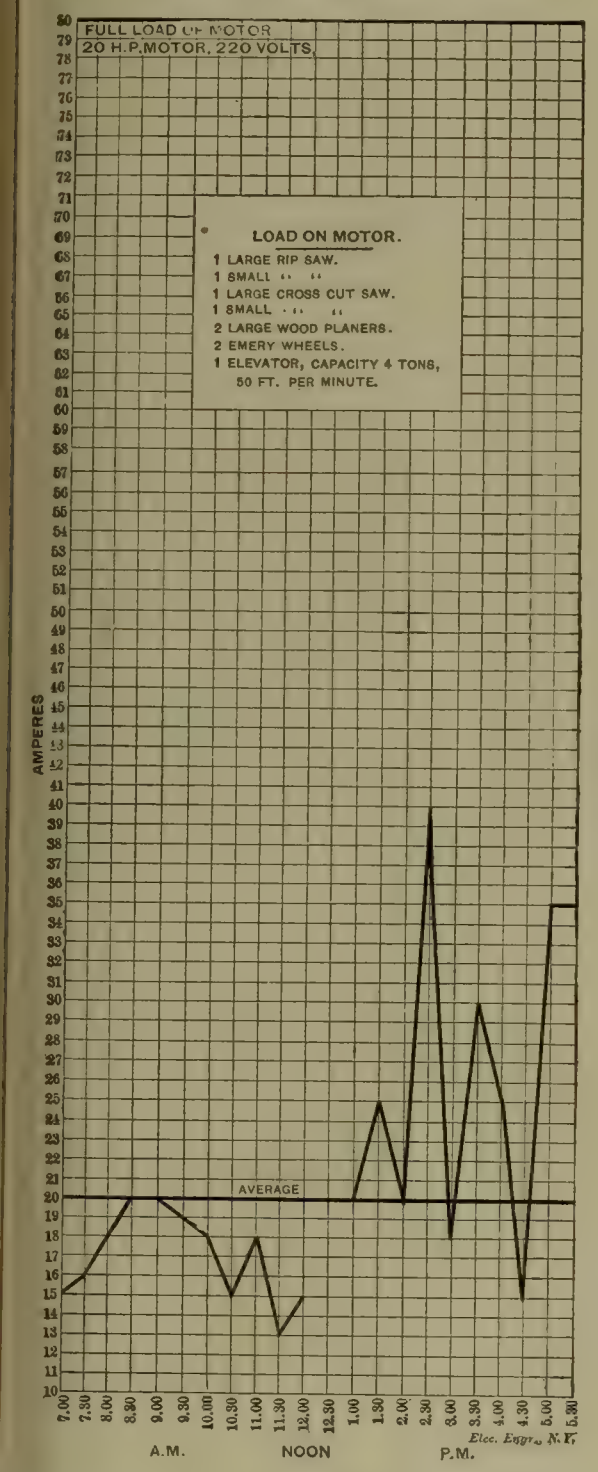
(*Continued on page 14*).

A PROPER BASIS FOR DETERMINING ELECTRO-MOTOR RATES.

BY H. L. LUFKIN.

The equitable adjustment of motor rates, or rather the rates per month, or year, for the supply of current for the operation of electric motors, has long been a matter of considerable annoyance to companies supplying electric power. It is obvious that to invariably charge the motor user an arbitrary rate per horse-power for the motor which he uses, based on its rated capacity, and regardless of the work it is doing, is not satisfactory for the reason that the manufacturer usually prefers to buy a motor somewhat more powerful than his work really requires and thus avoid the possible damage to his motor from overload, or the strain to which any piece of machinery is subjected when constantly operated above its normal working capacity. Again, the manufacturer may contemplate an increase in his plant in the near future, and, in buying a motor, will provide one of sufficient capacity to operate his prospective increase.

H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....25 per cent. of Rated Capacity.
Maximum Load.....50 per cent. of Rated Capacity.
Average Load.....50 per cent. of Maximum Load.
Shafting.....75 per cent. of Average Load.

No. 1.

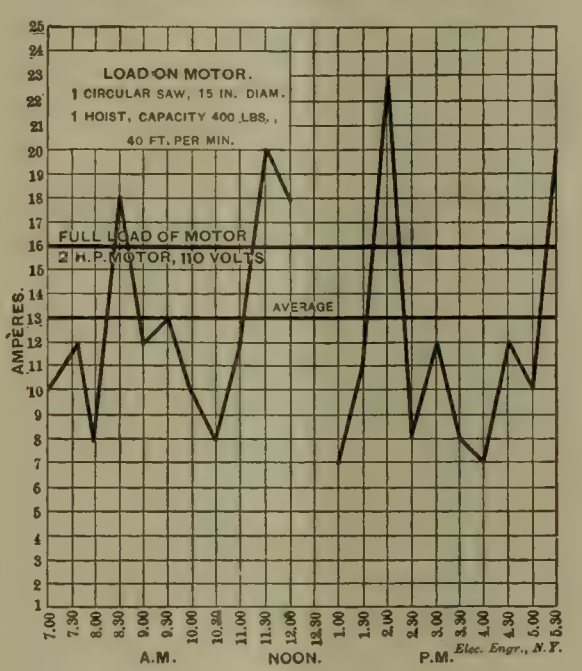
To illustrate graphically the practical operations of motors under load, I have taken a large number of records of motors in actual service and from these records have laid out ampere curves or daily load diagrams which will illustrate very clearly the fluctuations in the current supplied to motors in actual practice. Other interesting features of these curves are the maximum, minimum and average readings as related to each other; the current consumed in driving the shafting as related to the average current consumed; and the peculiarity of the records of motors operating elevators.

Copies of these load records are illustrated in the accompanying diagrams. The vertical lines of these charts, you will notice, represent hours of the day, and the horizontal lines, amperes. In making these records an ampere meter was placed in the circuit in series with the motor and each reading taken was dotted on the chart where the ampere line, corresponding with the reading taken, intersected the hour line corresponding with the time at which the reading was taken. By connecting these dots together by a continuous line we, of course, obtain the diagrams or curves shown.

The highest average use shown in any of the records is in diagram No. 2, with an average use of 81 per cent. of the capacity of the motor; this record also shows an overload of 44 per cent. at the 2 P. M. reading. Diagram No. 16 shows the lowest average, it being in this case but 24 per cent. of the capacity of the motor. A composite average of all these records shows that the average use of an electric motor is but 43.57 per cent. of its rated capacity.

It is a fact that many central stations which still use a "maximum or motor capacity system" of charges have adopted a schedule with the fact in view that where the motor is used for the usual run of intermittent work its average use is much below its capacity. The circumstances of motor use are, however, so varied that a system of rates or charges for power which shall better adapt itself to this wide range of conditions has already been adopted by many central stations, especially

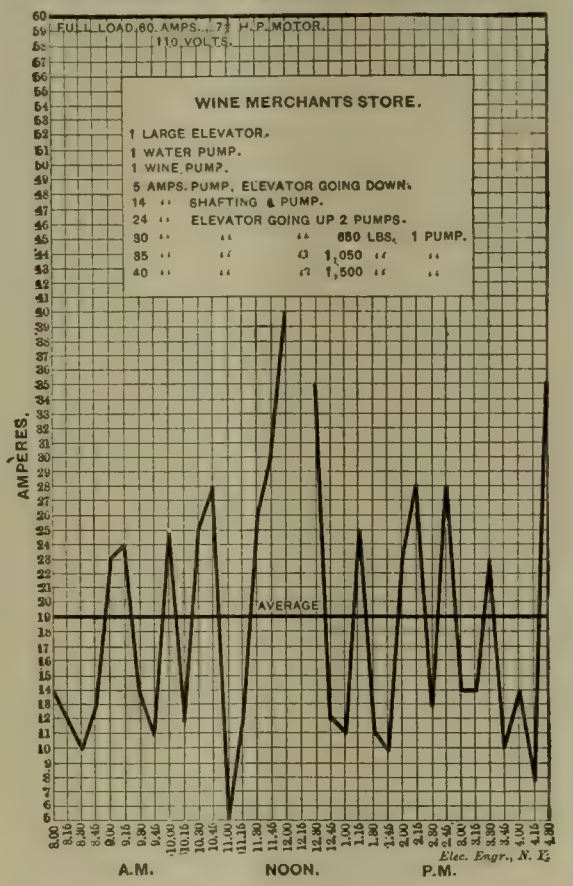
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....81 per cent. of Rated Capacity.
Maximum Load..... 44 per cent. in excess of Rated Capacity
Average Load.....51 per cent. of Maximum Load.
Shafting..... 55 per cent. of Average Load.

No. 2.

H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....32 per cent. of Rated Capacity.
Maximum Load..... .....67 per cent. of Rated Capacity.
Average Load.....47½ per cent. of Maximum Load.

No. 3.

those operating constant potential power circuits. This system of charges I will call the "maximum reading system," which is based on the maximum reading of an ampere meter in series with the motor. The station supplying the power reserves the right in their contract with the customer to change or modify the charge for power from time to time as any increase is shown by these readings.

To illustrate more clearly this "maximum reading system" I would refer to diagram No. 23, which is a fair average record. This represents the record of a 15 h. p. motor operating lithograph presses, etc., the maximum reading in this case being 75 amperes, or, approximately, 10 h. p. The user is given a 10 h. p. rate which in this case happens to be $60 per month, or at a rate of $6 per month per h. p. based on maximum readings. As the average power delivered to this user is but 67 per cent. of the maximum reading, the station actually receives at this nominal rate of $6 per h. p. an actual rate of $9 per month per h. p. for the power actually delivered.

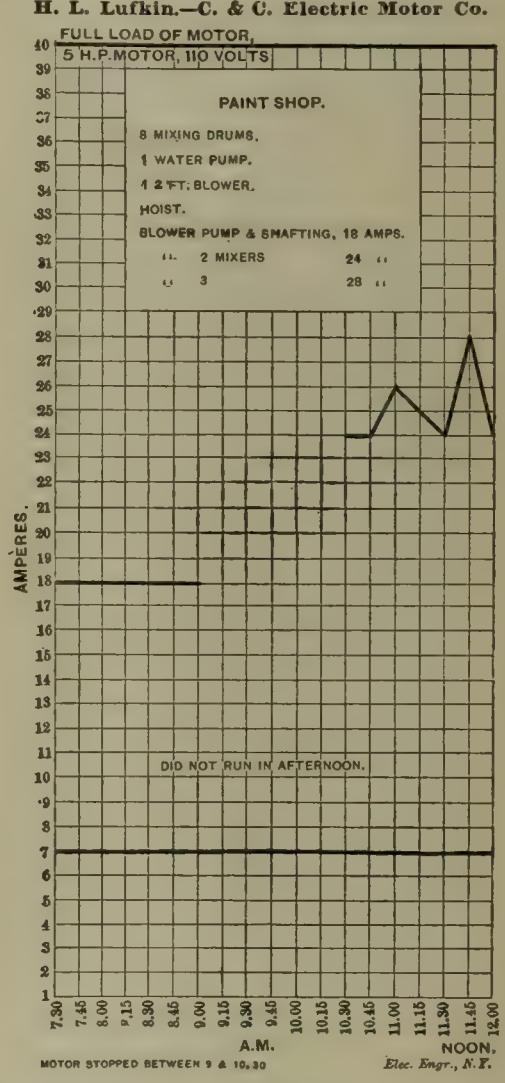
The central station supplying this particular motor has adopted the "maximum reading system," and this rate of $6 per month per h. p. is their standard charge for motors showing a reading of 4 h. p. and over and up to 15 h. p. From 15 h. p. up their charge is $5 per month per h. p. Their monthly bills are also subject to a discount of 5 per cent. I believe, if paid promptly on the first of each month.

To return again to the diagrams. The records, twenty-nine in number, are of so varied a character that an average taken from all the records, will, I think, show within 1 per cent. or 2 per cent. of the general average conditions found in electric motor practice. The conditions as shown by these records are as follows:

Average load on motor, 43.57 per cent. of its capacity.
Maximum load on motor, 68.24 per cent. of its capacity.
Average load on motor, 64 per cent. of maximum load.

Reducing these averages to dollars and cents we have the following results:

H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....17½ per cent. of Rated Capacity.
Maximum Load..... ....70 per cent. of Rated Capacity.
Average Load... .....25 per cent. of Maximum Load.
Shafting.... ....— per cent. of Average Load.

No. 4.

A "maximum capacity" rate of $6 per month per h. p. pays the station $13.80 per month per h. p. for the power actually delivered. A "maximum reading" rate of $6 per month per h. p. pays the station $9.37 per month per h. p. for the power actually delivered.

$13.80 per month per h. p. is certainly a tempting price for power, but it is open to some serious objections. In the first place, at this price the electric motor, even with its much higher efficiency, cannot compete with the gas engine. A good gas engine uses about 20 feet of gas per hour per h. p., or about 5,200 cubic feet per month. Giving gas at $1.50 per thousand (and in many places it is much lower than this), the gas engine will deliver power at a cost of $7.80 per month per h. p. We can, without much trouble, obtain the $9.37 rate per month for a motor in competition with the gas engine, on account of its many and obvious advantages, but we can seldom obtain the $13.80 rate. This maximum capacity rate also very much hampers the user in a selection of a motor, and the motor salesman, in order surely to affect a sale, is very apt to underrate the prospective load on the motor, as the customer is governed in his purchase of a machine much more by the monthly charge than by the first cost of the motor.

Another feature which must not be lost sight of is the fact that a motor user who has bought and paid for his machine becomes your permanent customer, his income being entirely derived from the product of the work of his motor. His bills for power you are also sure of collecting, for the moment his power is shut off

* Paper read before the National Electric Light Association, Cape May, N. J., August 19, 1890.

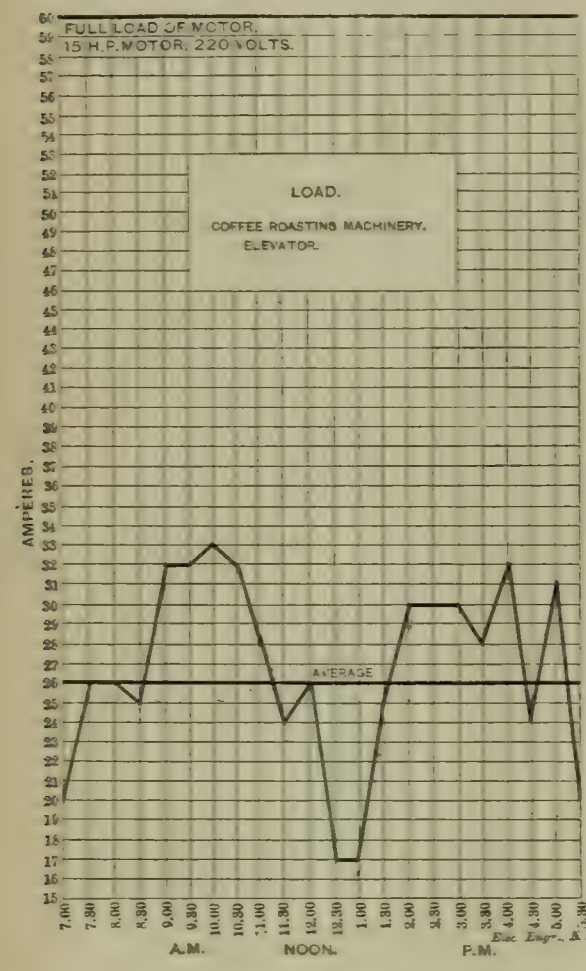
his earning capacity ceases. The motor becomes to him an absolute necessity instead of a seasonable luxury, as is the case with many electric lights.

Another very remarkable feature brought out by these diagrams is the fact that the average power consumed in doing serviceable work is but three-eighths of the total power used and the remaining five-eighths or 62½ per cent. is consumed in driving shafting. This enormous loss in shafting would indicate that the day may not be far distant when each machine will be equipped with its own direct-geared motor and that the days of shafting and belting are numbered.

As a concluding reference to these diagrams, let me call your attention to diagram No. 3, in which a condition presents itself with which you are familiar in theory, but which has, I believe, never before been practically illustrated, namely, the counter E. M.F. in the armature of a shunt wound motor driving a spur gear elevator. When the elevator is coming down with a load the counter E.M.F. runs above the E.M.F. of the supplying circuit, and therefore the motor becomes a producer instead of a consumer, and thus acts as a break to retard the too rapid descent of the elevator.

Diagram No. 3 represents the record of a 7½ h. p. motor in a wine merchant's store operating an elevator, a small piston water pump and wine pump. The water pump is in continuous operation, the wine pump and elevator being only used intermittently. The current consumed in the shafting and water pump, which constitute the continuous load, is 14 amperes. The difference between this 15 amperes and the several readings below that amount, shows the amount of current generated by the motor when the elevator is coming down. As this class

H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....43½ per cent. of Rated Capacity.
Maximum Load.....55 per cent. of Rated Capacity.
Average Load.....78 per cent. of Maximum Load.
Shafting.....65 per cent. of Average Load.

No. 5.

of elevator is largely used, this peculiar fact becomes an item of considerable importance to the central station, and is also a strong argument in favor of a constant potential power circuit, as only on this circuit can these conditions be obtained.

I had hoped to prepare some diagrams of motors on series or arc light circuits for comparison with the records here submitted, and thereby illustrate graphically the advantages of the constant potential circuit for power distribution. Want of time has, however, prevented this.

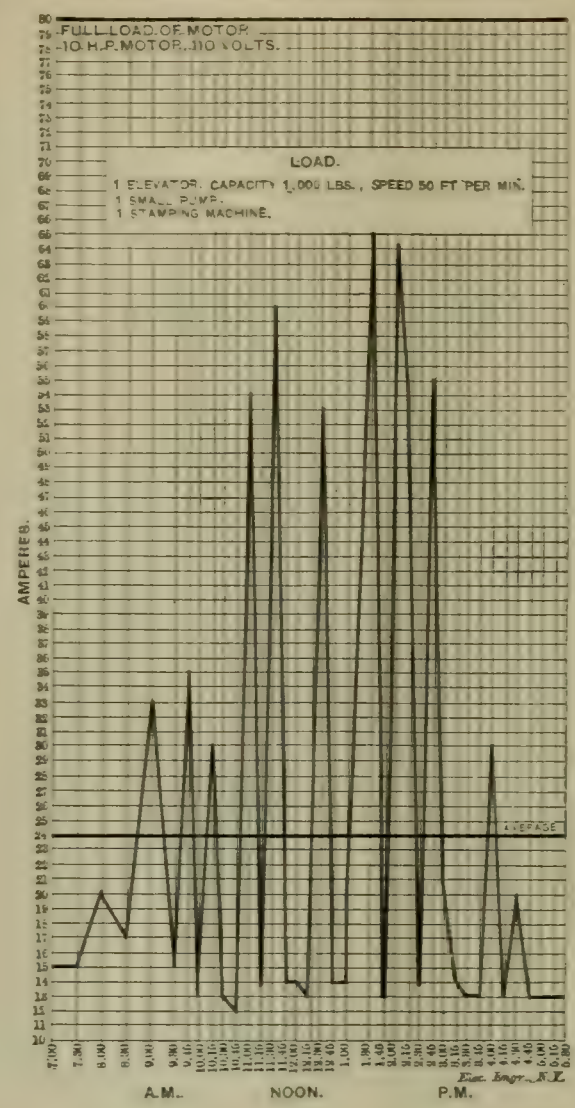
In conclusion let me read you some extracts from a letter received in March last from a prominent manufacturing corporation using 75 to 80 h. p. in motors in their work shops:

"We are running with one motor a large 4-ton Graves' elevator, and several wood-working machines, such as planers, cross-cut saws etc. In our machine department, the several motors run several lines of shafting, independent of each other. In this department we run heavy planers, lathes, drill presses, shapers, slotters, gear-cutters and other machinery necessary to a complete machine shop. A motor in our department for fine wood work furnishes power for various machines necessary to the manufacture of articles needing turning lathes, gig-saws, rip-saws, etc.

"In our experimental department and show room, we use a smaller motor, set with the necessary speed reducing pulleys and belts upon a movable frame. This we roll from place to place as convenience dictates. All of these motors are giving us unqualified satisfaction, and we would not willingly return to direct steam engine power."

This company is being supplied with power by the local electric light company, on a basis of $50 per year per h. p. based on maximum reading. The user is apparently delighted with his service and perfectly satisfied with the cost of his power, and I have the assurance of the electric light company supplying the power, that they would be glad to load their plant under the same terms given this customer.

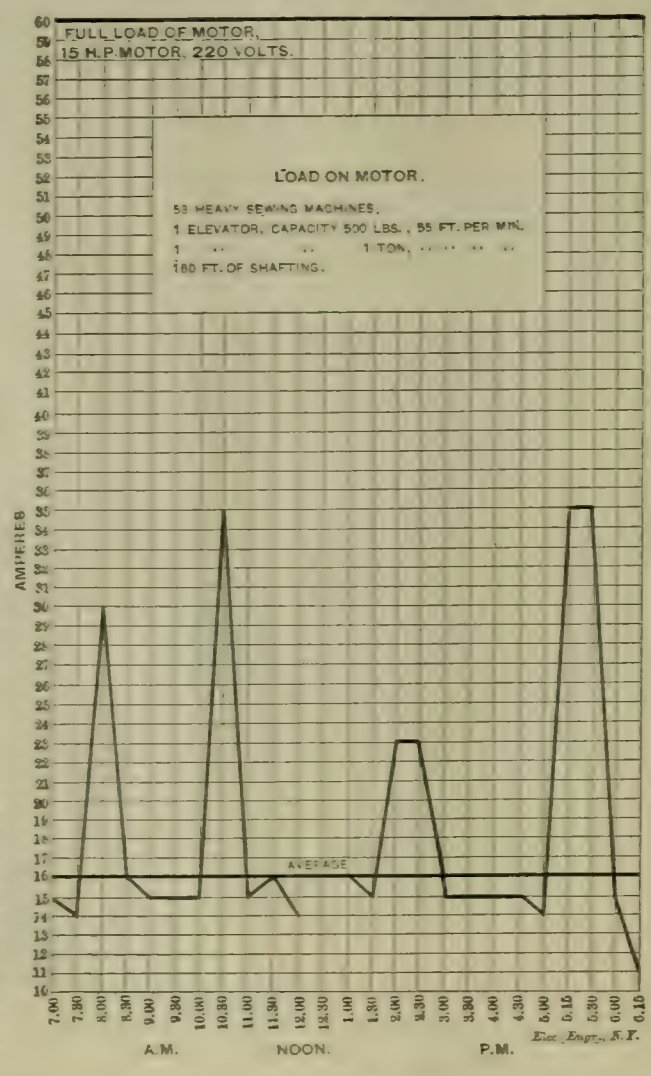
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....30 per cent. of Rated Capacity.
Maximum Load.....61 per cent. of Rated Capacity.
Average Load.....37 per cent. of Maximum Load.

No. 6.

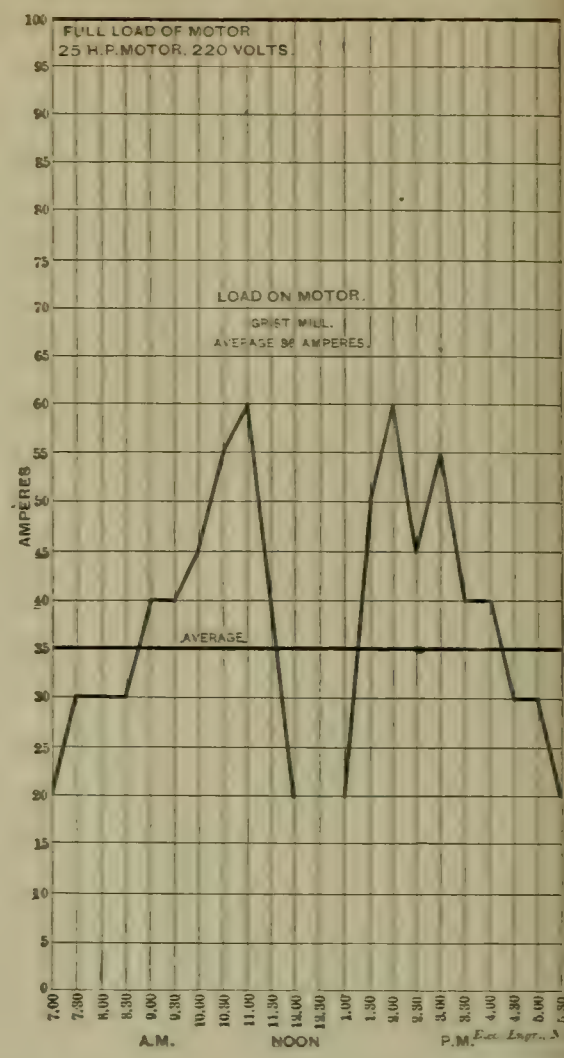
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....36 per cent. of Rated Capacity
Maximum Load.....58 per cent. of Rated Capacity.
Average Load.....46 per cent. of Maximum Load.
Shafting.....71 per cent. of Average Load.

No. 7.

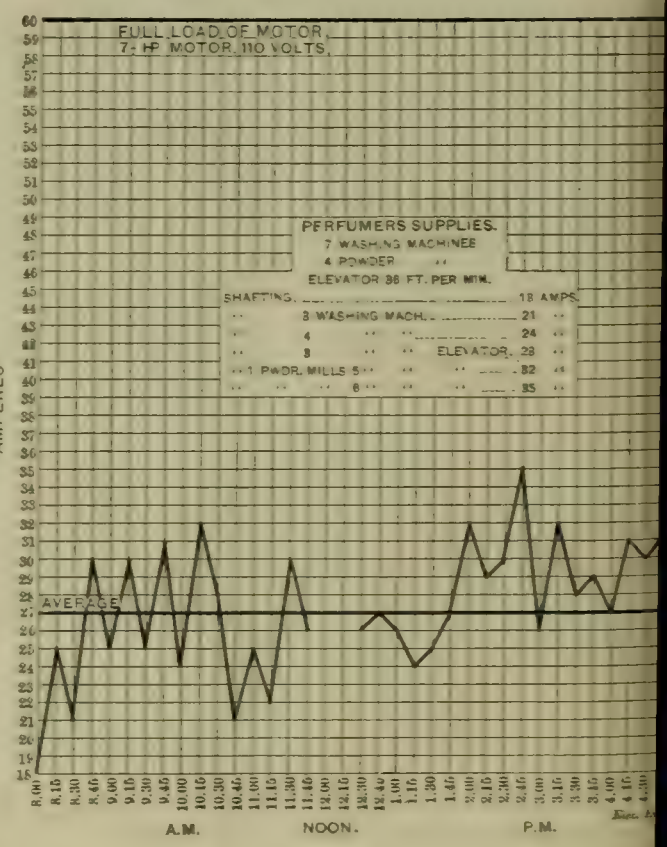
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....35 per cent. of Rated Capacity.
Maximum Load.....60 per cent. of Rated Capacity.
Average Load.....58 per cent. of Maximum Load.
Shafting.....58 per cent. of Average Load.

No. 8.

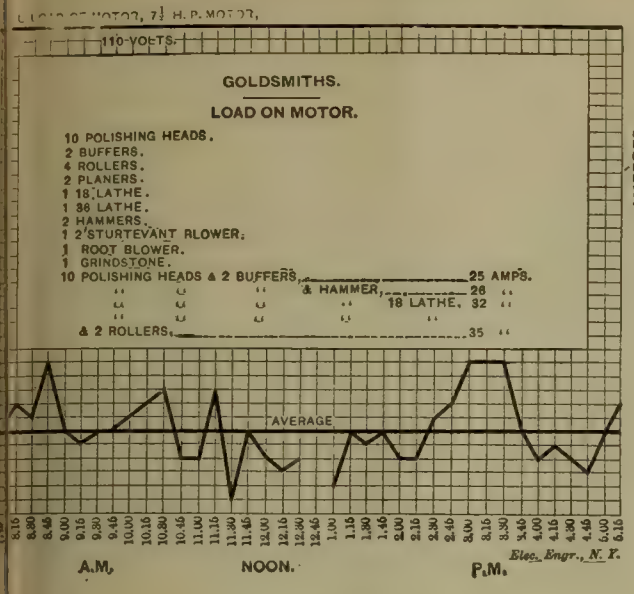
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....45 per cent. of Rated Capacity.
Maximum Load.....58 per cent. of Rated Capacity.
Average Load.....77 per cent. of Maximum Load.
Shafting.....66 per cent. of Average Load.

No. 9.

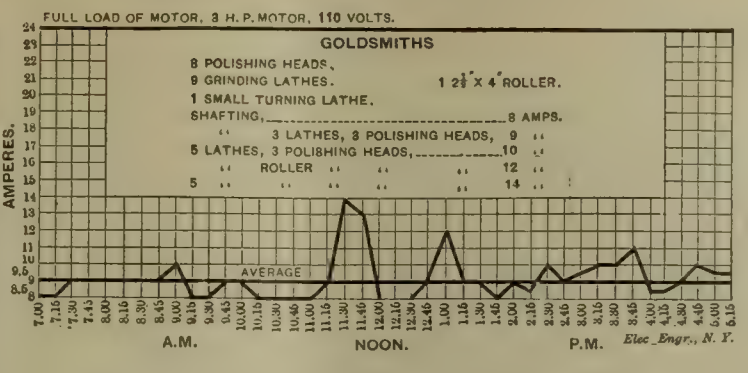
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....50 per cent. of Rated Capacity.
Maximum Load.....58 per cent. of Rated Capacity.
Average Load.....76 per cent. of Maximum Load.

No. 10.

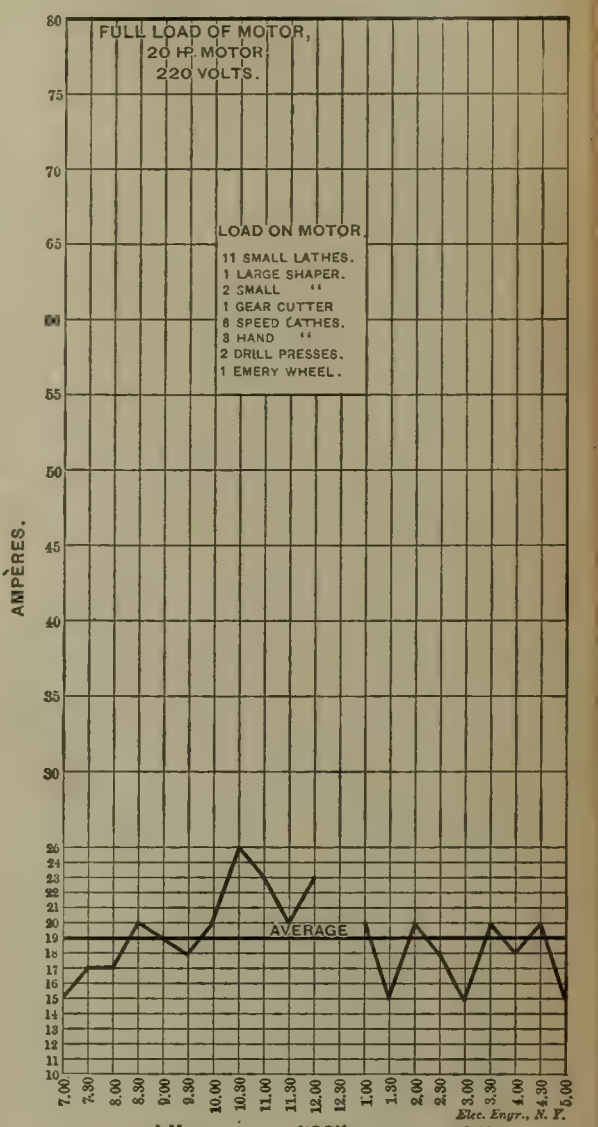
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....37½ per cent. of Rated Capacity.
Maximum Load.....59 per cent. of Rated Capacity.
Average Load.....64 per cent. of Maximum Load.
Shafting.....89 per cent. of Average Load.

No. 13.

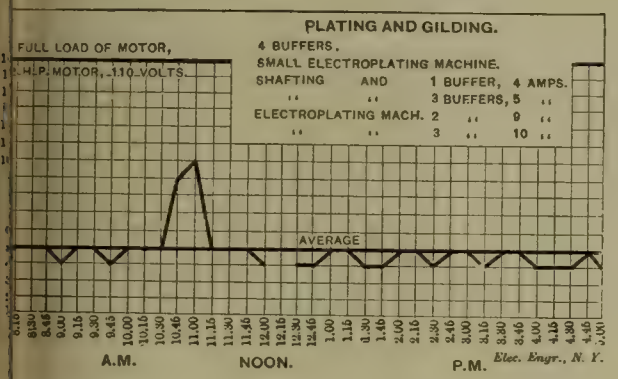
H. L. Lufkin.—C. & C. Electric Motor



Average Load.....24 per cent. of Rated Capacity.
Maximum Load.....31 per cent. of Rated Capacity.
Average Load.....76 per cent. of Maximum Load.
Shafting.....79 per cent. of Average Load.

No. 16.

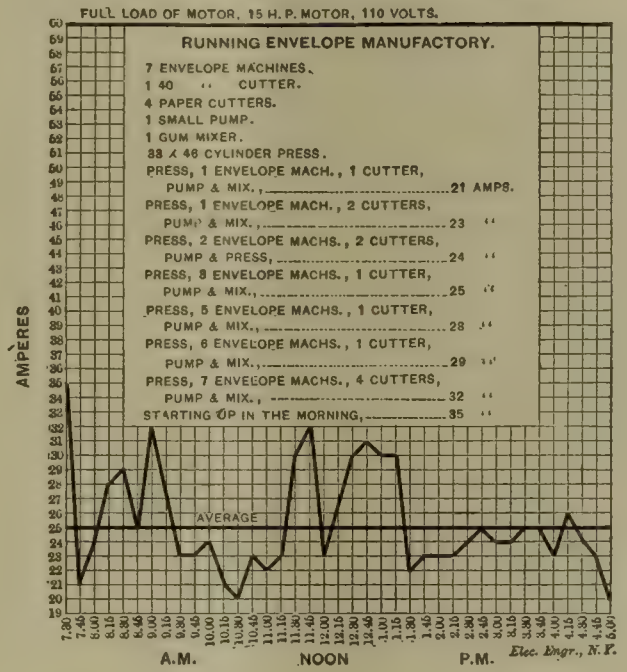
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....31 per cent. of Rated Capacity.
Maximum Load.....63 per cent. of Rated Capacity.
Average Load.....50 per cent. of Maximum Load.
Shafting.....80 per cent. of Average Load.

No. 11.

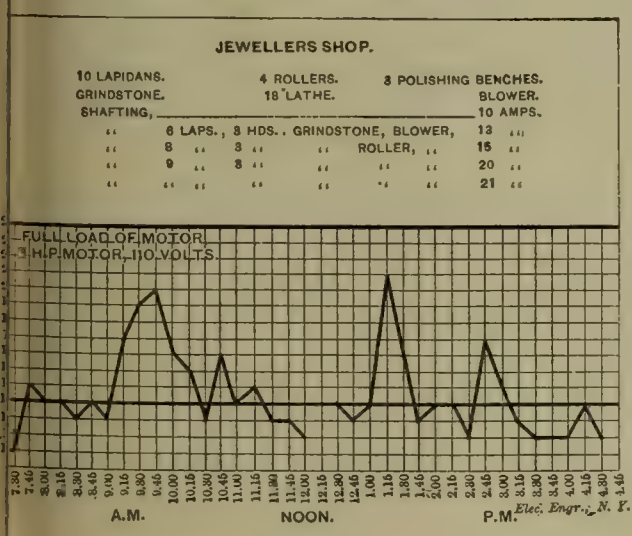
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....41½ per cent. of Rated Capacity.
Maximum Load.....58 per cent. of Rated Capacity.
Average Load.....71½ per cent. of Maximum Load.
Shafting.....80 per cent. of Average Load.

No. 14.

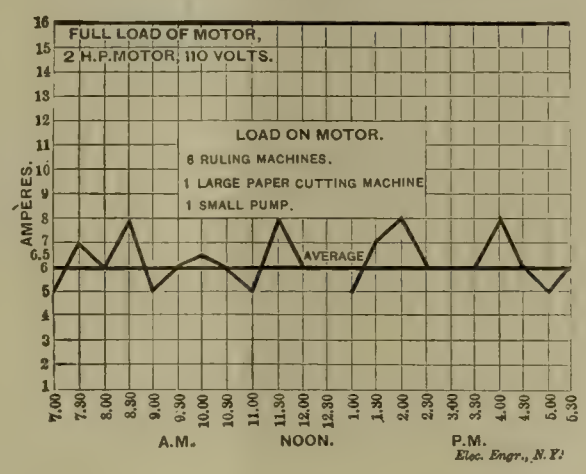
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....54 per cent. of Rated Capacity.
Maximum Load.....87½ per cent. of Rated Capacity.
Average Load.....62 per cent. of Maximum Load.
Shafting.....78 per cent. of Average Load.

No. 12.

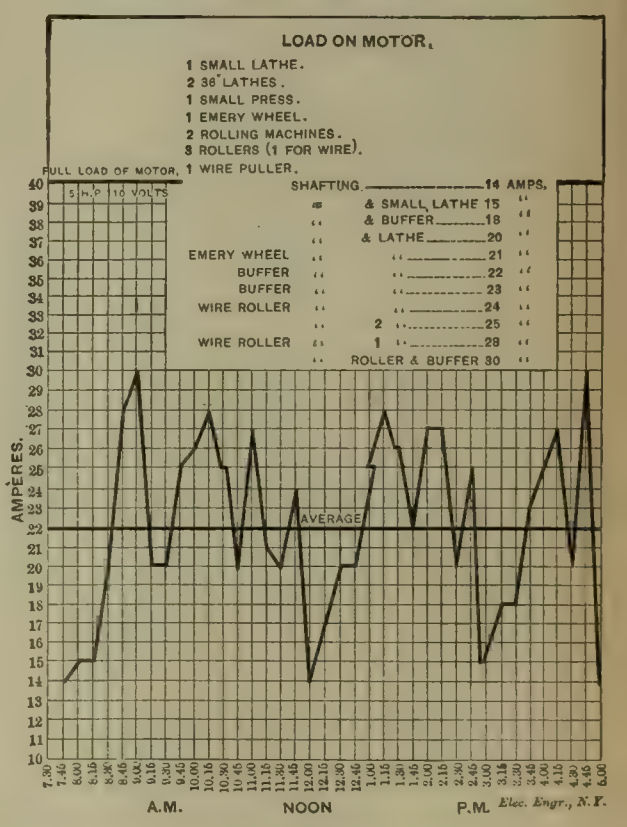
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....39 per cent. of Rated Capacity.
Maximum Load.....50 per cent. of Rated Capacity.
Average Load.....75 per cent. of Maximum Load.
Shafting.....85 per cent. of Average Load.

No. 15.

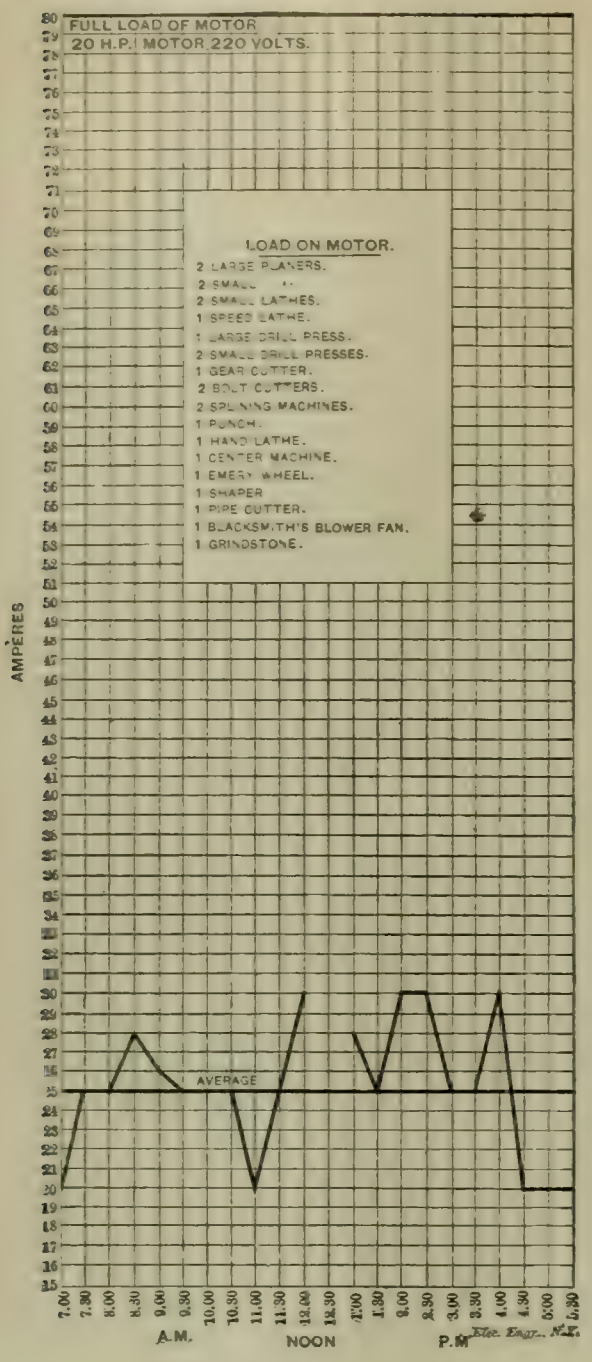
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....55 per cent. of Rated Capacity.
Maximum Load.....75 per cent. of Rated Capacity.
Average Load.....74 per cent. of Maximum Load.
Shafting.....64 per cent. of Average Load.

No. 19.

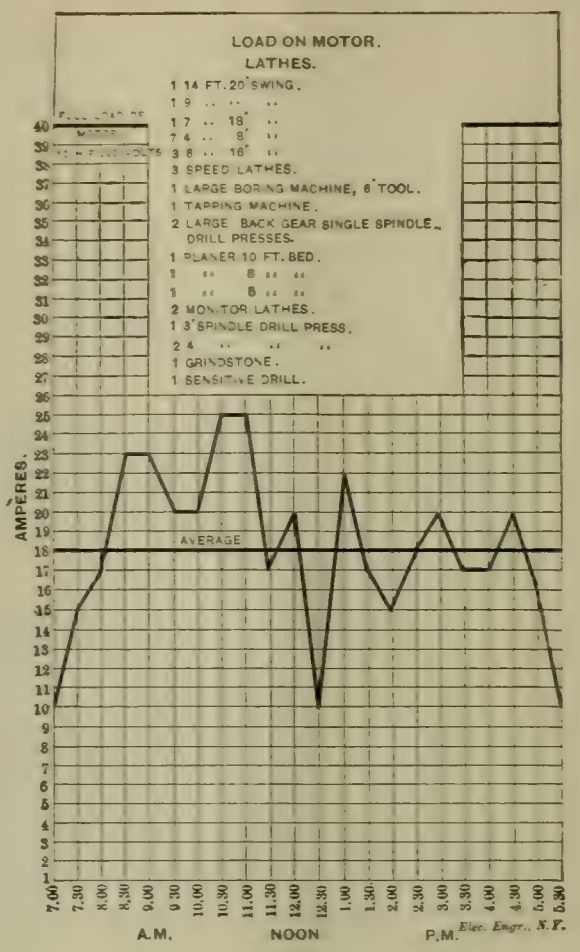
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....32½ per cent. of Rated Capacity.
Maximum Load.....37½ per cent. of Rated Capacity.
Average Load.....83 per cent. of Maximum Load.
Shafting.....80 per cent. of Average Load.

No. 17.

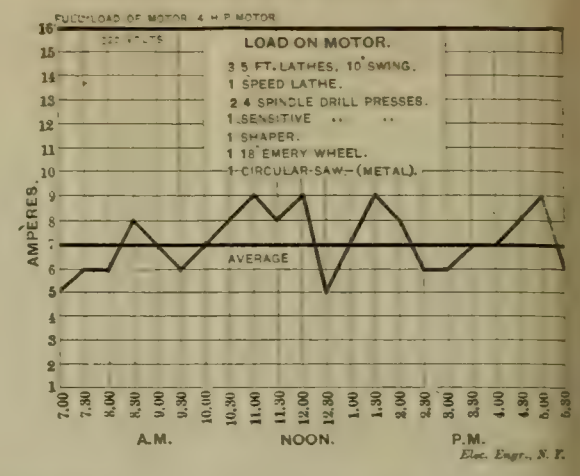
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....45 per cent. of Rated Capacity.
Maximum Load.....62½ per cent. of Rated Capacity.
Average Load.....72 per cent. of Maximum Load.
Shafting.....56 per cent. of Average Load.

No. 20.

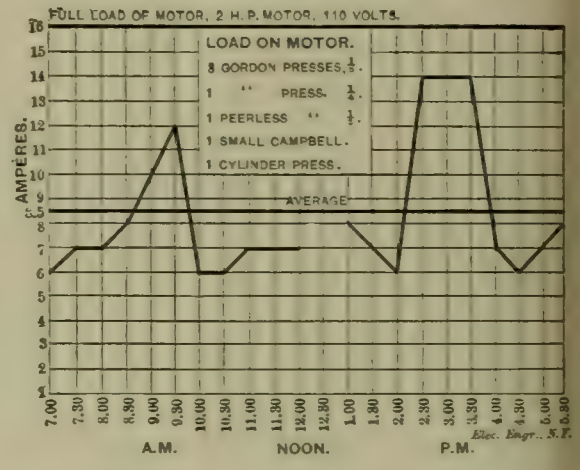
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....45 per cent. of Rated Capacity.
Maximum Load.....56 per cent. of Rated Capacity.
Average Load.....77 per cent. of Maximum Load.
Shafting.....70 per cent. of Average Load.

No. 21.

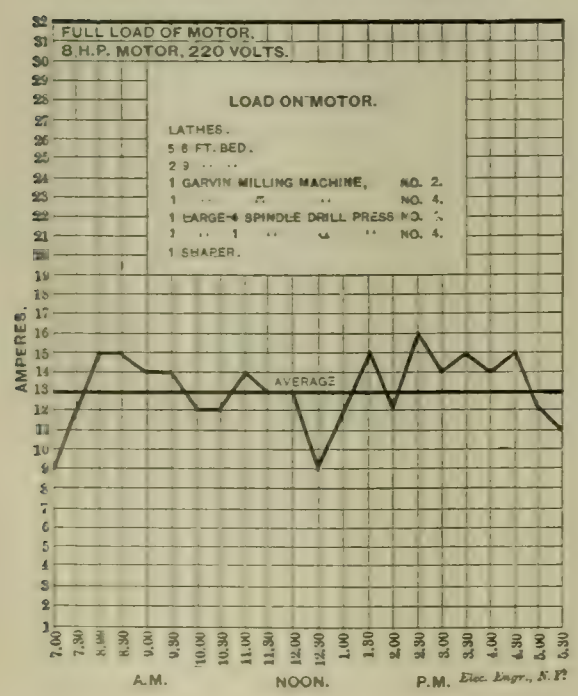
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....[illegible] per cent. of Rated Capacity.
Maximum Load.....88 per cent. of Rated Capacity.
Average Load.....60 per cent. of Maximum Load.
Shafting.....70 per cent. of Average Load.

No. 25.

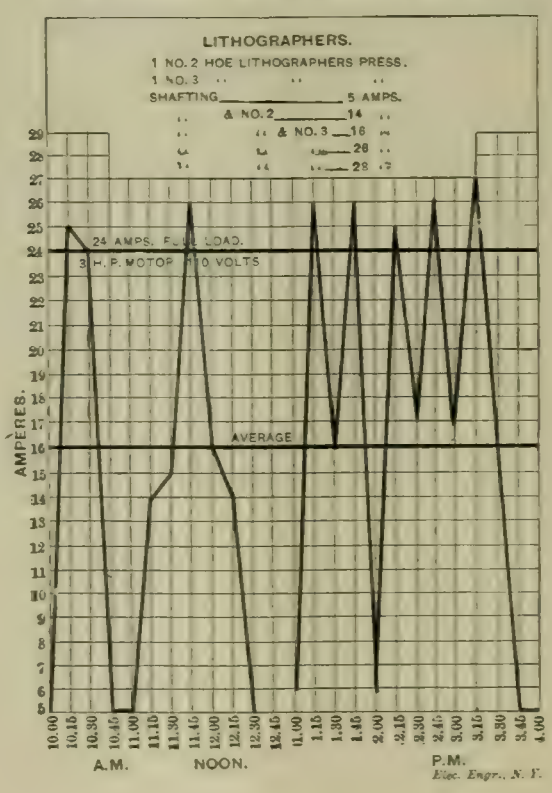
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....40 per cent. of Rated Capacity.
Maximum Load.....50 per cent. of Rated Capacity.
Average Load.....81 per cent. of Maximum Load.
Shafting.....70 per cent. of Average Load.

No. 18.

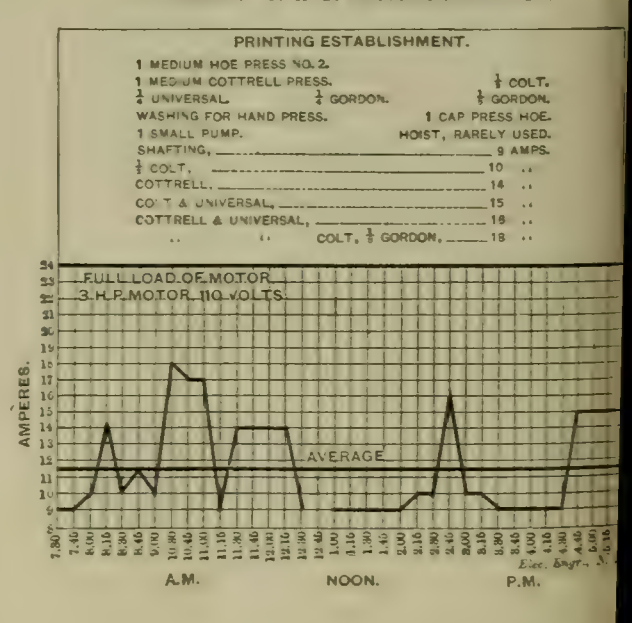
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....67 per cent. of Rated Capacity.
Maximum Overload.....12½ per cent. of Rated Capacity.
Average Load.....59 per cent. of Maximum Load.
Shafting.....39 per cent. of Average Load.

No. 22.

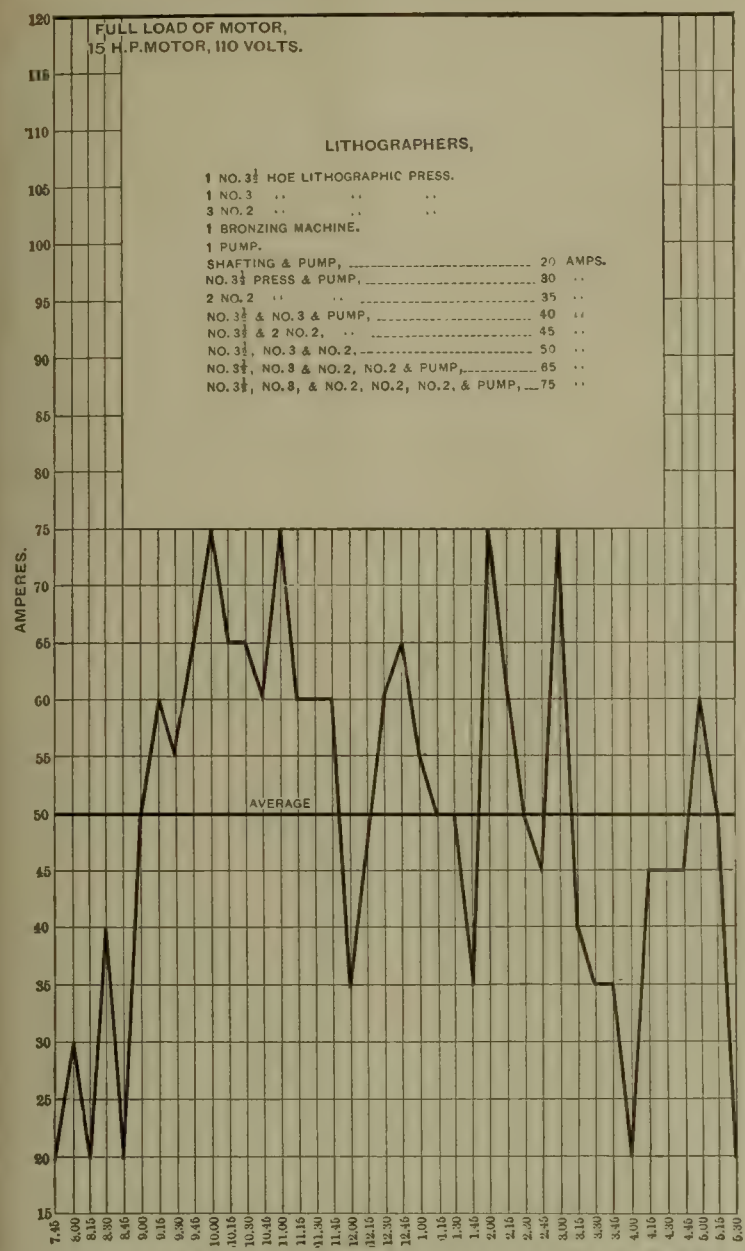
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....48 per cent. of Rated Capacity.
Maximum Load.....75 per cent. of Rated Capacity.
Average Load.....64¼ per cent. of Maximum Load.
Shafting.....79 per cent. of Average Load.

No. 26.

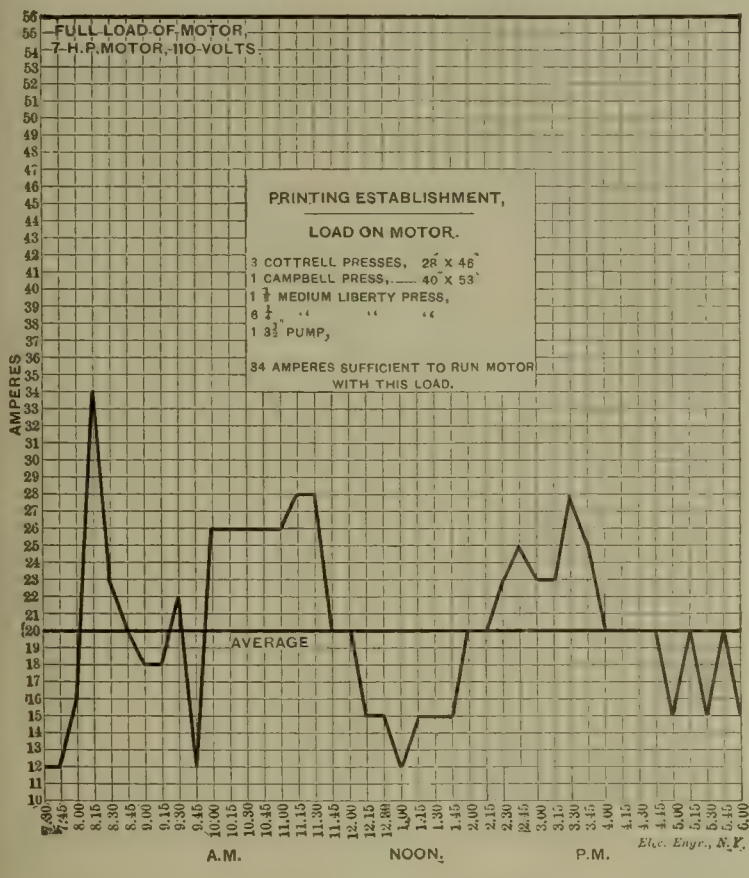
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....42 per cent. of Rated Capacity.
Maximum Load.....62½ per cent. of Rated Capacity.
Average Load.....67 per cent. of Maximum Load.
Shafting.....40 per cent. of Average Load.

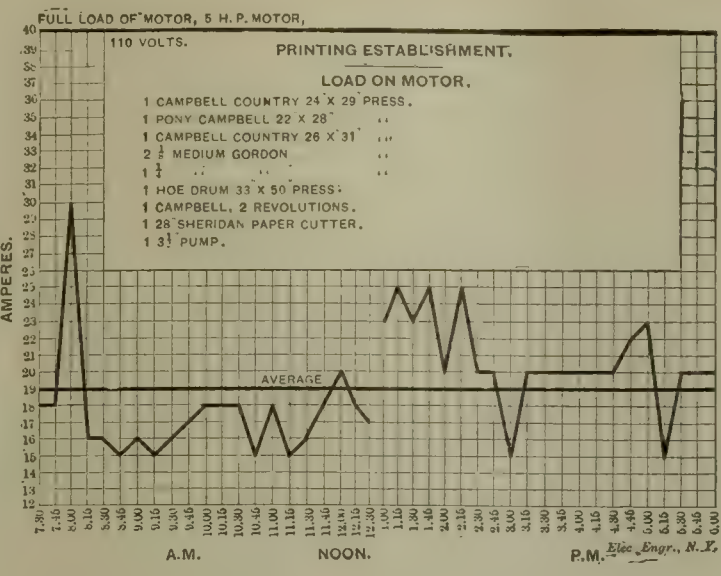
No. 23.

H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....36 per cent. of Rated Capacity.
Maximum Load.....61 per cent. of Rated Capacity.
Average Load.....58½ per cent. of Maximum Load.
Shafting.....60 per cent. of Average Load.

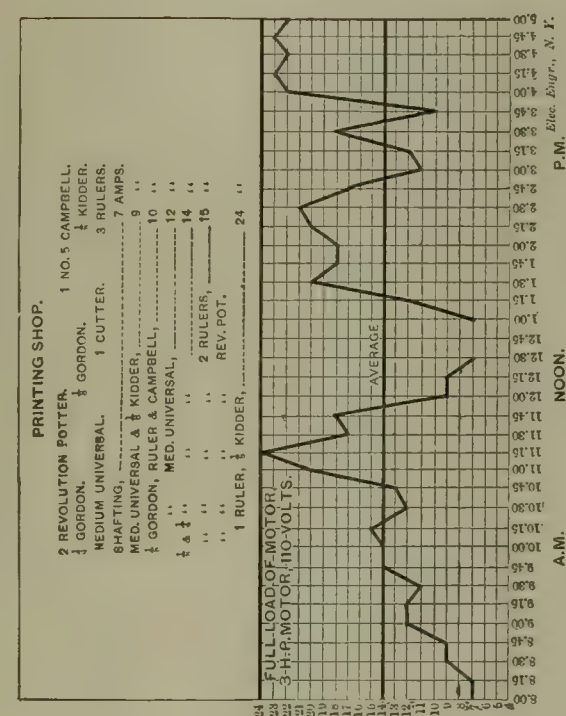
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Loud.....48 per cent. of Rated Capacity.
Maximum Load.....75 per cent. of Rated Capacity.
Average Load.....63 per cent. of Maximum Load.
Shafting.....80 per cent. of Average Load.

No. 28.

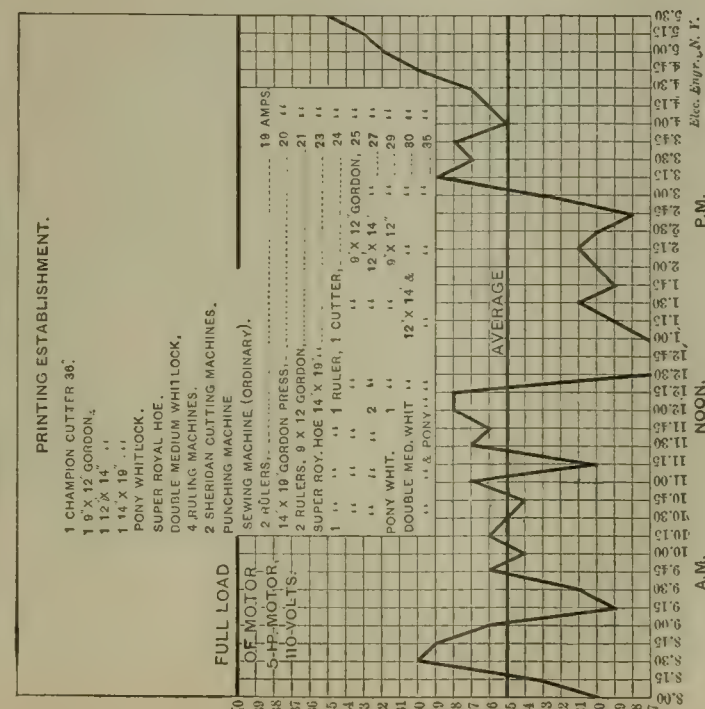
H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....58 per cent. of Rated Capacity.
Maximum Load.....100 per cent. of Rated Capacity.
Average Load.....60 per cent. of Maximum Load.
Shafting.....50 per cent. of Average Load.

No. 24.

H. L. Lufkin.—C. & C. Electric Motor Co.



Average Load.....63 per cent. of Rated Capacity.
Maximum Load.....75 per cent. of Rated Capacity.
Average Load.....83 per cent. of Maximum Load.
Shafting.....71 per cent. of Average Load.

No. 29.

CONTINUED FROM PAGE 8.

and power. Such legislation affects primarily the interest of those who have their capital invested in plants for furnishing such service and thus establishes a community of interest between them. The interests or manufacturing companies and supply houses in such legislation is secondary, as they are only affected through the effect on operating companies. For these reasons, and in view of the fact that legislation is confined to State Legislatures, there is a real necessity for the operating companies in every State to form themselves into associations for the development and protection of their mutual interests.

In analyzing the subjects of legislation, this committee would be untrue to the interests it represents, should it fail to bring to notice the fact that most of the so-called antagonistic legislation is not the result of a popular demand, but issues from those interests that seek a commercial advantage by legislation that, either directly or by implication, would create conditions favorable to their particular apparatus or systems. A diminution of efforts of this kind may be reasonably expected, as the art of generating, distributing and using electric currents becomes more and more a matter of common information and electrical systems approach more nearly to the zenith of their development.

The President—The Committee on Legislation have in their possession, and it will be transferred to the Secretary to be incorporated in the volume of proceedings of the Convention, all of the bills, in full, referred to in that paper, and of course they will be at the service of the central station men; and I have no doubt they will prove very valuable indeed as showing the general trend of the legislatures throughout the country.

I learned with much pleasure this morning of the presence here among us of the first man who ever occupied the chair of the National Electric Light Association; and, without consulting the Convention, I shall venture to appoint two gentlemen to escort him to the platform; and I think we shall all be very glad indeed to hear a few remarks from him. The Chair will appoint Vice-President Edgar and Mr. DeCamp as such committee.

Mr. Edgar and Mr. DeCamp escorted Mr. George S. Bowen to the platform.

The President—Gentlemen, I have great pleasure in introducing to you Mr. Bowen, one of the early fathers, who has now come to take a look at his child. (Applause).

Mr. Bowen—Mr. President, and Gentlemen of the Electric Light Association. You certainly have placed me under great obligation by the graceful compliment which you have conferred upon me in asking me to stand before you and look at the child that was born some six years ago. It is true, as the Chairman has stated, that I called a convention to order in Chicago; and I did it after some weeks of labor in sending out circulars, etc., inviting the men who were engaged in the electric lighting business to get together, to become acquainted, to rub together slightly and see what the effect might be. My own opinion was that it would be useful to us all, and to that end we created a little committee in Chicago, and I was made the Chairman of it, and I had the honor of sending out those circulars; and in responding to the circulars there were about one hundred and fifty gentlemen who came from all quarters of the Union to Chicago. I mention, as I stand before you, an incident which occurred, which often has come to my mind, and it was this. Mr. Morrison of Baltimore said to me, on being acquainted, "what are your plans?" I said, "well, we have no underground plans or overhead plans. My plan has been simply this: To invite the electric light men to come together, to become acquainted with each other; and after I have called the Convention to order and you are all in the room which has been provided for you my duty is done. I have no plans at all because I have the utmost confidence in the capacity of the men that have taken hold of this great business, the lighting of the world, to take care of themselves, and so I have made no plan whatever." (Applause). And so you see, gentlemen, that it gives me the greatest pleasure; I can scarcely find words equal to the expression of the pleasure that I have experienced in all these years in seeing the growth and the activity and the real benefits that have come to the country from the organization of the electric light fraternity. I cannot go anywhere scarcely, it may be the most remote town—and I have been all over this country and a good deal over Europe during the last year, and I say to you that America to my mind seems to be ahead of Europe in the electric lighting business; and so what shall we finally come to? I do not make any prediction but I say to you, gentlemen, you have only opened the first page.

I expect to live to see the day when all these little towns all over the country shall be illuminated with electric light and we shall not have to grope about in darkness as much as we have heretofore, because some of you gentlemen, I see it now cropping out in your brains, are going to develop a plan by which all the world may have the light at an expense so cheap and so nominal that they cannot afford to be in darkness; and so the world will be indebted to the electric light men for all of that. If it shall happen in the course of your discussions here in regard to the action that has been taken by some of the State legislatures to make use of electricity to take human life—if that agitation shall finally develop into an expression of thought in the minds of the American people that human life is too sacred to be taken by any means whatever, I shall thank God for that, because I do not believe it is in the power of man to take human life—something you cannot restore. Certainly the man whom you would execute under these laws, and who has committed an act deserving, under the laws of the State, to be executed by electricity, or the rope or any other means, certainly is unfit to die and he is quite unprepared to live; and so my plan to get along with that kind of men is to educate them; give them good cold water baths, and hot too, inside and out, and wholesome food and plenty of work, and let them live long enough to be fitted and prepared either to live or die, just as God in His wisdom shall see fit. Those are my sentiments. (Applause.)

It has only fallen to the lot of a few of the great inventors of the world to see the work of their hands finally culminate in great success; and as I look over this body there comes to my mind an incident which occurred a few years ago, and I will take your time, as it will be very brief, just to recount it. I was riding down through the State of New Jersey with John I. Blair, the great railroad builder, who has spent many millions of dollars in building railroads, and passing by a little hamlet he said: "There is where Professor Morse used to live, in that little house." "Ah, indeed!" I said. "If I had the time I would like to get out of the train and walk around there, just to get a little of the aroma, the scintillations of inspiration that filled that old man's soul when he was trying to make you believe that he could send a message on a wire. What did you think of the old man," I said, "when he was trying to make you believe that he could send a message on a wire?" "Oh," he said "we all thought he was a crazy old fool." Now, that was about the idea expressed in regard to him; and here is some bright young electrician who may bring to you something and you will say, "Oh, get away; he is a crazy fool." But let me tell you, my dear friends, it is these crazy old fools that have stirred the world from its foundation to its very height, and when I read the account of Professor Morse as he sat on the platform in the Cooper Union—I need not recount the history of his experience about going to Congress, and his labors, and finally getting his telegraph wire from Baltimore to Washington and sending that first message over that line, that wonderful message, ignoring himself completely, this crazy old fool, saying, "What hath God wrought?" Not me, but *what hath God wrought?* And then when he stood on the platform of Cooper Union and with that simple messenger sent that other message flying around the world, "Glory to God in the highest and peace on earth, good will to men," what more could come to fill his soul with all that was great and noble and successful in life?

Here stood this crazy old fool, the admired genius of all the universe. Nothing could be more magnificent or grand in its accomplishments than that. And so I expect to see the day when these young electricians shall accomplish other things. I do not think we have got to the end by any means; and so I want to see you do what you do well. When you want a street railway and put down an electric current, put it down well. I was down at Asbury Park last night and they had a terrible storm there and they were frightened because there was electricity on the track; and of course water is a fine conductor. I hope some day to see the wires underground, carefully put away where they will be dry and operative, and then you will get good results and we shall not be hearing of these terrible accidents. Either put them down underground where they are safe or else put them up so high that they won't disturb people; and when you put them up make them secure. Whatever you do, let it be done well; that is my idea; and then you will get good results. I expect to see the day when every house, every little household in the land, shall have its little storage battery and electric lights. We are going to dispense with tallow candles and even with kerosene oil. Why, just think of it; in the Island of San Domingo they use kerosene oil to-day all over the Island. There was a concession brought to me a few weeks ago for lighting the Island; and gentlemen, you could scarcely get anybody in this country to go down there and put in electric lights because they say it is too much of a venture; and still you can go there, and, you can go to Hayti, and you can go all through the southern district and there is a field that is just as full of riches as any gold mine in Colorado or California; and it is all there just waiting for you to take it; and if I was a young man twenty years of age I would plant myself down there in some of those countries and I would make my fortune there. There is no mistake about it. It is there and the people are ready to pay, and they have got the money and are able to pay and what they want to do is to utilize it.

I have taken too much of your time I think gentlemen, I am under great obligation for your courtesy in asking me to say a word and I can assure you that wherever I am, wherever I have been in these years, I never take up a paper that has an account of the Electric Light Association that it does not attract my attention and absorb my interest most intensely; and so I wish you the greatest, the most unbounded success, as I am sure you will have. (Applause.)

Mr. Weeks—Mr. President, on behalf of the Executive Committee I would report to the Convention their recommendation that Mr. George S. Bowen, who has just addressed the Convention, and to whom more than to any one else this Association owes its existence, be elected an honorary member of this Association.

The motion was duly seconded and carried.

Mr. Bowen—Mr. President and gentlemen, you have placed me under still renewed and lasting obligation. I assure you that I appreciate this delicate and beautiful compliment to me in all its best phases, and so I only wish you the very best that God Almighty can give to you all through your lives. (Applause.)

The President—We will now resume the regular order of business and proceed to the consideration of the report of the National Committe on Legislation.

Mr. Mason—Mr. President, I notice that this report now under consideration and recently read by Mr. Wilmerding, refers to a bill that is now in the Committee on the Census—the Committee of the Senate. I beg to offer the following preamble and resolutions:

WHEREAS, On the 15th of August, 1890, the honorable Senator, Eugene Hale, introduced in the Senate of the United States a bill to amend an act entitled, An Act to Provide for the taking of the Eleventh and Subsequent Censuses, approved March 1, 1889, and

WHEREAS, The said bill was read twice and referred to the Committee on the Census, and

WHEREAS, In the opinion of the National Electric Light Association the passage of this bill is essential to render the investigation of the electrical industries by the Eleventh Census thorough and complete, therefore,

Resolved, That the President of this Association be requested to express this, our opinion, to the Committee on the Census and urge the Committee to favorably report to the Senate the bill referred to.

Resolved, That the thanks of this Association be tendered to Senator Hale for his services in the matter of the bill above referred to.

The President—Gentlemen, you have heard the preambles and resolutions offered by Mr. Mason. What is your pleasure?

Mr. DeCamp—I move they be adopted.

The motion was duly seconded and carried.

Mr. Francisco, of Rutland, Vt., then read a paper on Municipal Lighting, which will be found in full on another page.

The President—The Chair will announce the appointment of the Committee of three on the proper classification of the lighting power of incandescent lamps: A. V. Garratt, Louis Bell, P. H. Alexander.

The paper which has just been read is now open for discussion. Are there any remarks on the paper just presented by Mr. Francisco?

Mr. Wilmerding—I move a vote of thanks to Mr. Francisco for the able way in which he has set forth this matter. I hope that the paper will have a circulation all over the country, and do some good; and I think that the Association ought to thank Mr. Francisco for the labor and care he has taken in preparing this valuable paper.

Mr. DeCamp—I think that the most lasting compliment which can be paid to the author of that paper will be for this Association to authorize its printing for general distribution among the members, so that they may all have an opportunity of making direct use of it. I do not think that a paper of that kind should pass without very general remark by this Convention upon it. Personally I do not feel competent to do it, because I have not been touched as yet in that direction. I would probably be a little more lively at the present time if I had been. But, in listening to the paper these struck me. It is known to every man on the floor of this Convention who is engaged in the business of electric lighting that municipal ownership of electric light plants has its origin among a few politicians who wish to add another plum to the public pudding that they may pluck it. There is no question about that. The public, who have to pay for this know nothing else excepting perhaps the two or three points which the public know fully as well as their servants in these matters; and one of them is the fact that there are certain things in connection with municipal management that are always notably extravagant. It is not the fact that a municipal government has no right to engage in anything in which it is the sole consumer. I do not admit that at all. I admit it to be for the general good for them to keep their hands out of everything, and let whatever profit there may be in it go to the taxpaying citizens. But that is my view, and that is perhaps a radical view. If you take it on the ground that the public should do their own printing—then there is a measure of truth in that, and there is a measure of justice in that which does not apply to anything like the municipal ownership of an electric light plant, or gas plant, from the fact that their ownership of that effects nothing except their own trade. Printers do business just the same as other concerns do business; they are not obliged to go to the State Legislature and get a charter, or their charter rights. For that reason they are excepted from the conditions which apply to electric light companies. But there is one point that might well go forth in some shape, and which would waken the people up a little who have the final decision of these matters. I suppose that it is pretty nearly a correct statement that from fifty to sixty per cent. of the total cost of producing electric light is in the labor account alone. It is one of the most difficult problems that electric light companies have to contend with. It is something that is the hardest to control. Now, if there is anything under God's Heaven in which there is extravagance practiced by municipal governments it is in the matter of labor. For municipal governments it invariably takes two men to do one man's work. They are as a rule extraordinarily extravagant in the matter of labor, to say nothing of the other elements of political patronage which enter into it. Some time ago a man left our employ who was getting what we thought good wages, two dollars per day. He was not a skilled laborer in the true sense of that term. He took a position under the City Government at two dollars per day, in which he worked eight hours per day, whereas he had been working twelve hours; and he took a position in which two men had been doing the whole duty, yet he made the fourth man who went in there. Figuring this up it means about two hundred per cent. increase on the cost of labor for that one particular thing. The extravagance of municipal governments in the matter of labor is a fact pretty generally appreciated. But I would like to see this report printed, and I would like to have copies for free distribution among the members. I will pay for it if it cannot be done in any other way.

Mr. Armstrong—I feel myself very much obliged to Mr. Francisco for this paper. The instances he cites were used as against our company about a month ago when we made our annual bid for lighting our city. It so happened that our general manager had the answer ready to the most of these criticisms, and yet a new member of the City Council, flushed with his victory at the polls, and believing that the eyes of the whole community were upon him, and that upon his shoulders rested the protection of the taxpayers against a grasping monopoly that had the lighting of the streets, went into the City Council and claimed that our bid for lighting the city was entirely too high, and that Bay City, Bangor, Dunkirk, and all the rest were having the lighting done at so much less. The answer to all those criticisms was made in such a manner that nothing further could be said. But how much better, Mr. President, we could have answered it had we just this paper to hand to every member of the City Council, so that we could say to them, there is the author's name; there are the facts; now say what you please concerning it. There was one thing further—and possibly an opportunity will come to speak of that later—which we cannot so well answer. There were parties who desired to sell one or two dynamos to other companies that

inspired other bids thereby. We may be able to speak of that after a while under another subject. But, Mr. President, let it be clearly understood here—and I think it is clearly understood—that never does a municipality desire to engage in any business. I wish that Mr. De Camp had illustrated how the citizens of Philadelphia felt about their ownership of the gas plant that they have been blessed with for a good many years. I wish that he had given that here. Now, let it be understood that at no time, and under no circumstances, does a municipality desire to engage in business. Why then does it own water works? Why does it own gas works? Why does it own electric light plants? Usually because it cannot find citizens who are willing for the public benefit to put their own money into the enterprises, because the enterprise at the time it starts is too large to enlist the citizens or induce them into it. Gentlemen, when you start an electric light plant in your city you do it with the distinct understanding that for a long time you are to get no returns; you do it looking after the future. If you start a gas plant, if you start a railroad, if you start a water plant, if you do anything of that kind to supply the public, you do it, of course, expecting an ultimate return to yourself and to your stockholders; you do it looking to the future. Sometimes cities are enterprising enough to look out for the future themselves without asking the citizens to do it, and without expecting the citizens to do it. Now, I venture the assertion that no economist who has studied the question, no economist who has gone over the whole ground, will ever advocate taking from a private enterprise anything like electric lighting, or like water works, or like a gas plant, or like printing, or like the railroads, or any other such enterprise, and putting it under municipal control. I will ask the managers of electric light companies here if they were managing for the public, if they had a public treasury to call on for anything and everything they wanted, whether they would be (and I think they are perfectly honest and upright men) as careful of their expenditures as they are compelled to be to-day?

If my purse were unlimited I would have the very best that was there; I would indulge in the most costly experiments, for I would have wherewith to pay for them. And so would you do the same thing. It is a natural thing, and a proper thing, I take it. Therefore it is to say that the cost of lighting must be far greater to a municipality, by necessity, than to a private enterprise. I want again to thank the author of this paper. I want to endorse very heartily Mr. DeCamp's suggestion that we have this printed by the Association for distribution throughout all of the cities where electric light is furnished by private corporations; and the facts contained in this paper will do much towards making a proper feeling, a kindly feeling from the taxpayers and citizens towards our companies; and when we shall have accomplished that I think we shall have done a great good in the way of making popular our work, in the way of enlightening the people on just exactly the grounds we have to work; and where we expect to get our returns, and what we furnish for it, and how we furnish it.

Mr. Barrett—I am unfortunate in having such a cold that I cannot make any extended remarks on this subject; but I notice in looking over the account here that I am asked, or the city electrician is asked some very pertinent questions. I do not advocate the absorption of a commercial business by any municipality. That never does. The City of Chicago, through its electrician, has simply performed the orders which he received. This statement strikes me as rather a singular thing I find here that the cost of municipal lighting is set forth very clearly, very extensively and very expensively; but I have never, in all my experience with this Association, seen a tabulated statement of what it cost to light a commercial plant, per light, never in my life. Now, this is what strikes me as being rather singular. Why cannot a city light its streets as cheaply as a commercial company can? Ain't the market open to the city to purchase its material? Can't it hire its laborers as cheaply as anybody else? Has it not an officer, and is he not compelled to report expenditures just as clearly and distinctly as does the head of any private concern? Why should it cost the city more than it does anybody else? This is rather different at home. I have charge of the municipal service of the police, fire, Board of Health, and the city lighting. I place my hand usually in either one of these departments, and therefore I get economy as to materials. I do not claim that I can light a lamp any cheaper than anybody else. I do not claim that it costs me any more than it does anybody else to light that lamp, except in labor alone. We do have to pay more for labor than anybody else. If I could get this lighting from corporations, anywhere here, for what it costs us to maintain our own lights, I assure you, gentlemen, that I would recommend it. You will excuse me for not saying more, because I am not able to talk; but if you want to ask me any questions I will try to answer them, although I do not want you to ask me to make any speech.

Mr. Garratt—It seems to be that the simplest reply which can be made to the question why, or why shall not a city do its own lighting, will be found right in the words of President Cleveland, on the Tariff question, when he said, "In this matter we are dealing with a condition of things and not with a theory." If we were dealing with a theory there is absolutely no reason why a municipality cannot do any business that any citizens are engaged in more profitably than the individual citizens can do it themselves. We are dealing with a condition of things which, in the United States under our form of government, is this, that the government shall not in any way interfere with the rights and privileges, the pursuit of happiness and the success of its citizens; that the citizens themselves shall do the industries of the country; that the government shall be as small and as insignificant as is possible to hold people together in a civilized community. That is the simple question. Theoretically speaking, I see no reason why a municipality cannot bake the bread for the people, or why it cannot butcher the beeves. There is no reason why, except that in the condition of things under which we are living it is entirely unfeasible

Mr. DeCamp—I think Mr. Barrett put the true question when he said "Why can't it be done?" Well, there ought not to be anybody more competent to answer that question than Professor Barrett himself, because he is right in the business, but he don't do it. Now, in reply to the other point, in which he says that no commercial plant has come forth to say what their lights have cost them. There is a plain answer to that. That has not yet become necessary, and it is not customary, except by the lowest bidder. Now the figures which Professor Barrett has named and set forth and published broadcast over the world, or which have generally gone forth; I don't say that he published them—have been so much lower than any commercial company has ever produced their lights under anything like similar circumstances, that that thing is not at all necessary; there is no use of doing it. A commercial company who have stockholders to serve and who are under certain confidential obligations, which are generally recognized, are not in the habit of publishing that sort of statement. So that I presume when the commercial lighting comes down to a point where they can produce the lights at a less cost than the municipal plants are now costing, we shall hear just what they cost; and they can very well afford to wait until that time.

Mr. Duncan—Mr. President, our friend, Judge Armstrong of New Jersey, has hit the case fairly well when he stated the case of the representative of the municipal body who lacked information. I am not here to defend municipal bodies. I know something about the manner in which municipalities are conducted. While my friend DeCamp thinks that every man who has ever had any connection with a municipal body must naturally become dishonest. I differ with him. (Laughter.) I believe that the same percentage of honesty will prevail in municipalities as in the Electric Light Association. But, sir, the information that the gentleman from New Jersey had to put before his man was meagre, What we want to do at the present time is to place the statistical information which has been prepared by Mr. Francisco, with a great deal of labor and care, in such shape that members of this association can use it when this question arises in their own cities or towns. Now, I do not blame that man in the New Jersey town as much as I do the judge. I think it was his duty, as he was the most interested party of the two, to obtain this information at any cost. We are to-day all on the same platform and we are going to commence and get this information where it will do some good. I hope the resolution will pass.

Mr. DeCamp—Mr. Chairman, I have got a question here for Professor Barrett, but he seems to have left the room. The question is whether in the published statement that the Chicago lamps costs sixteen cents per light, he includes interest on investment, his salary, and depreciation. I am sorry Mr. Barrett is not here to answer it. He no doubt would if he could.

Mr. Francisco—Mr. President, I can answer that for Mr. Barrett. I have a letter from Professor Barrett in which he states point blank that he does not include it.

The President—I think the question is answered.

Mr. Hammer—Mr. President, I have a suggestion which I think is very pertinent to this subject, which comes from across the water. I lived in the city of Paris last year and I became acquainted with some of the gentlemen connected with the municipal government there, and among them the Chief Engineer of the city who had charge of the municipal lighting affairs, and I learned some things which have considerable interest as bearing directly on this subject. As is probably known by every gentleman in the room, the city of Paris some time ago offered a prize for the best electric meter that was brought to the attention of the expert. Tests were conducted, and there is to be, I believe, a second series of tests. It may also be known by many of the gentlemen here that the city of Paris at a very considerable expense has placed in one of the sections of Paris a large plant on the direct current system, and also a large plant, a similar plant, on the alternating system. The city of Paris, a great many people have supposed, was going into municipal lighting, and that these experiments were intended as leading up to the city of Paris putting in enormous central stations for doing the general lighting of the city. I asked the engineer if he would give me an expression of his opinion of just the status of the government in regard to this matter, and he said it was this: That the municipality of Paris appreciated that electric lighting had come to stay, and it was an enormous industry, one of great importance to them, and one in which the French people were backward in taking hold and pushing forward; and they desired, as has always been characteristic of the French people to encourage the arts and sciences, and in this particular case they wanted to encourage and enforce this industry which seems to be in the background in their country. With that end in view they took a representative of the direct current system and a representative of the alternating current system and placed them in one of the sections of the city and said, "Now, when we are through with the test the system which has given us the greatest satisfaction and which we can endorse as being the best for the city of Paris will be applied, and the municipal lighting will be done by that system." And I asked him about the relation of the meter tests, and he said they were very similar; he said the meters were to be tested, prizes awarded, and the city of Paris would retain the privilege of utilizing any meter which they decided upon as being the best; but that that utilization would be only very limited, to be used in these experimental stations, and that the city of Paris did not propose to go into the manufacture of electric light any more than they were going into the manufacture of any other commodity; that they did it entirely to foster the industry. (Applause).

The President—Mr. DeCamp, Professor Barrett has now returned to the room and you will have an opportunity to ask him the question.

Mr. DeCamp—Mr. Francisco answered the question that I asked, whether the published statement of sixteen cents per lamp included interest, his own salary, and depreciation.

Mr. Barrett—It don't include interest; it don't include water taxes, rent or—yes, it includes depreciation. We don't have any depreciation. (Laughter.) We buy a class of goods that will last. I will say that sixty-two miles of wire last year cost me $16—for maintenance—underground.

Mr. DeCamp—How many lamps did you have on?

Mr. Barrett—I don't know.

Mr. DeCamp— That is a very important factor.

Mr. Barrett.—I will not attempt to answer it; I don't know the amount of wire that we have in that district. But there is another consideration that I want to mention, and that is this: That by the action of the Council the gas and the oil and the electric light is one fund and the electrician has charge of all, and of course it would cost less. I have endeavored to be more honest with you, gentlemen, and I have endeavored to get an honest expression. (Applause).

Mr. Alexander—Mr. President, it seems to me Professor Barrett is right in so far that when the municipality makes an appropriation and comes within that appropriation, or goes outside of it, the proper office states: "We have expended in this department so much money." Now in the Fire Department you are never asked whether you are to have the apparatus capitalized, or the buildings capitalized, but you say, "Our Fire Department cost us the year $7,445." Why should you make a difference as a municipal officer in that particular branch? These are reports that are published. Central station men want naturally to give the stockholders of their companies a complete statement, not as to what the lights cost but as to how much money they have made or lost during the year, while the municipality from year to year have new appropriations made, and old apparatus is replaced by new appropriations.

Mr. Barrett—The only report that I make is the gas and oil. I show the comparative cost between gas and electric light and oil—always in favor of electric light.

Mr. T. Carpenter Smith—There is one point on this question that I think we should look at fairly. There is no doubt that a municipality under certain conditions can, and under all conditions ought to be able to run its plant cheaper than any corporation. On the other hand, I think there is very little doubt that it very seldom does. The remark that Mr. Garratt made about dealing with conditions and not theories I think is a very pertinent one; and I think if you will examine into the administration of a good many of the larger European cities you will find that a good many of these cities do own their own gas works and water works and do furnish gas and water as cheaply as a corporation would; but on the other hand you will find a very large number of cities, and especially the large ones, who do not own the gas works or water works, and yet water and gas are supplied at a far less rate than when the cities do own them. Another thing you have to take into consideration is what is meant when you speak of the cost of running gas works in the city, or an electric light plant. In Philadelphia they have a good chance to supply gas as cheap as anybody. There gas goes along the water; they can get cheap transportation for coal; they have an excellent market for coke and all waste products, and they charge $1.65 for about the meanest gas I ever saw. I am informed that is $1.60 now. Not only that, but the city pays $150,000 for gasoline lamps. I think that $150,000 should be charged right into the gas works, for the city is supposed to do its lighting and yet it pays an outside corporation that money. I think there are a good many things that we want to look at very carefully, and I think the more this thing is probed the more baseless you will find the claim to be that the city does run the lights cheaper; and I think Mr. Francisco's paper ought to be published as widely as possible because when you go into any average Council Chamber and listen to the talk you will find very soon that it is not facts that are taken into consideration but talk; and if you have good solid facts that you can put to these people that can not be controverted, it will have more weight with the public than anything else. I have seen these statemeuts of the cost of lights in the various cities that have been sent around, and some of them are very wonderful, as Mr. Francisco has shown them to be.

Mr. De Camp—Mr. President, I wish to make a statement of fact. The city of Philadelphia has owned the gas works for a great many years. In the annual statement of the Board of Gas Trustees they always showed an enormous profit, but under the new charter it was taken out of the hands of the Board of Trustees, and for all moral purposes it is generally conceded for the better. It is a matter of history that the gas trust in the city of Philadelphia, politically, was one of the greatest sinks of corruption in the whole city, and on moral grounds, if on no other, it was taken from the Board of Trustees and placed in the Department of Public Works which, in point of honesty, has the confidence of the whole community, unpopular as it may be personally. They found that the capacity of the present established plant was not sufficient to supply the needs of the city for public purposes and for private purposes too—be-

cause they furnish light to private parties. There was no money to build additional plant. The next thing was to contract with a new company for the furnishing of three million feet of gas a day to make up the deficiency. They contract for that at 37½ cents per thousand feet delivered in the holder. They sell it for $1 50 a thousand, and according to the official reports published for last year shows profit—I don't know just what the amount is, but if they had not had the profit on these three million feet a day of the difference between 7½ cents and $1.50 which they sold it for, with all the increased effort and with the prestige of an honest, business-like administration of those affairs, the gas department of the city of Philadelphla would have shown a very heavy loss for the year 1889, even with gas at $1.50 a thousand. Now it is done by private corporations. The city of Philadelphia had the proposition made to it to lease those gas works to the city of Philadelphia under a guaranty that they would furnish all the gas that was necessary for both public and private purposes for $1 a thousund feet, which is just 50 cents less than they are now paying for it.

Mr. Alexander—I do not believe in municipal plants, but I hope the statements that are made here to go out as printed will be fair to all parties; 37½ cents is the price of gas in the holder—the gentleman did not say that—not including the cost of distribution and leakage in the pipes, which will diminish the profits to the city of Philadelphia on that three million feet considerably.

Mr. Duncan—He said in the holder.

Mr. De Camp—Mr. Alexander calls attention to the fact that there is the cost of distribution.

Mr. Alexander—Distribution and leakage in pipes.

Mr. De Camp—I know that. I will call that statement back. I am not certain about it.

Mr. T. Carpenter Smith—The city pays for delivery into the holder, but the gas is distributed in exactly the same service; there is no additional service laid down. You have the cost of distribution in the same pipes.

Mr. Faben—An analysis of the statements that they made shows that if their business was self-sustaining before this three million was added, the buying of this three million feet at 37½ cents, and selling it at $1.50, ought to give them a profit of the difference between those two prices; but they did not realize the difference between the cost of three million feet at 37½ cents, and the sale at $1.50, which would show that their business before they bought this three million feet at 37½ cents was not self-sustaining.

Mr. Alexander—That is exactly what I am getting at, that the difference between 37½ and $1.50 is not the profit, but they realized a profit beyond the cost of distribution.

Mr. Duncan—I should like to ask one question of this committee. While this is a very gratifying report, it does not seem exactly fair that we should make a statement in regard to a company which is furnishing lights to a city, on a bid, unless we ask whether they take into account or not their other business in connection with it, whether they make a separate item of that alone, as run as a separate business, which the municipality does. You have got to get them on the same basis to make a fair statement. Did the Committee on Data get any information of that kind?

The President—This is not the report of the Committee on Data that is under consideration.

Mr. Duncan—The committee need not answer it now.

Mr. De Camp—It is a pertinent question to come in here. I have always felt perfectly safe in making these statements, because whatever doubt there was in it was on the other side. I do not, as far as I am concerned—nor am I able, and I do not see how I could do it—eliminate it and get the fixed cost of the special city service, as distinct from our general service; but, if you take it on the hour basis, you can make a very safe approximation. The city lighting in the city of Philadelphia, I think, averages about eleven hours and some few minutes, ten to twelve minutes. Now, the general average of the whole business, including commercial, is practically the same thing, eleven hours. But a large portion of the commercial business, if you took the commercial business by itself, would not average probably more than six hours. Now, if you eliminate that, you have got the advantage of the short hour service in commercial business, and, if you were to eliminate all commercial business and take city business, whatever difference there is would be against the city, because you would have nothing to offset in the way of short hours. I am perfectly safe in saying that our general average is a fair one when you are discussing the matter of municipal lighting

The President—Unless there are some further remarks, Mr. Bowen will close the discussion.

Mr. Bowen—Mr. Chairman and Gentlemen: I have listened to the discussion with a great deal of interest, having had something to do with city lighting myself, and I rise especially for the purpose of approving and commending the suggestion of our friend from Philadelphia, Mr. De Camp, who advises the publication of this paper for general free distribution. I know of nothing that will dispel so much darkness as light; and this paper throws a good deal of light upon this subject; and I should recommend and should be quite willing to pay my proportion for the publication of ten or twenty thousand copies of that paper, and it might be distributed very generally all over the country, and I am quite sure that if that paper were sent to a great many towns in the United States, to aldermen, perhaps, or the mayor, or some of the principal persons there, that it would create a disposition to look into the subject of electric lighting and see if they could not improve and benefit the town by a better system of illumination; and I am quite sure that there would be one of the very best advertising documents that electric light men could send out; it would bring you a great many orders.

While I have the floor I will take just a moment to say that, although I am out of the electric lighting field now, I extend my cordial sympathy to all of the gentlemen who are in the electric lighting business, who are furnishing cities with light and have to deal with city councils. Criticisms are frequently made; I have been the subject myself of newspaper criticism to such an extent and to such a degree that I have been almost immortalized in my own locality as the great coupon clipper of an electric lighting company that made its lights without any cost. In fact, I have been charged with producing electric light without the consumption of any coal. It is most surprising, all these things that you hear talked about. Here is something which throws light on these subjects. I always contended that if you want to make a good light you must first produce power, and you cannot produce power unless you consume coal, and that costs money in our country and I think it does down here. So the information which is conveyed in this paper will be very useful and will produce a great deal of excellent thought, and you will get good results from it. In this statement regarding the lighting of the city of Dunkirk, it is said that after using their machinery for a year and eight months, their lines are in a better and more perfect condition than when they first started. That differs from what my experience was, because about the first of the year, after I put in my plant, I had to build it all over again, and I have heard of others that had to do the same thing, and that is why I suggest to you that whenever you do a thing do it well. On that point I want to say one thing. Professor Barrett enjoys the confidence of every man in Chicago, whether he is a Democrat or a Republican. They all refer to him as an absolute authority, and he has absolute authority to carry on the electric light business, and his bills are paid. There is the great advantage that he possesses. I happen to know of a city where, a while ago, they wanted a few brushes, and they sent the city clerk to the nearest seaport town, and that happened to be Chicago, to buy a couple of pairs of brushes. That cost the city some fares, etc., and gave the man a chance to go to Chicago.

There cannot be a thing done unless a Committee passes upon it. If a man wants to sell a few carbons they call the Committee together; and all of you know, who have had anything to do with selling carbons, what you have to do when you meet a Committee. (Laughter.) All those things can be avoided by absolute authority, as Mr. Barrett has. I congratulate him and congratulate the city, because he is a man of great capacity as an electrician, and is an honest and square man. That is the kind of a man we want to run our electric light. (Applause.)

The President—The question is upon the resolution. Shall we print a certain number of copies to be left with the Executive Committee for general distribution.

The motion to that effect was carried.

The President—Next in order is the report of the Committee on Resolutions, A. F. Mason, Chairman.

Mr. Mason—To your Committee on Resolutions have been referred only two. I will read the first:

"That a Committee of five be appointed, of which number the President of the Association shall be *ex-officio* one, the other four members to be appointed by the President, who shall offer their services to the authorities of the Columbian Exposition with a view to securing suitable facilities for the proper exhibition of electrical manufactures and appliances, and in general to work for the advancement of electrical interests and to offer the authorities of the Columbian Exposition the co-operation of the National Electric Light Association to aid in making the Exposition a success."

Your Committee recommend that this resolution be passed. Will you take action upon that, or shall I read the other and finish my report?

The President—You better present both.

Mr. Mason—The second resolution which came to our hands is the following:

"That the Committee request the selection by the authorities of the Columbian Exposition of Mr. John P. Barrett to have practical charge and control of the electrical department of the World's Columbian Exposition."

Your Committee recognizing the fact that, while before the present gathering probably the larger part of the members of this Association had personally recommended the appointment of Mr. John P. Barrett by the authorities of the Columbian Exposition to the charge of the electrical department of the World's Columbian Exposition, yet that, on the floor of the Convention members have expressed the opinion that it is outside the province of this Association to offer such recommendation. Your Committee, therefore, return this resolution to the Association, suggesting that it act upon the same without suggestion from its Committee. (Signed by the Committee)

The report of the Committee as to the first resolution was then adopted.

The President—The second is a resolution that the Committee request the selection by the authorities of the Columbian Exposition of Mr. John P. Barrett to have practical charge and control of the electrical department of the World's Columbian Exposition. The Committee return it without recommendation.

Mr. Alexander—I move that that resolution be laid on the table.

On this motion a lengthy discussion ensued, after which the roll call was demanded.

Mr. Duncan—As a roll call has been demanded and as I have already asked for information, I now ask for the reading of the proceedings, if there was any such, on the census business, and what recommendation was made, if we made any, through the Executive Committee on the census matter. I ask that that be read, as I have no copy furnished me from which I can find it so that I can vote intelligently. I am in the dark.

Mr. Alexander—Mr. President, is the question debatable? If it is I would like to say this. In the census question the members of the National Electric Light Association were very much interested, as the information gathered there was directly to their interest, and in getting up an exposition the manufacturers are the ones that are interested; and therefore I think the two questions are not inimical at all. In one the manufacturer displays his goods and shows them to the world at large; the other was a question that directly affected your interest as central station men

The President—I wish the gentlemen would not compel me to decline to hear any more discussion on this subject. I have given more latitude than I ought to have done, because the parties are very much interested; and we will now proceed to the call of the roll.

Mr. Brown—I rise for information. Was not action similar to this taken with reference to the selection of a representative of this body when it was expected that the World's Fair would go to New York? My recollection is that that was done.

The President—Wait a moment.

Mr. Duncan—Mr. Chairman, you should understand my position. I don't want to inject any remarks. I simply ask for information, that it may be read.

Mr. Garratt—On page 29 of the official record, I find:

"The President—The Secretary will now read some communications.

"The Secretary read the following communication," which was Mayor Grant's letter:

"Mr. De Camp moved that the question of appointing a committee to co-operate with Mayor Grant be referred to the Executive Committee."

A debate upon that subject took place. The question was raised whether the Executive Committee should settle this thing or formulate it to bring it before the Convention, the President saying, "It comes before the Convention for action." The Executive Committee got ready to report on that, and some of you may remember that at Niagara Falls the Convention adjourned rather abruptly and they never reported; but the following Executive Committee instructed the Secretary (myself at that time) to append to the official report the report which the Executive Committee would have brought in if it had had an opportunity. I was asked if there was any business in my hands and I said I had none whatever, which was absolutely true; I did not have any report; they did not turn it in to me. Now I will undertake to find in this—the report of the Executive Committee is rather long and unless requested I will not read it. The Executive Committee did recommend the appointment of a Committee of five, of which the Chairman, Dr. Moses, should be the principal one. It never was passed officially by the Convention, because the report of the Executive Committee never came before the Convention.

Mr. De Camp—Let us hear what that report was.

The President—If it was at any Convention at which I was not present, of course I have no knowledge on the subject, but the Secretary seems to understand what you want. Do you refer to the recommending of Dr. Moses to confer with Mayor Grant? Is that what you refer to?

Mr. Brown—That is what I have reference to.

The President—The Convention at Niagara Falls did recommend Dr. Moses to confer with Mayor Grant, with a view of securing the National Fair for New York City.

Mr. Brown—I think the record will show something more than that. That is what I wanted to find out. I rose for the information. I cannot get it myself or I would not ask for it.

The President—The printed volume of the report of the Association has been sent for. The report having been procured the President requested Mr. Garratt to read extracts from it.

Mr. Garratt—Is it your pleasure that I should read that report?

Mr. DeCamp—I don't care to hear the whole report. The report says I made that motion. I don't remember; perhaps I did; I have no doubt I did. I understand you to say the Executive Committee did not report at that Convention on account of the abrupt ending of the meeting.

Mr. Garratt—Yes.

Mr. DeCamp—But they subsequently instructed you to put it into the appendix of the proceedings?

Mr. Garratt—Not that Executive Committee, but the one that was elected at Niagara Falls.

The President—Read the report.

Mr. Garratt—I will read it through rapidly until I strike the place. I have not read it for some time.

Mr. Alexander—Do I understand that Mayor Grant requested the appointment?

The President—I have not the slightest idea.

Mr. Alexander—I understood a letter was received that requested that appointment.

Mr. Garratt—(After examining the report) Mr. President, and members of the Convention, very much to my surprise I find that the Executive Committee in that report which they failed to materialize, made no reference to the World's Fair in New York. I was not aware of that until this moment. I knew it was referred to them and they were instructed to report back to the Convention. This is an absolute transcript for I have read every word of it out loud to the proofreader of that report, not a copy of the report, but the actual report signed by Mr. Benjamin Rhodes, and there is no reference to the World's Fair in it. It was referred to the Executive Committee and the Committee did not report on it.

Mr. Brown—Mr. President, I ask for information; I would like to know if the Kansas City Convention did not

make a selection of gentlemen to represent the Association at the St. Louis Exposition.

Mr. Garratt—I can answer that question. The Secretary of the Association received an official communication from the St. Louis Exhibition Corporation to the effect that a committee of three, I think, were asked to co operate with the St. Louis Exposition. The American Institute of Electrical Engineers were to appoint one, and they afterwards appointed one; the National Association was to appoint one, and they appointed E. R. Weeks of Kansas City; and the third one was to be chosen by the electrical fraternity at large, and I cannot inform you as to that as I don't know that it has been decided officially. I have no knowledge of it.

Mr. Brown—Mr. President, as this question is one of importance it should not, in my judgment, be disposed of without some discussion, and I move as an amendment to the motion of Mr. Alexander that the motion for reference to the committee be laid on the table to be taken therefrom and discussed as the first order of business at our next session.

Mr. Armstrong—I rise to a point of order, Mr. President An undebated question was before the house and voted upon, and the Chair being unable to decide ordered a roll call. No question of information concerning that question is at all allowable now and the roll call must proceed. We have wasted nearly an hour.

The point was sustained and the secretary proceeded to call the roll.

The President—This is to lay on the table. A vote, Yes, as I understand it, lays the resolution on the table; No, brings it before the Convention for consideration. The official stenographer will please note the result.

The Secretary then called the roll.

A Member—The Schuyler Electric Company of Middletown, Conn., has not been called.

The President—The Secretary does not find it on the roll. If by mistake it has gone on to the Association list it should be corrected. Are you a manufacturing or associate member? a manufacturer of apparatus or of electric light?

The Member—Manufacturer of apparatus.

The President—That would be properly on the list as associate member, then.

Mr. Garratt : Mr. President, I raise to challenge that roll call. If my ears did not deceive me the name of the Kansas City Electric Lighting Company was called, and Mr. E. R. Weeks said aye; the name of the Edison Electric Light and Power Company of Kansas City was called, and Mr. Weeks said aye; the name of E. R. Weeks was called and he voted aye. I want to know if a corporation can vote and then the officer under his own individual name also vote. I don't understand it.

Mr. Wilmerding—I also noticed that the name of Mr. Hageman was called. He does not represent a central station that I know of, and I would like to know why he votes.

The President—Copies of the Constitution seem to be rather scarce. The question is with reference to whether individual memberships can be held?

Mr. Brown—With reference to one man voting any number of times. That is, the question comes down to this: whether twenty dollars buys a vote?

The President—If the Association in the past has issued its certificate and taken the twenty dollars, two corporations can select the same man to represent them.

Mr. Brown—I simply inquire whether that was the ruling of the Chair.

Mr. Garratt—That was not my point.

The President—A question of personal membership?

Mr. Garratt—No, sir; not a question of personal membership, but a question whether a man representing one or more corporations which vote would have an active vote on top of that. I could have paid and had another vote, and you could have had a vote on top of the Narragansett Electric Light Company. It is a very grave question, because it exactly doubles the voting capacity of this Association. It does not touch the question whether one man represents a number of corporations and he has to answer for them all.

Mr. DeCamp.—As I understand, Mr. Garratt accords to Mr. Weeks the right to vote as the representative of one or more central station companies; but he questions his right to vote as an individual, having not as an individual operated at a central station.

Mr. Garratt.—That is my point.

Mr. DeCamp.—I think the point is well taken; that is, the question is whether Mr. Weeks, by virtue of his having a right as a representative of one or more companies who are unquestionably entitled to vote, has under that right as an operator of those companies a right to vote individually by virtue of having paid an individual fee. I think the point is well taken and ought to be decided.

The President (reading the Constitution)—"Active members shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power, for commercial or public use, and the members of the Executive Committee."

Now will you state the point and let us see if I understand it? What you claim is this: you do not raise any question as to the right of two corporations to select the same man to come here and represent them?

Mr. Garratt—No, sir.

The President.—You do question the right of an individual who does not own and operate a central station himself to have an active membership here?

Mr. Garratt.—Not quite. He may own a central station, and if he votes under the name of the central station he cannot vote under his own name.

The President.—That is the same thing.

Mr. Garratt.—Not quite.

Mr. Weeks.—I think I understand that point, and I think I can relieve you from embarrassment.

The President—I am not embarrassed when I got the point.

Mr. Weeks—I can save the time of the Convention, which is of more importance than the Presidents's embarrassment. You have read the section and the point raised by Mr. Garratt is well taken; that is my personal opinion in regard to the matter. I will therefore withdraw the vote which was given on account of my personal membership. I will state, however, in justification of having voted, that this matter was brought before the Committee on Credentials and it was decided by the Committee to let it stand just as it had been. I had taken out a personal membership in the Association, not as a representative of any company, (I have two memberships, representing two companies) but as an individual whose whole time and interest is in central stations, which would qualify me to active membership under this constitution. I therefore think the point is well taken and I withdraw the vote.

Mr. Alexander—Mr. President, the language of the section is, "Active members shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power, for commercial or public use, and the members of the Executive Committee." As a member of the Executive Committee I took it that Mr. Weeks voted.

Mr. Garratt—I object to that expression of opinion for this reason. The members of the Executive Committee have not been called on the roll as voting members. I thought of that I was quite as well aware of that as Mr. Alexander is. The names of the Executive Committee were not called on the voting roll. Still your roll is wrong; if you rule that way your roll is wrong. It don't make any difference.

Mr. DeCamp—Well, what is the vote?

The President—Do you challenge Mr. Hageman's vote?

Mr. Wilmerding—Yes.

Mr. Hageman—I withdraw my vote.

The President—The Secretary will announce the vote.

Secretary Foote—The vote as corrected, eliminating the two votes that were challenged, stands 26 yes and 17 no

The President—The motion to lay on the table has prevailed.

On motion of Mr. DeCamp, properly seconded, the Convention adjourned until 4 P. M.

AFTERNOON SESSION.

The Convention was called to order at 4:40 P. M.

The President—The first business in order will be a paper or address by A. J. DeCamp of Philadelphia on Care and Labor in Electric Light Stations and its value.

Mr. De Camp—Mr. President. I did not prepare any paper on this subject. It is pretty hard to do. This Association would get very tired of a subject treated that way. In the first place I would amend that title by calling that the value of detail which cover——

The President—Value of detail in the care and labor of electric light stations.

Mr. De Camp—Yes; value of details in electric light stations. It certainly is a fact apparent to any one who has had the handling of electric light stations that it is essentially a business of detail. The larger items about the business are very easily handled. They will take care of themselves if they are put in the right direction: but there is an infinate number of small things which very materially affect the successful operation of an electric light station. As an illustration of what I mean by that term, I will say that after considerable reflection and dividing the items worthy of care and attention in the management of the business under fifty heads all of which have to be kept track of, all of which are a positive and a direct item of expense or income, I find in looking over it for this purpose, one, two, three, four, five items which I have had to class as miscellaneous expenses, by which I mean are grouped all those items of expense which have a bearing on the business in general not chargeable to any one of the particular heads under which I have seen fit to group the business. Now in going further in that, in looking at the records I find that the amount involved in miscellaneous items for the last year, in one company, was about $15,000; going further in looking into the records to see what they consist of, the space occupied on the books of the company to cover these small items was very nearly twice as much; in other words it covered twice as many pages as the whole of the other part of the business. The items there reached from one penny up. There is no doubt but that detail may be carried to such an extent that it becomes burdensome. It may become unprofitable on some particular item, but we can only treat this matter as a whole. Now the effect of that, other than the actual amount of money, is that by the insistance upon a detail and consequently a check upon waste inasmuch as those details develop on the part of employés of the company and those who have the use of your property—you either use it for good or for ill—that there is a supervision over that and consequently a greater care on their part. I will have to illustrate somewhat, and I will say that in one item of carbons alone, where they were treated, you might say, by the inch, the reduction in the expense of the carbon caused after a system was adopted by which they were accounted for on the basis of the inches, was a saving of nearly fifty per cent. in that item alone and on following the adoption of that plan. This is proved to be correct because it has been in practice for the last five years fully. Another important thing is the matter of discipline, because it is utterly impossibe to get the detail part of your business thoroughly carried out unless you have a thorough discipline about your station. The most important item in the whole operation of an electric light station in point of dollars and cents is that of labor and I do not see but what it will always be the case. It is a most unsatisfactory th ng to deal with. I remember there was a time when we thought that sixty lamps on an ordinary circuit was a day's work for a man. Now they trim a hundred lamps more easily than they used to trim sixty, and my own judgment is that in the course of time we will work up so that 150 will be no harder than 100. But it takes patience and great care to bring that about without a t mporary effect upon your busine s and the perfection of your service. A custom of dealing with labor, I think, which requires the counting of every minute of time for which a man is employed has a very beneficial effect. I think that alone can be credited with a reduction in the pay roll in the course of three months in which it is getting into shape—a reduction of the pay roll account (that is the pay roll account which refers to labor) of some twenty five per cent. Now it takes a little time to do that and you can count that time lost, and when you get ten or fifteen or twenty men they are scattered all over a great city in groups of two or three or a single man. He gets outside of your control and you have no means of checking him. He may do a half day's work in a day, or he may do a quarter, if the account is settled at the end of the week or at pay day. A custom adopted for the men, which is a slip furnished to him by which he accounts for every hour of that service gives the man who has charge of him an opportunity of judging for himself whether that man has employed his time properly during that ten hours. The adoption and the rigid enforcement of the thing in our station did not grow out of any idea of accomplishing the object which it has accomplished. In the early history of the business—I think I have stated so here before but I will repeat it for this purpose—it was the custom of my company to do a great deal of work without charge. That was done for policy sake. The question arose as to the enormous expense of our labor and the number of employees we had on our pay roll, what they did and how they could employ their time, and as the balance was on the wrong side of the sheet, among other things, it received very careful attention. The number of men apparently required for the operation of the station was very far in excess of what anybody ever represented it to be or supposed it to be. In looking into it we found that there were two or three men working here and two or three there and three or four somewhere else. What were they doing? Well, they were making changes; they were shifting the position of lamps; they were doing this, that and the other thing. Well, we were going to be through with that—that would all be done with and we could let these man go, we thought. But the fact is they never did go; they hung right straight on all the time. That work was all being done without any charge, and the shortest way of getting at it was to say here now, that is all right; we must attend to the demands of our customers. If they have anything that they want done it must be done and there is nobody who is better qualified to it than we are. We do not want to leave it to somebody else to do. So we closed that month and started in the next on the basis of charging for that work. The basis of that charge was mainly for the labor. The labor was charged at thirty cents an hour and all waste materials—that was absolutely wasted. We did not charge for anything that would be incorporated into our own property there at all, but wires and screws and things of that kind that would probably never be of any use except for that particular purpose. At that time I think, we were running about 350 lights, and when at the end of the month we charged that up and footed it up to see what it amounted to, it amounted to eight hundred and some odd dollars. We tried to collect it, but I presume we did not collect more than $200 out of the $800. People demurred and would not pay it. But it brought the thing to an understanding. Now, no work is done after the first installation—no work will be done—unless it is to be paid for by our customer, and we get an order from our customers in which they order the work to be done and to charge to their account. That brought the next month's charges down and all we had occasion to charge them was something less than $200. There could be no better proof in the world than that very fact that as long as people did not have to pay for a thing they were very free to indulge their fancies. We would move a lamp here one week and move it back the next and move it to one side the next—mere freaks of fancy; but as soon as it cost a penny it stopped—it was not worth anything. Now we go on and follow that and our charges are very small.

Another point: We send a man out to do a job and he comes in and charges three, four, five, six, ten hours' time. The man for whom that work is done cannot account for more than an hour or two. Then comes your discussion on the payment of that account, and it is a great trouble. We know nothing. We charge a man

time from the time he leaves the station till he gets back and reports to us, and whether he has put in that amount of time, less the time of coming and going, of course we have no means of knowing -at least we did not : we get nearer to it now. Consequently comes this : a man goes in and goes on duty at seven o'clock, and is employed for ten hours. He has got to account for those ten hours through the day—where he has been. Now your superintendent can follow and he can come to some conclusion. If the man says "I was there two hours," and in the superintendent's judgment it is a one hour's job, you put a check on that man ; but under the old system he could not tell where that man went to, he might have been on two or three jobs. That is one of the things that takes a great deal of time, and I have noticed that our charges for that sort of work are very much more equitable, according to the judgment of our customers, than they have been heretofore, and, moreover, we find that the men do a great deal more work, Hence, the conclusion that any one would naturally come to is, that under a loose system a man has spent a good deal of time in doing nothing, and at our expense, or at the expense of the people whom we propose to charge for it.

Another question which I think can be very profitably discussed is that which relates to small matters of income on your revenue account. I would be very glad to hear such a discussion, and I will simply throw out a few suggestions so that some one who has perhaps taken the matter up, and has had more experience, can talk upon it The electric lighting business is not in such condition that you can take the ordinary stand and say to the public, "You will take just what we can give you, and just as we want to give it to you, or nothing." We make our contracts as specific as we can ; but we have not got a contract under which we have not given more service than we agreed to give in that contract. The service rendered is never below the standard. We have lights running on the twelve o'clock service plan, and our contracts for that service cover seven hours of maximum burning. That would mean strictly that at no time was the service rendered by those lights to exceed seven hours, which, in the winter months, is from five to twelve. But that does not do, because five o'clock is not early enough in three or four months of the year, when the lamps are sometimes lighted as early as three o'clock. It means more than seven hours in point of fact. It means rather an average of seven hours than it does a maximum of seven hours. In any city where the restrictions on the running of wires makes it necessary, or sometimes it is demanded, that you put half night lights on all night circuits with the object and purposes of switching them off, individually, perhaps, at twelve o'clock. A customer can hardly be relied upon to do that. He may do it, or he may not do it. The only safe way to do is to have them switched off by your own employés. In the same way with the all night lights which might be run, and continuously run, for fifteen, sixteen or seventeen hours—starting a portion of the lights at three or four o'clock, and switching them all out at two or three o'clock in the morning, but letting the street lights go on a couple of hours later, and running them all that much later. Now, that is a demand that is made upon you by the users of your light and it must be met. Those conditions must be met. You must give the people what they want or you will finally lose your business, and you will have to be getting new business all the time. A person will buy a property from you and pay you what it is worth, but he wants some consideration, and he will not continue to pay you for what it is supposed to be worth and only get half what he pays for, or only get it at the time when it is of the least value to him. Now, those are small things, but I have held to the opinion that to go into all those details of the means of which you rent your lights, and employ people to switch them off, or any other reasons that can be devised to do it, is an item of expense that does not pay ; that is, it does not pay for what you get in return ; and there is no element of discipline which is going to be an auxiliary or a collateral advantage resulting to us.

I do not think that there is a very general or a high appreciation put upon the methods of arriving at just what your product costs you. I think that this is recognized in the incandescent work, but not in the arc work. As long as I have been connected with this Association, and as large an acquaintance as I have among electric light central station men, I never have found any one yet who seemed to have any appreciation or any interest in knowing just exactly what his product cost him on the same basis on which he sold it. To get at the cost of a light, or of any particular part of it, it is very generally figured up as a horse power. But the point that I have always contended for is this : I rent a light for a given length of time—for a year, if you choose, which is the most favorable contract that I consider that we can make, because it gives us the longest service ; and in doing that if you figure it on the basis of excepting Sunday's you rent your lamps to furnish 312 lights, which you sell at so much per light. Now, you really want to know, not what the 312 lights cost you, and how much you get for them, and take the difference, and let that be profit or loss just as it happens to be : but you want to know just what each one of these lights costs you, and you want to know it as a whole ; you do not want to know whether it takes one horse power, or two horse power, or half a horse power, as there are a great many other things besides horse power that enters into this question.

Another thing that I find is a very common practice is to have a uniform price for a light of certain character, whether the contract is for furnishing light for six months or for a year. The same rate for the longer and the shorter term is unjust to your long contract customers. It is a very easy thing to rent lights during six months of the year, commencing the 1st of September, October or November, and it is a very easy thing to keep such customers because they want the lights most at that time. But in the summer time people discontinue the use along about the first of March, April, May or June, and so you have an idle lamp during the summer, in which you have your money invested, waiting until the fall season comes around again, in all probability. I contend that the user of that lamp has no right to expect to get that light at the same price per diem as the man who pays you for a service of 312 nights in the year. But that is almost universally done. There is just as much reason for a graduated scale of prices based upon the amount of service you get from your customer as there is for fixing the price for a ten o'clock circuit, a twelve o'clock circuit, or an all night circuit. There is just the same principle involved. When that first became apparent to me the first effort I made to equalize the prices on that basis showed me that there was really nothing to go upon excepting guess work. After the first year's experience I had the result of my own experience to go by, by means of which I could work it out probably in a little better shape. But I found myself doing an injustice to our customers when I thought that I was doing an injustice to myself.

A re-adjustment of those prices on what I worked out on the basis of an all year contract for an all night lamp—a lamp that would render me 312 nights of service of ten hours each, and give me the most continuous service, is the one that I started with: but I found that I was charging, in point of number, too little. It puts the company in the position of making a uniform contract in which they can say to every customer, or to every person that comes into the office that the company will duplicate for him any contract that it has on its books. I contend that if we could (and for one I want to try it some day) run our arc light machines from the time of starting up in the morning, continuously, as we run the incandescent machines and make your contracts to run from time to time at certain hours of the day,—if there was any possible way of doing that, and charge by the hour, or at least by a group of hours rates in that way, we would meet a very great demand and do justice to costumers and popularize the business.

I have not said much, but I would like to hear these things discussed ; and I presume that every one here has had some experience in the line of what I have been saying.

The President—The subject is open for discussion, and if anyone has anything to say on it we shall be glad to hear from him. If not, we shall take up the next paper.

Mr. C. R. Price—Before the matter is dropped I would like to ask Mr. De Camp a question. I did not get his idea with regards to the charges for electric light service under those circumstances,—whether he would change the rate for small customers, or whether he would fix one rate right straight th ough the year. I did not get his idea as to that.

Mr. De Camp—I have only referred to the gradation or scheduling of prices in accordance with the service required.

Mr. Price—You would make a charge at so much per hour ?

Mr. De Camp—No. What I say that we are doing now is that if we make a contract for a year, for a lamp which renders us an income for 312 nights in the year, we fix a rate for that. We consider it, on account of its giving us the most service for the period covered, the best form of contract that we can have. Now, if a party comes in and wants precisely the same lamp to burn the same number of hours per day, but says "I will contract to give you service for that lamp only for six months of the year," then I contend that man should be charged a very much higher price per diem than the man who takes it and gives you a guarantee of 312 nights of use.

Mr. Price—Whether it is a Summer or Winter lamp ?

Mr. DeCamp.—I base the charge on the all winter scale, of course. If a person was to come in and say, "I want to give you a contract, or an order, for a light to burn six months in the summer," then that would be an entirely different thing, and that man would be entitled to a very low price because he is going to rent from you your product when you are overstocked with it. That is a supposable case, but in point of fact such conditions do not exist to any extent, or at least they do not in our city. I think the highest that we have ever had since we have been in the business is not over eighteen or twenty exclusively summer lights. We do not follow that up, because we do not consider it a paying business ; but we do have during the months of November. December, and possibly in January, such business that I suppose we could double up the output of our station from the demand at that time, but only for that time. But during the other eight, nine or ten months of the year we would have our property there a dead stock. There was not enough service for that kind of business to warrant the outlay of money to meet it for the time, because we have got to make it just exactly like this hotel business. The business they do in this hotel has cost just as much money as it would for an all the year business, although they have got to do all their business and take in their money in about two months of the year. I saw a price-list not long ago where the difference in charge for a light on a year's contract, and the price for a light on a six months' contract, was five cents per night. That does not amount to anything ; it has no relation at all ; it does not bear the slightest proportion to the difference in the value of these contracts. As near as I can figure it there should be added to the schedule for a six months' contract at least fifty per cent. on the yearly product.

Mr. Price.—Do you make any difference for three months' customers ?

Mr. DeCamp.—We do not have any three months' customers. We do not make any contracts for anything less than six months. It is sometimes the case that we have lights that burn for two or three months, but we make the price without any reference at all to our schedule price. There is no reason why we should not do it. If a man comes in who is putting up a large building on our line, and wants temporary lights, and he may want them for a week, for a month, or for two months, if we have got a circuit there, and there is room on it for two or three lights more, or for whatever the man requires, and there is no probability of getting him into the regular service within the period of time that the lights can be rented for the temporary service, then we rent those lights to him sometimes for two or three dollars per night, just according to the time of the year and the location of the lights. But that is a business that cannot be counted on : it is a temporary business. I am talking now about the regular run of the business in which your money is invested in establishing and keeping up the business : and I do not think that I am out of the way when I say that if you rent on yearly contracts lights for 50c., you must get at the rate of 75c. for lights rented for six months only, in order to make the one meet the other as the result of the amount of capital invested to do the business.

Mr. Price—Can you read off your schedule of prices quite easily ?

Mr. De Camp—The price for a twelve months' contract (and that covers a distinction between a seven night light and a six night light) is 65 ; for eleven months, 62½ ; for ten months, 70 ; for a nine months, 75 ; for eight months, 80 ; for seven months, 85 ; for six months, 95.

Mr. Price—That is for all night ?

Mr. De Camp—No ; that is for half night lights. For all night lights we add fifteen cents to each one of those prices ; that is, we charge fifteen cents more for all night lights than for half night lights.

Mr. Wilmerding—Is there any discount from those prices ?

Mr. De Camp—Yes ; there is a discount. We render bills on the first of the month, and stamp each bill, "Ten per cent. off if paid before the 10th of the month:" but the contracts are made without reference to the ten per cent. deduction. We simply tell the customer that. We bill on the first of the month, and each bill is stamped subject to discount if paid on or before the 10th of the month ; and with very good results, as ninety-five per cent. of all our bills are paid at the end of the time, and we do not have to send for them.

Mr. Wilmerding—Do you deliver them promptly on the first of the month ?

Mr. De Camp—I do not suppose that they all get them but they are there on the second.

Mr. De Camp—In answer to a question.—On these particular rates we have been running for a year, but the same principle prevailed for three years previous. We started on the basis of having a uniform and graduated schedule of prices. I remember what the President of the company said :—our business was in very nice shape, and we were running I think at that time about 750 or 800 lamps, and we had an order from a customer which said. "Do thus and so we will pay you so much money." I have had one or two cases where I have had trouble, and where I had to bring a suit in order to get a settlement with parties, and I had found that we did not have any foundation for a suit except a contract by word of mouth : and it occurred to me that there was a great necessity of having a binding and substantial contract so that there would be no question about it when we had to resort to such means to collect a bill. I found out that they had made an attempt to get an equalization of prices, but such prices would not have been fair, and I would have made a mistake in adopting it. So I got up a new schedule and while doing it, and at the same time, I determined to make out a contract or lease ; and so I drew up a lease, had it approved by a competent attorney, and when I took it to the president of the company he said. "Now, look here ; that is all right : there is nothing unfair about it : and if any man wants to do the right thing and live up to a contract he ought not to have any objections to signing that." Then when I came to the question of having our prices uniform he said. "That is about right, but I do not believe that you had better undertake it. I

figure out where some of our customers would be very seriously affected by a uniform price,—that is, they would have the price shoot away up on them ; but I have not looked over the whole thing." I said, "I guess we can afford to take that risk." I think that in the effort to get the thing straightened out, and to get those contracts signed, I lost about five lights on the six months basis. I think that five or six men would not sign the contract, and abandoned the light, and we let them go. But others took it up. Now it requires some effort to do that. We would rent a great many more lights if the difference between our prices for twelve months and for six months contract were not so great. But I think the difference is quite fair. It is certainly a great loss to any one to have a part of their plant idle a part of the time.

Mr. Wilmerding—In Chicago, on the twelve months' contract we charge 65 cents, with fifteen cents discount per lamp per night. But I am speaking of the arc light only. Where the wire is paid for by the customer it lets us out on the short contracts. If a customer does not want it for more than three months we have got to have some rule established by which we can give it to him; and they are willing to pay for what time they use the lamp. In that case it is the same to us whether the customer uses the lamp for three months or for a year. So long as he pays for the actual cost of construction, and we are getting our regular rates out of him, we will get out whole.

Mr. De Camp—I do not think you are getting out whole. I do not think you are getting enough for it.

Mr. Wilmerding—But you must be in a position to accommodate the public more or less, and so you cannot make an absolute rule which will suit all classes of people. If you are willing to get the public down on you, then you can be indifferent about that; but if you are going to furnish electric lights, and wish to keep the business in your own hands, and not give up the field for some one else to come in, then you have got to accommodate the public by giving them lights for short terms if they wish them.

Mr. Price—I understand those are for full arcs. Did you have any half arcs?

Mr. De Camp—Nine are six-tenths, or nominally 2,000.

Mr. Price—Did you have any 1,200?

Mr. De Camp—No.

Mr. Wilmerding—Do you wire those lamps free?

Mr. De Camp—Yes; We charge nothing for inspection.

Mr. Wilmerding—On the six months or on the twelve months contracts?

Mr. De Camp—In neither case.

Mr. E. R. Weeks—Mr. Wilmerding has the advantage of being placed in a city where the interest amounts to nothing, and where the depreciation is nil.

Mr. De Camp—That shows a disposition on the part of the public to be fair to the company, but still they are not paying near enough. If your year's service will render you one hundred dollars, and your six months' service would render you only $50, and the man pays you for the cost of putting the light in, which would be five or ten dollars, he would not be paying enough. I say that if you can fix upon a correct and true value for your service and plant, then you can very easily fix the proper charge for the difference between 156 days and 312 days. If a man does not want the light for more than six months it is a great deal better for him to pay a higher price for the six months when he does want the light than to pay for it for six months when he does not want it at all. That is the argument that we use, and it is pretty generally accepted, because it is fair. If you rent a house in the City of Philadelphia for twelve months, you cannot pay for that house for nine months, and then go to the seashore for three months in the Summer and tell the landlord that you do not want to pay rent for that house during those three months. If you want to rent the house from him for nine months, and then leave it for three months in the year, he may make you a price for the nine months, but he will not give you the regular price for twelve months, and nobody expects him to.

After further discussion on this subject engaged in by Messrs. Wilmerding, De Camp, Hart and Renshaw, during which the latter gentleman gave his experience in Washington, the President called a halt and intimated that the discussion was getting beyond its proper limits. The discussion was then closed and the next paper read was on "The Proper Basis for Determining Electric Motor Rates" by Mr. H. L. Lufkin, of New York. The paper was read by Mr. Joseph Wetlzer.

A short while ago, said Mr. Wetlzer in discussing with Mr. Lufkin the charges paid for electric motor service, he pointed out what seemed to me a number of anomalies in this matter ; and when I expressed my opinion on the matter also he brought out a large number of diagrams in support of his opinion. A small number of these—although they may appear large in the aggregate—have been embodied in the diagrams which have been distributed here, and which will elucidate the paper which I am about to read.

Mr. Wetzler then read the Mr. Lufkin's paper, which found on page 9.

The President—The paper is now open for discussion.

Mr. Worth.—I think the writer of this paper is a little bit too fair to the gas engine. I am not very familiar with those figures at present—not as familiar with them as I was at one time—but I think it would be a very large gas engine, a very good gas engine, to give a horse-power for twenty feet. I was talking a little to a gas expert and he told me that with some kinds of gas it would burn as high as fifty feet—that was fuel gas. I remember the result of a test where twenty-two feet was used per horse-power per hour, but I would not expect to get that result with commercial and small engines.

Mr. Garratt—May the apparent discrepancy not be this, that the figure of twenty feet for horse-power of gas engine meant on an intermittent load.

Mr. Faben—The Otto Gas Engine people of Philadelphia, who make the gas engine, will warrant that the engine will not consume to exceed two and a half feet per hour, per horse-power, with an average commercial illuminating gas. Experiments were made in New York by the *Popular Science Monthly* in treating domestic motors. They cited that fact of twenty-one and a half feet ; but the experience had rarely shown that that quantity was consumed. It ran less than that. I have the observations of a number of engines running with ten-horse power and less which ran with about twelve hundred feet of gas per ten hours. That was on the basis of a ten-horse engine.

Dr. Louis Bell—I have some little interest in this question of the gas engine for the reason that the gas engine seems to be the principal opponent of the electric motor for light work. In all of the tests that I have ever seen, which were at all of an authoritative character, I should say that 20 feet per hour, per horse-power hour, was a minimum figure and not only a minimum figure but one considerably below the usual minimum. I have had occasion to handle in the last year and a half a large number of tests, both in this country and in Europe, and very few of them showed less than 23 or 24 feet of gas, although this figure was sometimes slightly better. Then further, it is interesting to raise the question as to whether this so-called 20 feet per horse-power hour is brake-horse power hour or indicated horse-power hour. Any of you who are familiar with the diagrams given by gas engines on indication are only two well aware that the light load diagram of a gas engine is by no means lean. It shows a very considerable consumption of power, and the only proper test of efficiency in gas per horse-power hour is in brake-horse power. The indicated horse-power hour of a gas engine is not at all comparable in most cases to the indicated horse-power hour of a steam engine. As a rule the friction comes in to play a much more important part, and further, the amount of oil used in gas engines is very considerable, so that in one prominent test in England, a short time since, an allowance of some five feet of gas per horse-power hour was made to cover the extra consumption of oil—that is, nominally—the oil being, say, 23 feet per horse-power hour it was considered fair to call the real consumption, to bring it down to a gas basis, 27 or 28 feet, on account of the extra amount of oil. A very considerable number of tests of small engines have been made, and although the lowest possible figures approximate somewhat nearly to those given, the average is very much higher—frequently nearer 30 feet than 20.

Mr. Worth—The gas engine uses water in considerable quantity. In some cases this expense would be well worth taking into account. Another matter with the gas engine is providing for the exhaust—there must be a large free exhaust, and this exhaust must be leaded to a point which makes it danger us in regard to fire and which makes it necessary to protect it thoroughly.

Mr. E. R. Weeks—I would call on Vice-President Edgar. He has had a very large experience in the matter of motors.

Mr. Edgar—I have listened with a great deal of interest to this article of Mr. Lufkin, because I have talked the matter over with him to a great extent, and I know that a great many of his curves were made from motors running from our station. Our efforts in the last year and a half to two years have been to sell motors entirely by meter—selling it by the absolute horse-power hour, and of the last 400 horse-power which has been used in Boston, I should think that 250 are now paying for their current entirely by meter at so much a horse-power hour. We make a nominal charge of 10 cents an hour per horse-power, making discounts from this down to 40 per cent., so that the minimum rate is six cents per hour, the average being from seven to eight. This is irrespective of the size of the motor. It depends entirely on the number of horse-power hours per day as compared with the maximum which that motor can generate. In other words, a one horse-power might get just as good a rate as a 30 horse-power motor, provided it used as much as its maximum, as if it were a larger motor. I think that the question of charging by the nominal capacity of the motor is something I never heard of. Our station has never tried to charge in that way. It has always charged by the maximum load of the motor. In other words, a man could put in any motor he pleased; he would simply be charged, when he was charged by contract, the maximum power which that motor used at any time by means of the ampere meter. If a person was going to use five horse-power and he was inclined to put in a ten horse-power motor, we were very glad to have him do so, and we would only charge for the five horse-power if he used only five horse-power. I never heard of a case where a person was charged for ten merely because he happened to put in a ten rather than a five.

The President—The next paper will be on "Standards of Economy in the Generation of Power and Steam under the Best Conditions." It will be presented by the author, Mr. H. M. Swetland, editor of *Power and Steam*, New York.

Mr. Swetland then read his paper as follows:

The text of this paper will be found on another page.

The President—The paper is now open for general discussion in the Convention. Perhaps it would be as well for Mr. Williams, who is to speak on a triple expansion engine, to follow with his paper. We can take them up and discuss them at once.

Mr. Williams, of Beloit, Wis.—I had hoped to get enough accurate data concerning the perfomance of triple engines to bring before you and to make the subject the basis of a paper, but circumstances have been such that the engine I attempted experimenting on has been so situated that I could not get it rigged up for making the tests, and therefore I cannot give you any accurate data in regard to high speed triple expansion engines for central station work. The main points to be considered in the matter are, however, first, the matter of regulation. Perhaps that is of the highest importance and the matter that is in most question by engineers as to whether there will be a momentary variation in the speed of the triple engines when the load is suddenly increased or decreased that would not occur in single cylinder engine practice. Now that matter depends mainly on the weight of wheel and the intermediate spaces or clearances, and will be modified more or less by the accuracy or quickness of the governor ; and as to whether this can be done or not, I will say yes, it can be done. The weight of wheel can be made sufficient, the clearances can be made sufficiently small and the governor can be made sufficiently quick and it is done so that the engine will not vary materially under sudden changes of load. Of course the smaller the clearances the heavier the wheel, and the quicker the governor the less will be the momentary variation. As to the matter of cost, taking the entire plant considered as a whole—boilers, engines, and all, the triple will cost, I presume, approximately 20 per cent. more in the compound. The economy of triple is unquestionably considerably in excess of compound on the evidences so far taken from marine practice. For example, about 20 per cent. in the compound. It is a fact that compound engines, compound plants under ordinary circumstances where coal is, say at an average price of $3 per ton, will consume their entire first cost in about five years' work, in coal bills. Assuming that the triple will save 20 per cent. over the compound, the triple would save the excess of cost over the compound in the first year's service.

There is another matter to be considered, namely, the reliability of the machine, the smoothness of action. The triple has advantages over the compound in that respect, theoretically, which, as far as we know of it so far, practice has sustained. It appears, as far as the evidence goes, and as far as we know of their action, that the triple engines are a much easier engine to care for than the compound. The compound is much easier to care for, ordinarily than the single for reasons which are accounted for in theory and I think the practice will sustain the theory.

I ask your pardon for not having a paper prepared but I could not get the exact facts to bring before you, therefore it has been quite impossible for me to do so.

Mr. Garratt—I unfortunately, did not hear the report of the Committee on Data, and it occurred to me that possibly the compilation and the very figures that were suggested in Mr. Swetland's paper might be a part of the plan of the committee. If not, I would suggest, and when I am informed, move that a small committee, say a committee of three, be appointed by the Chair, to report at the next Convention on the actual cost of producing power in central station practice in this country, giving actual data of operation, that is, the nature of fuel, the nature of steam equipment, and the nature of engine equipment. If that, however, is going to fall within the province of this other committee I will not make that motion. I am asking for information.

The President—The general plan which was originally adopted for the Committee on Data was intended to comprehend that subject, and you might make the motion to have it referred to the Committee on Data with instruction to report. It was intended to comprehend subjects generally of that character, and if they are pursuing a particular line of work there is no reason why they should not take this up and go ahead and report under instruction. The fact is that the Committee on Data has not reported.

A motion by Mr. Garratt that the subject of Mr. Swetland's paper be referred to the Committee on Data with the suggestion that if they are not going to make a specific report upon that subject that either a sub-committee or a new committee be appointed to report six months from now at the next Convention on the point touched upon in Mr. Swetland's paper, was carried.

Mr. Huntley, who was down for a paper, the title of which is, "How can the National Electric Association Best Serve the Interests of Central Stations?" not having put in an appearance, the President called for the report of the Committee on the Revision of the Constitution M. J. Francisco, chairman. I will state in that connection, said the President, that the committee will move the adoption of the report and it will then stand over until eleven o'clock to-morrow. In the meantime copies of that can be distributed by the page of the Convention.

Dr. Mason—Mr. President, will you kindly state what the order will be—that the report will be read and will stand over without discussion to-day.

The President—Stand over without discussion to-day. Simply move its adoption, and let it stand over for discussion.

Dr. Mason—Let me ask you if it is perfectly sure that we can make any amendment to the Constitution to-morrow in that report, and then act on it on the same day? Is there not grave doubt on that question?

The President—It is a revision of the Constitution, not an amendment.

Dr. Mason—Perhaps some will wish to offer amendments. It is a question which, if you will settle, perhaps we can be clearer as to our course. It is a serious question whether, under our present Constitution under which we are acting, any amendment offered after this afternoon's session, could be acted upon for six months, providing we shall adjourn to-morrow. I think that is a very serious question and I have doubt about it.

Mr. Armstrong—I do not think that there can be any question at all but that any amendment proposed by any member can be acted on properly to-morrow when this comes to a vote. That very question that Dr. Mason raised is raised almost every time a proposed amendment is offered to the Constitution. The purpose of giving notice is that no one

may be surprised by an amendment. Here is a total revision of the whole matter to be put to vote at once, and you propose to put it over until to-morrow's session. There is no amendment here which we should not have. Any change necessary to be made in that, in the judgment of the House can be made before that vote is taken. If it were the contrary, you would have to consider the whole thing and in order discussion, and simply postpone the vote to the next day. See how contrary to all rule it would be. The purpose for which this lies over is that every member can see whether it meets his views. If it does not, then to propose amendments, before it comes to a vote, to-morrow. I think there can be no doubt that it can be amended in any possible way to-morrow before vote is taken.

Dr. Mason—Mr. President, will you kindly rule on the question I make now?

The President—I think that I should rule that that provision was inserted in order to give due notice, so that any one interested in the Convention should have an ample opportunity to examine what is proposed to be adopted and prepare himself for discussion—that it should not be rushed through—arranged for and rushed through, in the absence of certain members, perhaps, who would oppose it, if they knew it was coming up. Therefore, it seems to me that justice is done and I think the object of the section is met by introducing the report, reading its adoption, and any amendment that needs to be offered now can be accepted or rejected by the Chairman of the Committee, and making it the special order for 11 o'clock to-morrow.

The report of the committee was read by Mr. Francisco, as follows. In behalf of the committee I offer the following resolution:

Resolved, That the report of the Committee on the Revision of the Constitution be accepted and adopted, and the new Constitution to take effect January 1, 1891.

Mr. Duncan—Mr. Chairman, I move that the report of the committee be received and the order of business be fixed for its consideration to-morrow morning at 11 o'clock, and that we take it up for consideration *seriatim*, and that immediately thereafter follow the resolution as reported by the Chairman of the Committee. Carried.

Secretary Foote then announced the programme of the evening entertainment, after which the Convention adjourned until 10 A. M., Thursday, August 21st.

FIFTH SESSION.

The Association met Thursday, August 21st at 11 A. M.

Mr. Barrett rose for information but the President ruled him out of order, and a somewhat animated fusillade of words ensued between the two. Mr. Barrett finally took his seat with the understanding that he should be heard at another time.

Mr. Mason asked if the report of the Committee on the Constitution now before the Convention, was to be read, or is its consideration now in order. The motion, he thought, was that it should be taken up this time Article by Article.

The President—It was presented last night, and read when presented. Copies of it have been distributed to all who have applied, and I do not think it is necessary to proceed to read it again. I think the gentlemen have acquainted themselves with it. That was the object of giving them an opportunity to become acquainted with it, beyond simply by hearing it read quickly.

Mr. Mason—Will you kindly permit me to give notice that when we shall come to the consideration of Article III. I have an amendment which I wish to offer.

Mr. Armstrong—I believe that the resolution offered by Mr. Duncan was that the Constitution be taken up seriatim this morning. By that I suppose it is understood that the Secretary need not read the words of each Article, but that he need merely read the title of the Article, as we have the Constitution in our hands, and can consider the articles as read. That will save time, as you have suggested.

The President—The Secretary will read the first Article.

The Secretary—(Reading) "Article I.—Name. This Association shall be entitled the National Electric Light Association." The word "the" is not printed here as being a part of the name. Adopted.

The Secretary—(Continuing.) "Article II. Object. The object of this Association shall be to foster and protect the interests of those engaged in the commercial production of electricity, for conversion into light, heat or power." Adopted.

Article III.—Membership. Section I.—Members shall be divided into three classes—Active, Associate, and Honorary. Active members only shall be entitled to vote and take part in the deliberations of the Convention, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power, for commercial or public use."

Mr. Mason moved an amendment to make the section read "Members shall be divided into two classes—active and honorary. Active members only shall be entitled to vote, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power, for commercial or public use," and gave notice that if the motion was seconded he wished to make a remark upon his amendment.

The motion was seconded by Mr. Seely.

Mr. Mason—Now, Mr. President, I wish to say that I had the honor to be a member of the Committee on the Constitution, whose report is now before you. The proposed Constitution, as it is printed and in your hands, was brought before this Committee; and I was appointed in the committee to say that I would not sign the report, and I never have signed it. I stated to the committee that it seemed to me that the Association—I will not say a deliberate and intentional—but it was nevertheless a real insult to every associate member, that it asked him to occupy a position here which it would be no man could long and maintain his self-respect; that it asked him to become a so-called associate member of this body, but with absolutely no rights or privileges, except those of being here during the period of sessions, and not when executive business was being considered—giving him not even the privilege of sitting here during those times. I do not agree with what I have said or am saying; but further I wish to say that I do not see how any gentleman can maintain his self-respect and occupy such a position as that in any body. The intent of this is undoubtedly to shut associate members entirely out of all contact with the Association. Now, gentlemen, if I were purely and simply engaged in the business of producing and supplying electricity for light, heat or power, for commercial or public use, I think it is quite probable that I should desire to be a member of an association composed only of such men; or at least only where such men should have any voice in the proceedings.

Things have been developed which seemed to render it necessary for the self-protection of the class of gentlemen referred to here that they should have just such a closed door association. I am not one of those, however. I happen here to represent a central station for the time being in which central station I am not an officer. I do not intend ever to be an officer: I may be in some other; but it does not seem to me possible that I could ever, while engaged in business as I am, permit myself to be a member of the National Electric Light Association under the conditions proposed in this revised constitution or in the one which may exist if my amendment obtains. So much for the personal part. Now it is a fact that certain members—my own impression is a large majority of the active members of the National Electric Light Association—feel that it is necessary for them to be by themselves; they feel that the associate membership, as a whole, is a disturbing element, a dangerous element. I recognize the fact that originally they received associate members into it with certain privileges. They have since curtailed those privileges. They now propose to curtail them yet more. I say they have a right to. I do not dispute it for an instant. Whether they have the right or not I would accord it. I would vote that they might have it; but I would not sit in any such body, occupying the relation I do to business interests. Therefore I make this motion in order that if anything like this constitution is to be passed by this body and accepted as its governing plan we shall not be found in the position in which this would leave us. It is without any spirit of anger, without any rancor, without the slightest feeling that I offer this amendment. I am aware that some gentlemen might be found to vote that I not vote to leave it about as it is now—that associate members may have certain privileges but not that of voting. I believe that the National Electric Light Association in its active membership has its rights; they alone will vote upon this constitution. I speak to them now when I say this: You do offer us an insult if you pass this article and adopt this constitution as it reads here, and for one I do not want it. You do what you have a right to do if you strike these words out and leave us entirely in the cold. I believe it would have been more courageous of you, more manly to put it squarely to us in that way. I say either leave us with all the privileges we have under the present constitution or strike those words out and leave us out with the words. (Applause.)

Mr. Alexander—Mr. President, the gentleman did not object when Article II. was adopted which reads that the object of this Association shall be to foster and protect the interests of those members.

After considerable discussion on a question of parliamentary law, Mr. Alexander withdrew his substitute, and the question reverted to the amendment offered by Mr. Mason.

Mr. T. Carpenter Smith then arose and said—As I understand the case now, Dr. Mason has presented his amendment with the idea of bringing out the feeling of the active members of the Association with regard to this change in the Constitution. I am one of the active members and always have been a central station man and I speak with more freedom. The first words I ever spoke in a convention of this Association were to urge one of the points in this paper on the committee that the associate members should not have a vote but should be entitled to all the privileges of the floor. At that time the feeling was very strongly against such a change being made, and I was called down very strongly by the then President of the Association, but as time has gone on things have changed and we now have the membership practically divided in that way. As a central station man I think that we most certainly do want the associate members in. The associate members are a very valuable part of this Association, and I think nothing brings that more strongly before us than the fact that in the first place the Association is founded for the benefit of central station men, that they may get information and help from it.

Now, my experience has been that where you get a body of men all working in the same business every one of those men will have a different way of doing that business, and as a rule can see no other, and even with the best intentions; his mind gets into a certain groove; and the little business secrets that he has may be devices of his own and he does not care always to give them away. Not only that, but in the present state of the industry in this country the central station is absolutely dependent upon the associate member in the manufacture. There is not, I believe, a single central station in this country that manufactures its own apparatus, its own wires, or its own supplies, except in such minor details as brushes and things of that kind, and there again he is dependent upon the copper men. The time may come when central stations may, as they are doing now, some of them in Europe, make their own machinery; but I think that time is pretty far off in this country. Now, when a central station man wishes to get information about the merits or demerits of an apparatus which he wishes to purchase, or supplies which he wishes to purchase, if he goes to another central station man to get his information the chances are that he will get an opinion and that will be all; the material supplied by that man may not be used under the proper conditions and the conditions intended by the manufacturer, and consequently it is not tried under fair conditions. But if we have associate members with us at these meetings, and a paper is presented by one of those associate members, or if they get up and make statements, and if those statements are not correct, there is sure to be some other associate member in the same line of business who will point out the defects, and the question is discussed; and the best time for central station men to get the best knowledge is when the associate members are quarreling among themselves. (Laughter.) Now, if you shut off the associate members from discussion on the floor you lose the benefit of all that. Not only that, but the minute you strike out the associate members from any representation in the convention they will do, I believe, as I would do, get right out and not come here. Now, I have stated more than once that the associate members and supply men will come to the Convention anyhow. Men who have goods to sell will come here. They will continue to do it, but it will be done in a very different way from what it was before. At present I think the manufacturers are some of the best men in the Convention—men who are not simply salesmen, but who discuss things intelligently and who can meet the central station man on his own ground and make an effort to provide material and devices that shall meet their wants; but if the supply men are only to have an opportunity to sell their goods they will send around a salesman with a big sample case, and that is the end of it.

Another point: We had a paper presented here yesterday by Mr. Lufkin. As a central station man I do not hesitate to say that I do think there is one central station man in ten in this country who can discuss that question; it is not in their line to discuss the efficiency of motors and things of that kind as regards their manufacture; it is only as regards their use; and when we get papers like that from the associate members it shows the value of the associate members. If you will look through the past proceedings of the Association you will find that a great many of those papers have come from those men. I hope Dr. Mason's amendment will be voted down, because I believe there is an amendment going to be offered which will cover that ground exactly; that is, to leave the associate members as members of the Convention, with the right to discuss all papers on the floor, and simply leaving them in the same condition as they were before; but giving to active members only the right to vote and the right to be in executive session and to direct the policy of the Association, which is after all intended for central station men. But I do not wish to see central station men cut off what I have always considered to be the most valuable source of information which they possess. (Applause).

Mr. Whipple—Mr. Chairman, it seems to me that in this Article III there are two questions: First, shall we have associate members; and second, if we do have them, what shall be their privilege? Therefore I move that we divide this question and that we vote first upon the first paragraph and then upon the second paragraph. I think there are two separate questions there.

Mr. DeCamp—I was going to suggest in the same line that if we take a vote on Section 3 as it stands, any amendment to be offered, would settle the formation of Section 1 as to the wording of active or associate members—whether they would be both in or only one.

Mr. Alexander—Mr. President, that does not cover the question that Dr. Mason raises, and that is whether you want any associate members at all. That is the question that he raises and that is the question that he wishes to have a vote on, and I think by voting on that question soon we can soon decide it.

Mr. Mason—Mr. President, I rise to be one to request that when the question is taken it will be by roll call.

The President—Dr. Mason will you read your resolution again and the Chair will order a roll call?

Mr. Mason—My motion was that in Section 1 of Article III, in line 4, the word "three" be changed to "two"; the word "Associate" be stricken out, and the interpolation in line 5, that is, the part that is written with a pen, be also stricken out.

The President—Will you kindly now read the Section as it will read if adopted.

Mr. Mason—"Members shall be divided into two classes—Active and Honorary. Active members only shall be entitled to vote, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power, for commercial or public use."

I wish to say, Mr. President, that certain gentlemen—if you will pardon me I will mention a name: Notably Mr. Seely thought that this written part was an amendment. You will inform the gentlemen, I am sure, that this written part is a part of the original report of the Committee.

The President—The Secretary will proceed to call the roll.

In answer to questions after the Secretary had called the first name the President said: If you vote No you vote to retain; if you vote Aye you vote to exclude associate members.

The Secretary then completed the calling of the roll.

The President—I think it is perfectly fair to say in regard to Mr. Barrett of Chicago, whose name is there under conditions under which the vote was challenged before—I think under the same conditions under which Mr. Weeks' and another gentleman's vote was challenged yesterday; and I think it should be passed by the Convention or should be withdrawn, because it is there on the roll, and I think it

should be passed upon just the same as those two yesterday.

Mr. Weeks—Mr. President, if it is in order, I would say that the Committee on Credentials would like instruction in regard to this case.

Secretary Foote—The entry on the roll is "Electric lighting, of Chicago, Ill., John P. Barrett, representative."

Mr. Armstrong—Do I understand, Mr. President, that you have ordered that called by the Secretary.

The President—I ordered that called.

Mr. Barrett—(Voting) No.

Mr. Armstrong—I challenge that vote. I desire to say that I do it on the ground of the challenge that was made yesterday to Mr. Weeks' individual vote. I believe my challenge to be wrong; I believe that challenge was wrong. If Mr. Barrett is entitled to vote, Mr Weeks is entitled to vote. I believed Mr Weeks was entitled to vote; I therefore believe that Mr. Barrett is entitled to vote, and that if we refuse one we must refuse both.

Mr. Duncan—Mr. Chairman, I would like to suggest that the Constitution under which we are acting says "corporations." I believe that the city of Chicago is a corporation.

Mr. Armstrong—"Corporation or individual."

Mr. Duncan—Yes, a corporation or a representative.

Mr. Armstrong—He is not a representative of the city at all.

Mr. President—The city of Chicago is a corporation—a municipal corporation.

Mr. Weeks—The city of Chicago corporation is not a member of this Association. This membership is taken out by Professor Barrett in his own name in the capacity of superintendent of lighting in that city. It is exactly a parallel case to my own, and very nearly a parallel case to that of Mr. Hageman, whose vote was also challenged on roll call yesterday. We have all three paid our $20.

Mr. Armstrong—If you will permit it as a privileged question, to gain the sense of this Association, I move that the vote of Mr. Barrett be permitted; and of course that, by the ruling of the Chair, will permit the vote of Mr. Weeks.

The motion was carried.

The name of E. R. Weeks was then called by the Secretary and he voted no.

Mr. G. S. Hageman was not present and his vote was not recorded.

Secretary Foote then announced that 41 votes had been cast, all of them No.

Mr. Alexander—Now, Mr. President, I am about to renew my amendment to Section I, Article III; but before I do it I would ask the President, to facilitate matters, if he would call instead of a roll call a rising vote, with the privilege of challenging whether they are active members or not; that is a rising vote of active members on each section, instead of a roll call, so as to facilitate business. I renew the amendment that I offered before that the word "only" in line 5, Section I, Article III, be stricken out, for reasons already given.

Mr. Mason seconded the motion.

Mr. Alexander—The section will read as follows:

"Members shall be divided into three classes—active, associate and honorary. Active members shall be entitled to vote and take part in the deliberations of the Convention, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use."

Mr. Armstrong—That will be allowed anyhow.

Mr. Francisco—Mr. President, if the gentleman, Mr. Alexander, will notice, it says, "Active members only shall be entitled to vote." Now, if you strike out the word "only" you then say, "Active members shall be entitled to vote." You leave the word "only" out and you do not say that associate members shall not vote; you say active members may. We do not want to mix this report so that there will be any ambiguity in the language. Put it so that every man will know what you mean and so that there will be no misconstruction. You do not say the associate members shall not vote and you do not say anything about it; you simply say active members may vote.

After some further discussion the President requested the Secretary to read the amendment as proposed finally by Mr. Alexander.

The Secretary read as follows:

"Section 1. Members shall be divided into three classes—active, associate and honorary. Active members only shall be entitled to vote, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use."

The amendment was then adopted.

The Convention then proceeded to the consideration of Section 11, Article III.

A lengthy discussion followed, and after various motions to amend the section it was finally got into proper shape to vote upon. As amended it read as follows:

"Section II—Associate members shall be electricians, electrical or mechanical engineers, manufacturers, corporations and individuals who are otherwise directly or indirectly interested in advancing the use of electricity, and shall have the right of attending all meetings of the Association, except executive sessions, and shall have the right to discuss papers before the conventions."

The section as read, was adopted.

Section III, as reported by the Committee was adopted as follows:

"Section III—In the case of a corporation the membership may stand in the name of the company, and such company shall have the right to be represented at any meeting of the Association by any of its officers or directors, or by its regularly employed managers or superintendent."

Section IV was next considered.

An amendment offered by Mr. Garratt that after Section IV (which is Section II as printed) the following is to be added:

"No individual actively associated with a corporation holding active membership shall become an active member individually, unless he shall own and operate a plant individually," was after considerable discussion lost.

An amendment was offered by Mr. Whipple to this effect: In Section IV. (the one printed as Section II.) after the word "Superintendent" in line 10, add the words "Or by a properly accredited representative," was, after considerable discussion, laid on the table.

Sections I. and II., of Article IV., were approved as they now stand.

Sections III., IV. and V. were also adopted without change

Section VI. was next taken up.

Mr. De Camp offered an amendment to that section as follows: "Section VI.—The Executive Committee shall be the governing body of the Association, and shall manage its affairs, pass upon all applications for membership subject to this Constitution, and with special rules or regulations as may be adopted by the Association from time to time, and five members of the committee shall constitute a quorum."

Also by adding after "membership" the words "and the eligibility of their representatives."

The amendment was accepted and the section thus amended was adopted.

Articles V., VI., VII. were adopted without division.

Mr. Whipple—If you will look at SectionV. of Article IV. you will notice a discrepancy between that and Article VIII. Section V. of Article IV. provides that the Secretary and the Treasurer shall be nominated by the President and ratified by the Executive Committee; whereas Article VIII. provides that all officers shall be elected by ballot. I move to amend Article VIII. I did not move to amend Section V. of Article IV., but now I want to call your attention to the fact that there is a discrepancy, and I move to amend Article VIII by inserting in line 47, after the word "officers" the words "except the secretary and the treasurer."

Mr. Armstrong—The Committee accepts that amendment. That makes it verbally correct.

Article VIII. as amended was adopted.

Articles IX., X., XI. and XII. were adopted.

Mr. Garratt—I would like to present a new article, to be known as Article V., and the subsequent articles to be set ahead one number, so that Article VI. would become Article VII, and so on. I move the adoption of this Article:

"Article V. No individual actively associated with a corporation holding active membership shall become an active member individually, unless he shall own or operate a central station plant individually."

The motion was carried.

Mr. Armstrong then offered this resolution, which was unanimously adopted:

Resolved, That the report of the Committee on the revision of the Constitution be accepted and adopted, and that the new constitution take effect January 1st, 1891.

A motion by Mr. Duncan that the revised constitution be referred back to the Committee for proper revision, in connection with the Secretary, for publication, was carried.

Mr. Barrett—I want to ask Mr. Francisco where he secured the figures with regard to the expenditures in Chicago.

Mr. Francisco—In answer to Mr. Barrett's question I will say that Mr. Barrett is too good a politician, and understands the working of these matters too well, to expect that I would disclose the name of the party in Chicago who gave that information. He is inside of that combination, or whatever you call it. The information was given to me from parties who are perfectly reliable; and of course Mr. Barrett knows perfectly well that when such things are given in our confidence they are not to be disclosed.

Mr. Barrett—I do not understand you.

Mr. Francisco—I mean that I would not give away any man in Chicago after he had given me that information.

Mr. Barrett—Is not the matter of expenditures in any department of the City Government a matter of public record?

Mr. Francisco—Is this a matter of public interest in Chicago?

Mr. Barrett—Certainly.

Mr. Francisco—All of these things?

Mr. Barrett—Certainly.

Mr. Francisco—Then can you tell me just where the expenses of the electric light business in Chicago is charged?

Mr. Barrett—I was just going to make a suggestion; if you refuse to answer my question—which evidently is not in accordance with honest treatment. I came here with very great respect for this Association. I expected to accord an honest answer to any question asked me, and I expected that in return. Now, sir, your expense account here runs up to—let me ask you what were those figures—for what year?

Mr. Francisco—Those figures were given me for last year.

Mr. Barrett—It is just the expenditure to maintain the 275 lights.

Mr. Francisco—If Mr. Barrett can read the English language he can see exactly what it shows. It gives the wages paid the different men, and the amount charged up for depreciation; and that depreciation I figured myself. The other figures are actual figures as given me as paid for those items. There they are in plain language. There is no chance for misconstruing or evading them. There they are, and I am here to sustain them.

Mr. Barrett—I want to say for the benefit of the Association that there ain't but two items throughout that statement correct—one is the salary of the engineer, and the second is the number of lights. As to the total expenditure as charged by you, there is the slight difference between that and the actual expenditure, and what you credit as expenditure, of $35,190. I do not believe that you want to do the city of Chicago, or any one else, an injustice. I am free to say that I have not got such poor faith in humanity as to believe that. My reason for asking that question this morning, Mr. Chairman—and for which I thinkI owe the Chair an apology, for I had a grievance and you had not—and I thought that youought to be more kind thn I was.

The President—There was a matter of importance set for 11 o'clock as a special order of business, and I thought that desultory exchange of words between you and the gentlemen might become more or less energetic, and so I thought it better to postpone it until later in the session.

Mr. Barrett—Perhaps that is so.

The President—I intended to give you fair treatment, and intended nothing disrespectful.

Mr. Barrett—Then we will not discuss that any further.

Mr. Francisco—I did not intend to reflect in any way upon the City of Chicago or upon Mr. Barrett; but it has gone broadcast over the country that it only cost nineteen cents per thousand to furnish light in Chicago.

Mr. Barrett—I tell you now that it does not cost that much. I think if there is any man in this country that tries to treat the electrical fraternity of the United States with every degree of fairness, it has been Mr. Barrett.

Mr. Francisco—The statement that it does not cost so much is a question that we will not enter into now. It is just a question of controversy between us.

Mr. Barrett—I want to make a suggestion, if you will permit me. I just want to say this, that if the balance of that document is in accordance with the statements made for Chicago, then it is the biggest tissue of falsehood that I ever saw published in my life, with all due respect to the Association. I want to offer this suggestion to the Association. I want to ask if you desire to send broadcast the truth about municipal lighting, and if you do, that you will appoint a committee—of whom you please except this gentleman here, and excepting him only—and I will pledge you my word of honor that they shall see every document in Chicago, from the date of its inception to the present time; and if it sustains that statement I will pay the expenses of this committee. I appeal to you, gentlemen, if there is anything more honest or square than that, I want to make.

Mr. Armstrong—If Mr Barrett will allow me I will make a suggestion. We cannot come here and undertake to weigh as between statements made, so as to prove the truth or the falsity of any statements made here. Mr. Francisco has presented here a document which is clear and unmistakable in its statement. If Mr. Francisco is wrong, then Mr. Barrett can by the facts and figures refute the statement, without our sending any committee there; and we will accord him just exactly what we have accorded to Mr. Francisco—no more and no less. He can send a statement of just exactly what his expenses are and can answer the questions that have been asked; and he can prove his statement just as well as any committee can do. Such a statement we would be glad to receive; it will be just the information that we want; and if we would send it to the Secretary I have no doubt that the President or Executive Committee will order it sent back to each member of the Association.

Mr. Barrett—This Association has never asked me for any figures on anything. I have been overwhelmed with questions, so that within the last three or four months I have refused to answer them at all, as to the expenditures for maintenance of light in the city of Chicago. I had no reason to cover up any expenditure there. I have more at stake than anybody else. I know what that light costs. Any citizen of Chicago, or any visitor has a perfect right to inquire into the expenditure. All that I want, all that ask is honest and square treatment. I want it at the hands of this Association. I want your treatment to be as liberal as your criticism is. I leave it with you to use any methods to acquire the information.

Mr. Armstrong—I move the adoption of a resolution which I will dictate to the stenographer.

"After hearing the statement made by Professor John P. Barrett, in relation to the municipal lighting of Chicago,

Resolved, That Professor Barrett be requested to communicate to this Association a statement showing the cost of producing and maintaining electric lights in the city of Chicago.

The resolution, with the addition that it be referred to the Executive Committee was, after some further discussion, adopted.

The Convention then took a recess until 3.30 P. M.

AFTERNOON SESSION.

The President—The Chair will appoint on the Committee on the Columbian Exposition, P. H. Alexander, Oldtown Maine; George H. Rose, San Francisco Electric Light Co., San Francisco; S. J. Hart, Louisiana Electric Light Co., New Orleans; and Mr. Edwards of the Charleston Electric Light and Power Co., Charleston, S. C. I thought, as it was a committee whose work would interest the whole country, I would make it to cover all sections. We will now listen to the report of the Secretary and Treasurer.

Secretary Foote read the report of the Secretary and Treasurer ar follows:

REPORT OF SECRETARY.

MEMBERSHIP.

Active members, dues paid,	79	
Active members, dues unpaid,	28	
Total active members,		107
Associate members, dues paid,	128	
Associate members, dues unpaid,	34	
Total associate members,		162
Total membership, July 1, 1890,		269
Total membership, January 1, 1890,		259
Gain in membership for the six months,		10

REPORT OF TREASURER.

Balance January 1, 1890,	$610.17	
Received from January 1 to July 1,	3,020.00	
Total to be accounted for,		$3,630.17
Expended from January 1 to July 1, per approved vouchers on file,	$2,396.57	
Balance in Bank, July 1, 1890,	1,233.60	
Total accounted for,		$3,630.17

The report of the Secretary and Treasurer was ordered, received, and spread upon the minutes.

Mr. Garratt—At the Kansas City Convention there was a committee appointed to draft resolutions on the death of two of our members. I caused two copies of these resolutions to be engrossed, which I will read.

PREAMBLE AND RESOLUTIONS

ADOPTED BY THE NATIONAL ELECTRIC LIGHT ASSOCIATION AT ITS CAPE MAY CONVENTION, AUGUST 19–21, 1890.

The special committee, composed of the following undersigned members, appointed at the Kansas City Convention of this Association, in February of this year, unanimously recommend the adoption of the following preamble and resolutions, to-wit:

WHEREAS, In the course of Divine Providence our fellow member has been taken from our midst by death, and

WHEREAS, It is our heartfelt desire to express individually and collectively our sorrow, and to extend to those who are endeared to him by the ties of kindred, our sympathy. Be it therefore

Resolved, That in the death of our fellow member, Mr. Miles W. Goodyear, this Association has sustained the loss of one whose integrity of character and many noble qualities have endeared his memory to us; and whose well-directed efforts in the arts and sciences pertaining to electrical industries, as well as his long and honorable connection with this Association, have earned our esteem; and be it further

Resolved, That we extend to the members of his family our deepest sympathy and condolence; and be it

Finally Resolved, That the Secretary is hereby instructed to spread these resolutions upon the minutes of this Association, and to transmit a true copy thereof to his family.

——— President.
——— Secretary.

F. E. DEGENHART, Chairman.
WILLARD L CANDEE,
ALLAN V. GARRATT,
Members of Committee.

I have had two copies engrossed, one in the name of Mr. Goodyear, and the other in the name of C. McIntire.

Mr. Seely—I move that the report of the Committee be received and the Committee discharged.

The President—If there is no objection, that motion will be adopted by a standing vote, in honor of the deceased members.

(All the members present here rose.)

The President—Next is the report of the Executive Committee—Mr. Huntley.

Mr. Huntley—Mr. Chairman, the Executive Committee have no written report, but its work has been shown perhaps in this meeting. It has had several meetings at the call of the Chairman, and if it would be of interest, the Secretary could give the records of those meetings. I don't know that that would be material. As that committee is now at an end I would ask that the work of that Committee be received, and that the Committee be discharged.

The President—That Committee is a standing Committee and it will only expire with the limitation of its term of office, unless they tender their resignation. Unfortunately you will have to continue in office some hours or longer.

The Chair will announce as Committee on Nominations for Executive Committee, Messrs. T. Carpenter Smith, DeCamp, Armstrong, Long and Alexander.

Mr. Seely, Chairman of the Committee on Finance, then read the report as follows:

REPORT OF FINANCE COMMITTEE.

1. The books of accounts have been audited to July 1, 1890, and have been found to be correct. This financial statement is as follows:

Balance December 31, 1889,	$610.17
Receipts,	3,020.00
Disbursements,	2,396.57
Balance June 30, 1890,	1,233.60

2. During the six months covered by this report, $725.02 of bills contracted previous to December 31, 1889, have been audited and paid. This shows the disbursements for bills contracted from December 31 1889 to June 30, 1890, $1,671.55.

3. Two volumes of reports of the Tenth and Eleventh Conventions have been published and are now ready for delivery. By resolution of the Executive Committee, the Secretary, Mr. Garratt, was authorized to contract for advertisements to be printed in each volume. Under this arrangement the cost of publishing these two volumes, Vol. VII and Vol. VIII, 500 copies of each, bound in cloth, is as follows:

Printing,	$1,039.80
Binding,	140.00
Wrapping for mailing and sundries,	10.00
	$1,189.80
Income from advertising,	976.60
Balance: net expense to association,	213.20

4. In looking over the accounts the committee has noted one change in the business method of the Association that in its opinion can be made with advantage. It relates to the payment of expenses incurred by the committees. Your committee recommends that hereafter whenever a committee is appointed, the Executive Committee shall fix the maximum amount it will allow for the expenses of such committee and notify its chairman that vouchers for the expenses of his committee will be allowed within the limit specified, and no more.

5. The committee find that the accounts of the Association are being kept in single entry and without a ledger of accounts. Your committee recommends that the Secretary be directed to open a new set of books of date of July 1, 1890, to be kept in double entry system and that the following be among the ledger accounts to be kept.

RECEIPTS.

1. Active members' dues.
2. Associate members' dues.
3. Sale of proceedings.
4. Advertising in proceedings.
5. Donations.
6. Sundry sources.

DISBURSEMENTS.

1. Rent.
2. Salaries.
3. Postage and telegrams.
4. Printing and stationary.
5. Publishing proceedings.
6. Committees (an account for each).
7. Furniture.
8. Sundries.

Respectfully submitted for Finance Committee,
JOHN A. SEELY, Chairman.

Mr. Seely—I will further state that we find that there has been no inventory kept as to the property of this Association, and the Committee have notified the Secretary to report to the Executive Committee as to all property belonging to this Association that is located in their office. The report was accepted and the recommendations ordered to be carried into effect.

The President—Report of Committee on underground conduits and conductors, Joseph E. Lockwood, Chairman.

Mr. Wilmerding of Chicago read the report as follows:

REPORT OF COMMITTEE ON UNDERGROUND CONDUITS AND CONDUCTORS.

Gentlemen:—At the Kansas City Convention, held last February, the following members were appointed a Committee on Underground Conduits and Conductors, viz:

J. E. Lockwood, of Detroit, Mich.
C. H. Wilmerding, of Chicago, Ill.
S. S. Wheeler, of New York.
T. C. Smith, of Philadelphia, Pa.
D. E. Evans, of Baltimore, Md.

Your committee now desire to report that they have perfected a plan of work, but before carrying out same, desire the opinion of the Association, and any suggestion that members, especially interested, may desire to make.

The plan of work adopted is, first to secure from each electric light and power company, operating any high tension, underground conductors, a full description of the conduit and conductors in use, the character of the current used, and how long same has been in use, which information, when classified and tabulated, will indicate plainly the condition of the subject at the present date, and will give us a starting point to work from. We then intend to secure the co-operation of these companies in our next step, which will be to have each company keep account of the cost of maintenance and repairs to the conduits and conductors, and of all changes or additions thereto, also of the average hours per day the system is operated; this information when classified and tabulated will show the cost of operating underground conductors, and if regularly reported to the committee, will show whether or not progress is being made in this direction, and whether the systems in use are likely to prove permanently successful or to finally fail.

It is also designed to include in these reports a list of all grounds, burn outs, etc., and their causes, with suggestions looking to the removing of said causes.

The committee would of course keep private the names of all companies furnishing such information, simply reporting same in tabulated form. These reports would be invaluable to companies operating such conductors, as they would have not only their own experience to improve upon but also that of all other companies operating underground conductors.

In regard to the details of the plan of work proposed, we have decided on first obtaining the following information, viz.:

CONDUITS.

1st. A full description of the conduit used, kind of man or hand-holes, provision for taking off service, etc.
2d. Mileage of conduits laid and in use.
3d. Mileage of duct laid and in use.
4th. Number of man-holes.
5th. Number of hand-holes.
6th. Length of time in use.

CONDUCTORS.

1st. Description of the conductor in use, stating size of conductor, kind and thickness of insulation, and if insulation is covered, in what manner.
2d. How long same has been laid and in use.
4th. Average hours per diem same is operated.
5th. Electric motive force and character of current used.

The above information would give us a good basis to work on; we would then endeavor to have each company operating high tension underground conductors, keep the following records, and report regularly to the committee, just before each convention so that same could be properly classified, tabulated and reported.

RECORDS.

CONDUITS.

Mileage of Conduit laid and in use.
Mileage of Duct laid and in use.
Number of Man Holes.
Number of Hand Holes.
Number of Services Taken Direct from Conduit.
Cost of Maintenance per month.
Cost of Repairs " "
Description of any new work done since last report.
Troubles with Conduit, Man or Hand Holes, and suggestions as to how same can be remedied.

CONDUCTORS.

Mileage of Conductors laid and in use, number of Circuits and Mileage of each.
Cost of Maintenance per month.
Cost of Repairs per month.
Number of Burn Outs and causes.
Troubels of other kinds and causes.
Suggestions as to how troubles can be remedied.
Average hours per Diem Circuits are operated.
Voltage and Character of Current used.

CHANGES OR NEW WORK.

Mileage of Conduit or Conductors abandoned.
Mileage of Conduit or Conduits added since last report.

The above reports would of course be separately classified for different kinds of conduits, conductors and currents.

Your committee think that these records should be kept continuously and reported regularly, until the question of operating high tension underground conductors is solved or effectually disposed of, and to do this we recommend that the committee be made permanent, and that members be elected annually at the February Conventions.

The committee should report at each convention, the number of companies operating high tension underground conductors, the mileage of conduits, ducts and conductors in use; the cost per mile, per month, of conductor maintenance and repairs; the average number of burn-outs and grounds per mile of conductors used and the causes. Also, report all conduits, conductors, etc., that had proved failures and were abandoned.

In this manner the association would keep thoroughly posted regarding the progress of the subject and would be supplied with the actual records made by the different systems; the members of the association could then judge for themselves of the success of the different systems and thus be able to act intelligently in case they desired to do any work in this line.

As this plan is intended to extend beyond the time for which this committee was selected, we have recommended that same be adopted by the Association and that provision be made for the annual appointing of members to the committee.

If this meets the approval, of the convention we would appreciate any suggestion from members, who are especially interested in this subject, looking to the perfecting of the plan of work.

Awaiting the action of the Associacion we remain
Yours respectfully,
J. E. LOCKWOOD,
C. H. WILMERDING,
S. S. WHEELER,
DAVID E. EVANS,
T. C. SMITH.

I would say in addition to that that I think Mr. Lockwood has omitted one point, in regard to the cost of the conduit that is down. That cuts a very important figure in the estimate of what it really means to operate underground conductors, and the Committee I think onght to have the privilege of adding any such questions to their catechism which they will submit to these other companies using underground work which they think may be necessary.

Mr. DeCamp—Mr. Chairman, I would move, inasmuch as the report is mainly a recommendation for future operations, all of which commend themselves to me, including the verbal statement of Mr. Wilmerding, that the report be received and the Committee continued. The motion was carried.

The President—The report of the Committee on Relations between Manufacturing and Central Station Companies will be read by Judge Armstrong, a member of the committee.

Mr. Armstrong read the report as follows:

REPORT ON RELATIONS BETWEEN MANUFACTURING AND CENTRAL STATION COMPANIES.

The vast sums of money invested now as capital in the United States in the various electric light and power companies makes the subject with which this committee has to deal more than ordinarily important.

From every point of view the policy that has been more or less surreptitiously pursued by parent companies in *permitting* their agencies, for the sake of a present sale of apparatus, to foster and encourage improper and hurtful competition with present central station companies, cannot in our judgment be too strongly condemned by this association.

Capital has been induced, in spite of its proverbial timidity, to invest in what has been an unexplored field. Often this investment has been brought about by the parent companies themselves. Then when it has seemed as if the stormy days of doubtful experiment were about over, and there was some little possibility that this investment might begin to make returns, along comes the agent of some parent company and by specious representations induces other citizens of the same place to start a new plant, always forgetting to tell of the weary journey of the pioneer company and pointing always to present position. The only province of this new plant is to damage and destroy what did give some promise of life and fruit, and incidentally to make a market for a little new apparatus, effectually closing, however, a profitable avenue of steady continuing business in sales to the original companies.

Concluded on page 25.

ELECTRICAL INDUSTRIES AND THE WORLD'S FAIR*

J. P. BARRETT, ELECTRICIAN, CHICAGO, ILL.

It has been stated by competent authority that had it not been for the exhibition of the speaking telephone at the Centennial Exhibition at Philadelphia, the telephone would have been ten years later in receiving popular recognition and becoming a success. It is well known that the individuals who were nearest the telephone invention looked upon it with distrust, considered it a toy and an invention of no great practical importance. But Sir William Thompson, who was in 1876, as he is now, the recognized authority in electrical science, seeing the telephone at the Centennial exhibition, became enthusiastic over it and endorsed it so warmly that it directed public attention to the invention and made it an immediate success.

Great as are the interests resulting from the telephone which was first publicly exhibited at the Centennial Exhibition at Philadelphia, the importance of this invention extends beyond the particular interests directly concerned. The public attention attracted by the telephone has stimulated activity in electrical industries which warrants the statement that the exhibition of the telephone marked a new era in electrical progress. The telephone and the relation of the Centennial Exhibition to the promotion of its popular success, is mentioned simply as an illustration of the importance of the World's Fair to electrical enterprises. Fourteen years have passed since then, and in three years more the Columbian exhibition in Chicago will be looked on to exhibit the progress which has been made since that date, and to be commensurate with an industry so progressive as to have absorbed an investment of $500,000,000 in the past ten years. It is not unreasonable to say that there will be more interest in the development of electrical science and in the evolution of the art of electricity as applied to various industries, than in any other one branch of the World's Fair. The rivalry in invention has led the United States to outstrip all other nations in the practical application of electricity. Thus it was that the electrical department of the United States Exhibition at the Paris Exposition saved the United States from complete disgrace; and yet the electrical department of the Paris Exposition was the weakest feature of the entire show. Probably the United States in the Columbian Exposition cannot hope to equal Paris in the matter of its general exposition but in machinery and electrical matters particularly we should do a great deal better.

The most striking failure of electricity to play its proper part at the Paris Exposition was exemplified by the Eiffel Tower, which was not only not lighted by electricity, but even had its numberless gas jets lighted by hand, after the old fashioned way. Then the general lighting of the show was not made a feature, but only a very subordinate affair. The only place where electric lighting can be said to have been a feature was in the working of the colored fountains, an English invention and already rather old, but a fine thing and worth repeating in Chicago, with better facilities for spectators. The next most striking lack of the Paris Exposition was in the matter of electric street railways. It would seem that an exposition in these days should have an organized system of electrical locomotion for carrying a lot of passengers quickly and cheaply from side to side and from end to end of the entire grounds. Paris had a steam dummy going around two sides of the grounds, but that was insufficient, and the cars were usually crowded just when people wanted to use them. That, however, was on account of the exposition being such an unexpected and tremendous success. The only means of electrical locomotion used at Paris, was an electric crane running from end to end of the machinery building, very slowly, to give people a chance to see the various exhibits from above, and incidentally some rest and some air.

There was also no organized telephone exchange system at Paris. Considering that the Melbourne Exhibition of 1890 had a telephone exchange in full operation inside the grounds, doing substantial service to exhibitors, as well as to the officers of the exhibition itself, Paris is to be pronounced behindhand in this respect. There was something done in the American section at Paris, for the offices of that section and for some exhibitors, but it was not very well done, and was on a very small scale. There may have been other similar telephone exchanges at work, but there was no good general system for everybody and in connection with the city.

It is the intention in the following paper to point out some lines in which the exhibition of that branch of industry, in which we are all interested, should be protected and promoted according to the brief consideration which the writer of this paper has been enabled to give the subject.

In the first place, electricity will find numerous applications in the way of actual service in carrying out the plan of the exposition. By this I refer to the fire alarm protection signaling apparatus, electric lighting, both arc and incandescent, transmission of power, telephoning and telegraphing. The location of the Main Exposition having been rightfully settled in favor of the Lake Front, which is practically in the heart of the city of Chicago, and within five squares of the telephone central office, the fire alarm central office and the Western Union and Postal Telegraph offices, it will be a matter of no serious difficulty to make such connections with the general city electrical service as will give the exposition the benefit not only of its own special outfit in each of these directions, but also the advantage of its outside connections. Aside from this application of electricity to the utility and necessities of the exposition, the features in which we are all particularly interested are those which illustrate the progress that has been made in the science and in the art. The success that has attended recent electrical exhibitions, such as the one in Philadelphia in '85, and the one in the American Institute Fair in New York, give us some idea of what can be accomplished in this direction with the immense multiplied facilities at the World's Fair in Chicago, and with the incentive to manufacturers and inventors which comes from having the attention of the whole world directed to their work.

With reference to telephones, as is generally known, the fundamental patent on the telephone will expire in 1893, and we may expect not only the inventions, accumulated and hoarded by the American Bell Telephone Company for the years that they have had control of the business, to be exhibited at the World's Fair, but also numerous other inventions which will be stimulated by the opening of the field to competition. Thus this feature should be given a much greater consideration, and more attention should be paid to it than to any other previous exhibition. We have seen only the beginning of the growth of the telephone business. This is shown by the fact that in the city of Berlin there are now 13,500 subscribers, and the exchange there is growing at the rate of 3,500 per year. I predict that in the city of Chicago inside of ten years there will be 30,000 telephones in use. Such a great increase in the use of telephones calls for apparatus and appliances, the invention of which will tax the best talent in the country for years to come. Of course, in addition to the historical exhibition, and the exhibition of recent inventions in telephones and apparatus applied to telephony, there will be immense numbers of telephones used in and about the buildings of the Exposition.

The matter of telegraphy also should receive its due share of attention. The different forms of quadruplex, the use of dynamos for furnishing the current instead of batteries, and other inventions in which the recent history of the telegraph is prolific should each and all be suitably presented. Police and fire alarm apparatus of the latest design and the best manufacture, together with all appurtenances, will attract a large share of attention.

The telautograph, which by 1893 will undoubtedly be a practical success, even if it shall not have ceased to be a novelty, will also come in for purposes of exhibition as well as for extensive practical use.

Motors for driving machinery, furnishing power for various purposes, running street cars, etc., will perhaps be even of more practical benefit than any other application of electricity; while electric lighting apparatus of various kinds will take the lead undoubtedly, as it now does, over all other electrical industries.

It is proposed to connect the two parts of the World's Fair, situated on the Lake Front and the other at Jackson Park, by means of a railroad built out on the lake. The expediency of adopting electricity for motive power on this railroad is at once obvious. Thus the two features of usefulness and exhibition can be readily combined, and in addition to the direct transmission of power, storage batteries could be employed for traction purposes on this road.

It is difficult in enumerating the different departments of electrical enterprise to foresee all of them, and particularly to foretell the relative importance of the different ones three years from the present time. In no field of human activity is invention so active and enterprise so energetic, and when we speak of the different forms of application of this science which are well known at the present day, we all know that we are simply on the threshold of future developments which may be confidently expected. No time in the history of the world has there been so great activity in any given direction as there now is in the department which we represent, and too much cannot be said with reference to the importance of having adequate facilities in the coming World's Fair to display the various industrial and artistic applications of electricity.

What will be exhibited at the World's Fair will undoubtedly be a revelation to the visitors. It should be the aim of the people having the exhibition in charge, to so organize and classify the exhibits as to present clearly and forcibly the progress of the art and the present state of the art in its various departments. A chaotic exhibition of the products of the different manufacturers would accomplish something in the way of creating astonishment and mystifying the beholder. This is not what is desired. It is desired that the World's Fair, as a whole, and the electrical exhibition, is perhaps the most important industrial feature of the exhibition, be made an education. It is not too early now to lay plans for the proper presentment of electrical industries for this great Exhibition of 1893. The combined intelligence of the men who are to-day pushing forward electrical enterprises, working in harmony, will be able to accomplish great results, results which will surprise all of us. But the element of time must enter into all calculations; especially is this the case with a subject so large and so involved as the suitable presentation to the public of the rapidly growing electrical enterprises in their various fields.

The Exposition should be made just what its name implies, a practical exposition of the progress and advances made in the several branches of the science of electricity, and the exhibits should be so arranged that the various improvements may be seen and be appreciated at a glance. Thus will the real object of the Exposition be accomplished and a saving of much valuable time to the visitor be effected. For it is quite probable that fully 50 per cent. of the visitors to the electrical section will go there with the earnest desire to become thoroughly familiar by practical observation and study with all that has been done in some certain industry, either to aid in carrying on a certain line of study or with a view to select what they may there conclude is the apparatus best adapted to their needs. In either case, time will be an important and valuable factor, and how to enable each visitor to quickly and understandingly grasp the more important details and points of superiority of any exhibit should be the main object of the respective exhibitors.

The usual method followed in the small expositions has been to allot a certain space to each exhibitor and allow him to place therein whatever he may desire to bring to the notice of the visitor. This is a good plan, and one which proves economical in many ways to the exhibitor. Another plan would be to allot space for the various types of apparatus, irrespective of the main display of the exhibitor. That is, to place all telephone apparatus and everything thereto pertaining in close proximity; the same with telegraphic apparatus, arc lighting dynamos, incandescent machines, motors, etc. The carrying out of such a plan will, of course, give two or more separate exhibits to each manufacturer, and thus entail some slight additional expense, both in the matter of suitable furniture, and possibly in the matter of attendance; but all this additional outlay would be more than returned in the excellent results attained, and in the simplifying of the study of any particular type of apparatus, to say nothing of the greater publicity given each exhibit. Of course, there would be no objection to an exhibitor reproducing a complete display of all his wares in the space allotted to him for his headquarters, irrespective of the fact that many articles may also be shown in the respective space to which they belong.

As far as possible a complete specimen of every article and every size should be placed on exhibition. For instance, in the line of motors, there should be one of each size from the smallest to the largest turned out; and so with dynamos, batteries, etc. In the space allotted to the display of testing instruments the showcases should be placed on a flooring above a foundation made sufficiently solid to prevent oscillation of the needle, or injury to the more delicate parts from vibration or other similar cause. Every article should have a neatly printed card attached, of size uniform in proportion to the character of the object displayed, containing the name of the article, the manufacturer's address, and a brief description of its intended use, the same appearing in English, French, German and Spanish.

At the present time there are about 430 separate companies or individuals whom we can expect to apply for space, many of whom will have but a single article or two to exhibit. But every one of this number will probably defer action until the last possible moment, unless the importance of securing the necessary space and having his exhibit in readiness within the appointed time, is impressed upon him. Some of the manufacturers will have to be coaxed into making exhibits, while others will hesitate on account of the expense entailed. The chief or his secretary must attend to all of this, and must spare no pains to secure not only an exhibit, but the *best exhibit* possible for each manufacturer to make.

Great assistance in carrying out a comprehensive and systematic plan for the Exposition may be looked for in the United States Census, the report of the Electrical Department of which is looked for with great interest.

* Paper readbefore the National Electric Light Association, Cape May, N. J., August 19, 1890.

MUNICIPAL LIGHTING.*

MUNICIPAL PLANTS AND ELECTRIC LIGHT COMPANIES COMPARED.

BY M. J. FRANCISCO, PRESIDENT RUTLAND ELECTRIC LIGHT COMPANY.

Mr. President and Gentlemen of the National Electric Light Association: The electric spark that Franklin gathered upon his key lay dormant for years, until from the fires of genius, guided by the finger of science, there flashed forth the electric light. This has been increased and magnified, until to-day America stands as the exponent of this science. with 300,000 arc and 4,000,000 incandescent lamps flashing like meteors across the continent. Thus has science aided nature in lighting up the streets and highways of our native land, from the shores of the Atlantic, across the snowy peaks of the Rocky Mountains, to the golden shores of the Pacific.

This vast industry, requiring an army of over 300,000 men and an investment of $300,000,000, is the result of American genius and enterprise. Truly we may well congratulate ourselves that we are here to-day as the representatives of this science and industry, which is revolutionizing the world. Not only has the globe been encircled with telegraph symbols and the human voice sent flying across [illegible] for thousands of miles, but the ocean itself has been studded with electric lights, guiding the mariner across its waste of waters and flashing its brilliant hues as a welcome beacon upon the weary eyes of many a watching crew, whose vessel was sinking in mid-ocean.

This science, fraught with so much good for mankind, which has put millions of money into circulation and furnished employment to thousands of laboring men and others, is now menaced by men who, posing as economists, desire to use this power for political and other purposes, as well as for their own aggrandizement, regardless of the interests of the masses or the public welfare. The plain English of this movement is municipal control of electric lighting plants.

Who are the great apostles of municipal ownership of electric lighting plants, claiming that municipalities can furnish lights cheaper than corporations? Not one has had a single day's practical experience in the electric lighting business. For example, we were treated to a specious article in the New York *Independent*, purporting to come from a professor of Johns Hopkins University. An examination of the article shows at once that the author has no experience or practical knowledge of the business, and proves to be simply a youth from Omaha, Neb., who has been studying there for a couple of years. He is now told to cry monopoly, and this article is the result. These are the persons who are being used by professed economists, wire-pullers, and others as figure-heads; who make statements based upon a state of things that do not exist, and use such statements in contradiction of the actual experience of practical men and the best scientists of this generation, who have not only made the subject a study, but demonstrated the same by testing it every night for years.

If a municipality can sell electricity cheaper than private corporations, why should they not manage all other industries and trades of the country? All cities have large amounts of printing done; why not have the city own and run paper-mills and printing offices? also street cars, and own mines and sell coal. They also use immense quantities of stone, building material, etc.; then have them run a marble quarry. The taxpayers use carriages; let the city build these also. And so on with every industry requiring the investment of private capital. If municipalities can save the taxpayer money in controlling and manipulating one industry, why not all? If they can do it cheaper, then every taxpayer would receive the same proportional benefit as is claimed for electric lights.

The great argument used in support of municipal control of lighting plants is a list of cities, with what purports to be accounts of the cost of their electric lights, where over half of the expense of the lights has been charged to other departments. Among these are Bay City, Bangor, Dunkirk, Chicago, Ypsilanti, Topeka and Lewiston.

We will examine a few of the claims made as to the cost of lights in these cities.

The City Superintendent of Bay City, Mich., reported that the cost of the electric lights was only $40 per year. The Council of Bay City appointed a special committee to investigate the expense of city lights, and they submitted a report showing that the city was running 137 lights at a cost of $59.42 each per year, not including taxes, water rates, interest or depreciation. Including interest, 5 per cent. on $35,000, cost of plant, taxes and water rates, 2½ per cent., 10 per cent. depreciation, the cost was $104 per year each lamp, running only dark nights. A short time since, during a thunder shower, the city was left in darkness, because the City Superintendent was afraid of burning out an armature if he ran the lights. A gentleman passing an evening in Bay City recently inquired why they did not have street lights, and the answer was "we do have them," and sure enough, at 9 o'clock they started the lights. Still the price charged by electric light companies for first-class service, with lights every night, even when obliged to compete with the rival forces of heaven's batteries, is compared with such service as shown in Bay City.

The city of Bangor claims that the average cost of burning a light each night is 12⅔ cents; that is $46.23 per year for each lamp. The electrician is paid $78.50 per month, or $942 per year; his assistant receives $520 per year; one lineman is employed at $624 per year; two trimmers at $1,248 for the year—making $3,334 for wages of these men, being $22.82 per lamp per year. They run all night, requiring double lamps and four carbons for each and every day, calling for 1,460 carbons per

* Paper read at Convention of National Electric Light Association, Cape May, N. J., August 19, 1890.

year each lamp; for these they pay $13 per thousand, and in addition pay 96 cents per thousand for freight and 5 cents per thousand for cartage from the freight-house, making cost of carbons $14 per thousand, or $20.44 per lamp per year. Allowing $2.97 per year for oil and waste, we find the amount paid by the city for wages, carbons, oil and waste was $46.23 per lamp per year. This is 12⅔ cents per lamp per night, just what is claimed as the entire cost to the city for running their lights. The plant cost $35,000, and this does not include anything for the water power nor for any portion of construction of the dam or cost of its maintenance, or for the station buildings. Interest on $35,000 at 6 per cent., $2,100; depreciation on electric apparatus, 10 per cent., $3,500; broken globes during the year. $130; wall-controller burned out, costing $160; 15 lamps broken, repairs costing about $300; damage to mast-arms, repairs costing $100; repairs at station, $500; also $730 paid for coal. Here is $7,520, which is part of the expense of the electric lights charged to some other department, while to get the true cost there must be added to this the repairs to the dam, interest on the cost of the buildings, wages of an engineer when engine is used, cost of new brushes and segments; also taxes and water rent, which the city would receive from a private corporation if running the lights, which, at the lowest estimate, would be over $1,000 per year, thus making a total cost to the city of $15,271.86 for running 146 lamps one year, being $104.59 per lamp, and that, too, with water power all the time except for about six weeks.

The favorite place quoted by advocates of municipal ownership is Dunkirk, N. Y. I herewith give the report of the water commissioners of Dunkirk. As a specimen of expert bookkeeping, and a sample of the way accounts are kept by cities, I recommend the plan to all electric light men; for, if you are endeavoring to satisfy your constituents or stockholders that electric lights can be run without money and without price, it cannot be excelled. The report reads as follows:—

"PAID ON ACCOUNT OF ELECTRIC LIGHT.

For linemen's salary	$ 540.00
For fuel	933.24
For supplies	447.60
For labor, repairing line	41.42
For repairs on engine and [illegible]	65.64
For repairs on machinery	99.40
For miscellaneous accounts	14.60
	$ 2,141.90

"The above statement shows very distinctly that the most sanguine predictions as to the cost of running the electric lights of this city have been more than realized. After a trial of one year and eight months, the machinery and line are in better and more perfect condition than when first started. The cost of our electric light does not exceed 1 cent per hour for each light."

Here we have a report from the city authorities stating that the entire cost to the city of running 55 arc lights one year was $2,141.90.

You will notice one item is repairs on engine and boiler; also one item for fuel, showing that the plant was steam power, and, what is far better, a style of boilers and engine that ran the entire year, starting and stopping at proper times automatically, without any one to look after them except a man occasionally to make a few repairs—the coal walked into the furnace without assistance, and no one was employed in or about the station, neither did the plant cost the city anything.

Here is a sample of the reports made by politicians and those professed economists, which shows just how reliable they are. Of course, a man of practical experience and knowing that electric lights do not run without human agency, would look further before accepting such a statement, and when we examine the accounts of the water works we find engineers and firemen paid $3,555; supplies, $449; general expenses under superintendent, $995; miscellaneous accounts, $240; superintendent's salary, $720; interest on bonds, $7,025:—making $12,984 additional. Even if only one-third of this is charged to electric lights, we have $4,328 to add to the $2,141, making $6,469 for 55 lights, or $177 each per year. Consistency, thou art a jewel!

Chicago, it is claimed, is the center of the world, and the only place on this mundane sphere where mortals can be happy, and where life can be spent without thought of money or the hereafter, because their electric lights only cost $73 per year. We admit that Chicago has triumphantly secured the World's Fair, and is now transposing our national air to "Hail, Chicago! happy land." But they have not yet seen the bills for the electric lights as furnished by the city and used on that occasion. When they do the city electrician will need to add something more to his stereotyped answers that the cost of city lights "does not include any expense such as you mention—taxes, water rent, interest on investment, insurance, repairs, depreciation or renewal of plant in general;" neither will it be expedient to charge the wages of the electric light linemen to the fire alarm telegraph department, notwithstanding it works very nicely now, and helps wonderfully to make the cost of an arc light appear small.

Upon investigation of one of their stations of 275 to 300 lights capacity, I find that the chief engineer receives $1,200; assistant, $1,030; four firemen, $2,880; six trimmers, $3,240; line-tester, $720; three linemen, $2,520; cost of carbons, $3,800; fuel, $12,000; interest, $14,000; depreciation, 2½ per cent., $8,750; oil, waste, repairs, globes, taxes, etc., $7,000—making $57,190 a year expense for running 300 arc lamps, being $190.63 per year per lamp, and this makes no provision for salary of electrician, superintendent, or for armatures burned out or any accidents or damages. With the linemen's wages charged to the fire alarm telegraph department, we can reduce this $2,520. Now, to what other depratment do they charge the other expenses to reduce it to $73 per year per lamp.

Ypsilanti, Mich., is the Mecca toward which all advocates of municipal ownership turn their longing eyes, and we are informed that the entire cost of a 2,000-candle power lamp is $23.61 per year, when the truth discloses the fact that Ypsilanti pays $72 per year, only running eighteen nights a month until midnight. Wishing to have the views of the prominent authorities of this wonderfully managed city, the following questions were propounded, and I give both the questions and answers.

Q. 1—With your experience, are you in favor of cities doing their own lighting? A.—No.

Q. 2—Why? A.—Political preferences and frequent changes of management are too expensive. Incompetent engineers, linemen and trimmers kept in place by a committee for political or other purposes; poor carbons, lack of attention generally, grounding of wires, breaking of globes, infringement of patents, constant repairs, etc., make this system expensive and an unknown amount till the year expires. *The wear and tear is immense*, all kinds of complaints and no responsible head is the rule. On the contract plan for a light you pay for what you get only, and know what to provide for in the estimate for tax levy.

Q. 3—If your city had the work to do over again, do you think they would do the same? A.—No.

Q. 4.—Has the municipal operation of your plant met all expectations and requirements? A.—No.

Topeka is another place where electric lights furnished by the city are cheaper than sunlight, and the city jubilant over their purchase. I quote from a letter written by a prominent official of the city of Topeka, which seems to prove that their millennium has not yet arrived. He says: "The agreement for all night lighting was $6 per light per month. We find that the cost of operating the plant of 184 lights for all night has been $11 per month. The agreement further provided that lights should be 2,000-candle power; all the tests we have made does not show them to be over 500-candle power. Our lights so far have been very unsatisfactory. My own opinion of the matter is that it would be much cheaper in the end for the city to have contracted with some of our electric light companies here to furnish the city with its lights at so much per light. We would then have known at least just what they would cost. As it is we have to take our medicine, which is liable to be a very expensive dose. It is a very expensive luxury, and there are so many expenses coming up that we cannot foresee; therefore, I say, when you take everything into consideration, interest on the investment, wear and tear on machinery, dynamos, etc. (the contractors are already building over ours, and they have not run two years yet), consider well before contracting for a plant." Here is the opinion of an honest official who has had experience with a city owning a plant.

Lewiston, Maine, is another brilliant example of municipal ownership. They have a plant of 100 arc lights, which cost the city $15,000. They burn, on an average, 24 nights per month on moonlight schedule, and the Mayor says the actual running expenses are $4,200 per year. Add interest on cost of plant, depreciation, 5 per cent., taxes, rent of water power which the city would have received from a private company, therefore it is costing the city for 100 arc lights, using water power, $7,200, or $72 per lamp per year, while the local electric light company offered to furnish the same lights for $5,760, being $1,440 less than it costs the city to run their own lights; and still it has been advertised broadcast that the cost of arc lights in Lewiston was only 14 cents per night.

I have secured reports from fifty municipal plants, embracing nearly all of the cities and towns in the United States owning plants, and find that the cost of these has been $1,511,225; that they are using 3,725 lamps; 12 places running all night, and 38 until midnight or on the moonlight schedule; that the average price paid for coal is $2.34 per ton; that the actual running expenses have been $251,194; that the interest on the cost of these plants is $90,691; depreciation at 5 per cent., $75,576; cost of replacing armatures actually burned out, $12,000; taxes city would have received from private corporations if they had furnished the lights, $15,715—making the total expense to these 50 cities of burning 3,725 lamps (two-thirds of them only until midnight) for one year $444,486, or an average cost of $119.24 per lamp per year. In the figures going to make up the cost of plants and the running expenses I have taken the statements and amounts as given by the city officials, but when we are told that the total amount paid for a complete plant of 68 arc lamps, with engines, boilers, dynamos, etc., was only $1,300, and informed that the total running expenses of a plant that cost $12,000 are only $1,100, and in the same communication the statement is made that they pay their engineer and lineman $125 per month, making an annual bill for these men's wages of $1,500, we naturally long for the secret which enables them to settle this amount and pay for repairs, oil, coal and other expenses with an expenditure of only $1,100.

I have statistics from 365 electric light companies furnishing 35,100 arc lamps for street lighting, three-fifths burning their lights all night and two-fifths burning until midnight or on the moonlight schedule. The average cost of coal is $2.76 per ton. The average price charged per lamp for street lights is $118 per year. This is the price when furnished by electric light companies, who have assumed all the risks and liabilities incurred in the business, and who must furnish first-class lights. This is the cost with lights burning every night without a break, as the contract calls for, and necessitating a rebate if the lights are out, which would reduce the price paid by the city.

Only one-third of the cities owning plants run them all night, while of street lights furnished by private companies three-fifths burn all night. Lamps all night and every night would burn 4,000 hours per lamp, while the moonlight schedule would only require about 2,100 hours per lamp. The cost to companies, of course, is much more for all night lights than it is until midnight, and had lights run by municipal plants been burned the same length of time as lamps furnished by private corporations, the average cost would have been still more, as lights must have burned about twice as many hours.

It will be noticed that the average cost of coal used by municipal plants was $2.34 per ton, owing to the fact that the majority were located near the mines or places where coal was cheap, and the average as shown for electric light companies is $2.76 per ton, owing to the fact that the coal was transported long distances, at high rates of freight. Even with this factor against them, it shows conclusively that private corporations are furnishing cities with lights for less money than they can themselves produce them while owning the plant. This, too, with the expense of operating city plants figured as given by the various cities, which their own report shows is incorrect, and less than actually paid.

It is well known that if a private corporation is furnishing municipal lights, when they are out for a short time or are not up to standard, a rebate has to be made, amounting in the aggregate to many thousands of dollars; but you will never see this item deducted when advocates of municipal control are quoting the cost of lights. Neither do they allow the fact of the city's liability for damages and accidents to be developed. If the municipality own the plant they assume their chances, and here is a feature of responsibility which in most States rests upon the individual as well as the city. The property of any citizen can be held for an execution against the town for injuries caused by a municipal plant, no matter if it amounts to thousands of dollars, and thus he might be deprived of his most valuable personal rights and liberties. If electric light companies furnish the lights, they must meet such claims and protect the city from loss, and the court records show that electric light companies have paid heavy damages on this account.

In the reports received from city officials regarding the cost and operation of their lights, one says: "No expenses charged to lighting account." Again: "Lights are not started for an hour after dark." Many say: "Whenever a thunderstorm approaches lights are shut down and city left in darkness." Another says: "Have not had lights for past two weeks, owing to some trouble at station;" while many report wages of employés charged to water department, and others that no account of lighting expenses is kept. Here we have the basis upon which reports are made that the cost to cities owning plants is so much less than it is when private corporations furnish them, simply deceiving the taxpayers by charging part of the cost to other departments, while raising a hue-and-cry about the extortion of electric light companies.

No sane or fair-minded man will, with the corruption and fraud practiced by politicians at the present day, attempt to prove that it is for the best interest of the taxpayer to place faith in the honest or conservative management of any enterprise which can be manipulated in the political arena for the advancement of the men in power. The histories of New York, Philadelphia and many other cities are samples of such methods and their purifying effects upon politics. Hypothesis and theory may do on paper, but actual results obtained by practical application and experience are the only reliable data upon which to base any statement relating to the cost of street lighting. In every case these have shown, where all the facts are given, that it has been for the best interest of the citizens and taxpayers to contract with an electric light company for lighting the streets of any city.

Many cities have found by actual experience, after spending a large amount of money, that this is a fact. The city of Grenville, S. C., has sold out its municipal electric lighting station, the purchasers agreeing to relieve the city of all pending liabilities in connection with the light plant. The city have agreed to pay $100 per year per lamp for not less than 40; the agreement to run for 15 years. Negotiations are pending in several other cities for a sale of their plants to the local or private electric lighting company, as they have found it was impsosible to produce the light, when managed by politicians with no interest in the business, as cheaply as could be done by a private corporation whose managers were financially interested in its success.

There is another features of this business that it is well to consider. Under the authority and sanction of the Legislature of the States, private capital amounting to millions of dollars have been invested in the enterprise of electric lighting. The benefit that municipalities have received from this capital is enormous, and it is a question whether the private capital thus locally invested under the sanction of the State can be jeopardized and endangered by the action of municipalities, who are subject to and under the control of the State. In England this matter is fully settled, and no municipality can operate its own plant, if by so doing it will interfere with any local or private company authorized by Parliament.

Judging the future by the past, with the mighty strides that have been made in electrical inventions, two years from now the entire apparatus at present owned by municipalities may be consigned to the scrap pile, and necessitate a new outfit costing thousands of dollars. What is to be done in this case? Levy another tax or issue more bonds, and thus load the city with more debts. Electric light companies have already had this experience, and I can cite a case where the company paid $4,500 for their dynamos, and, after a little over two years, could only realize $300 from those machines. Why is this? Simply that improved plans and apparatus have been discovered which reduces the cost of producing electricity, and unless companies can control these new patents they will be stranded in the race of invention.

Consider, then, for one moment the effect upon the business world if to-day it were possible to blot out electricity and electric lights, with all their conveniences, comforts and luxuries; to stop the progress and development of this wonderful science, and shroud America in a gloom that could only be expressed by Byron when he "had a dream which was not all a dream," and

> "The bright sun was extinguished,
> And morn came and went—and came—and brought no day,
> And all hearts were chilled into a selfish prayer for light.
> The rivers, lakes and ocean all stood still,
> And the clouds perished. Darkness had no need
> Of aid from them—she was the Universe."

STANDARDS OF ECONOMY IN THE GENERATION OF POWER.

BY H. M. SWETLAND, OF NEW YORK.

In suggesting to our Secretary the subject for this paper as one which would be of vital interest to the members of this Association, I had no idea that I should be called upon to prepare and present it, nor do I feel the fitness of my being chosen to instruct the gentlemen of this convention, whose knowledge upon these matters is the epitome of the best and highest accomplishment of the times.

The above title scarcely represents my treatment of the subject. I should prefer rather to call it "A plea for the collection and record of data for standards of economy."

In old and long established lines of work such would naturally be unnecessary. In the electric light business where so much is new, and development is so constant and rapid, it is essential that there should be established some authentic form of comparison of operations with the view of reaching the greatest economy in the shortest possible space of time. Further, in view of the rapidly changing conditions under which the generation of steam power is being operated, the concentration of small and individual plants into larger centres, etc., it becomes of the utmost importance that a careful and detailed system of standards shall be inaugurated and maintained.

Although far more able representatives than myself have heretofore approached this topic, there has been in the Convention a noticeable lack of definite, reliable, uncontrovertible information in this special direction.

Of course, no absolute standard or unit of economy can be established by a vote of convention or fiat of Association. A yard stick is a yard stick, an inch an inch, but a standard of economy must always vary in greater or less degree according to conditions and equipment.

Yet a sufficient similarity exists to enable us to prepare tables covering the main types of equipment, and the recorded performance of any special type would be relied upon and regarded as a standard.

Human ingenuity, talent, patience, skill and incessant labor are being exerted every day and hour in the direction of lowering the records. The ambition of the day is turned towards produc-

ing the maximum of result with the minimum of expenditure.

But to the superintendent of the station, more than any other person, these tables would be of paramount importance. They would enable him at a glance to learn what others are actually accomplishing under certain named conditions, and readily to institute comparisons with his own records. By their use he would not only gain enlightenment on many points, but be stimulated to the highest possible degree of efficiency and economy. He would also thus be furnished with unimpeachable authority to offer a doubting stockholder or too exacting president who, while perhaps not being initiated in the details of practical workings, is always glad to be reassured by accurate information.

These tables would not, however, be elastic enough to suit the purpose of the energetic boomer whose object in building a station is sale, not operation, for they will be found to show the necessity of the best modern appliance to the most economical production of power. Neither would they be particularly interesting reading to men who trade in inferior appliances.

A "standard of economy" is obtainable only by a combination of mechanism best adapted to the conditions and attendance which can secure from this mechanism the best possible results. A plant may be equipped with the most improved devices, the excellence of which may be practically nullified by neglect ot well-known duties, ignorance and mismanagement. A poor gun in the hands of a good soldier is a better combination than a good gun in the hands of a poor soldier. It is not the machine alone, but combined with the skillful man behind it that works out the best results.

This point was splendidly taken by Mr. Geo. H. Babcock in his most valuable paper on "Boiler Economy," read before us in Kansas City. We all remember his allusion to "boilers and brains," or the "co-efficient of common sense."

It is perhaps superfluous to mention that results obtained with different existing equipment and attendance vary fully as 1 to 5, with a possibility of the still further lowering of the former proportion by investment in still better equipment constructed by still greater skill managed and operated throughout by superior intelligence, and yet, these proportions which to-day show such wide results in fuel consumption may by the combination of intelligence, energy and care be made to show results more nearly proportioned to the possibilities of the present equipment by placing on record the best results obtained from a similiar system.

The subject of economy in general has received the attention of our best thought, but it has been directed to the operations of the complete system, and too often details of definite expense are overlooked by the superintendent, whose imperative duty is the running of the plant, not its most economical methods. He is obliged to keep a station in smooth running order, to furnish good, steady, reliable lights, under pressure of constant demand, in which case economy is not the first consideration.

At the last Convention the admirable paper read by Mr. T. Carpenter Smith, of Philadelphia, entitled "A System of Central Station Accounts," touched upon and almost comprehended this necessity, but he still further included the maintenance of outside equipment, whereas my paper is confined to the question of first cost of production of power expressed in pounds of fuel per developed horse power per hour.

The material for the data in furnishing standards of economy should naturally be the practical results of actual operations, compiled in tables from the results obtained by different managers. To what end? They would interest and benefit all desirous of investing in electric light and power enterprises, which are becoming such an attractive feature in the financial world. They would be useful to prevent the establishment of unnecessary and injurious competition frequently induced by statements of facts and figures, showing an utterly false and unattainable economy.

Standing in comparison with the fifteen minutes of the ocean racer, the second clipped from the tables of the turf, or the extra grain made to yield from the refractory ore, is the ounce of fuel measured in the economic generation of power, when considered on the large and increasing scale of commercial enterprise.

My plea is for the most minute and detailed system of tabulation as the means of reaching the best results. It is by the comparison of coal with coal, boiler with boiler, engine with engine, type with type, appliance with appliance, that these results may be obtained. Those who have had experience in collecting data of the kind required, will comprehend at once the difficulties encountered in the process of getting information which shall fully cover the many important points in the case.

Not only should there be no objection on the part of the companies, their managers or superintendents, to giving information that is reliable in character, accurate in detail, and comprehensive in scope, but there ought to be most cheerful acquiescence.

We are organized for purposes of free interchange of thought and experience, with a view to mutual advancement and benefit. In these tables each one is liable to discover information upon some important point which should be of great value to him. Naturally, the broad ground of justice, fairness and liberality of feeling is expected to be our starting point.

If I have succeeded in interesting the gentlemen in the importance of "collecting data for these standards," I will feel justified in having consumed the time of the Convention. If carried out, we will reap the benefit in having on record the facts and figures, which have been so often called for, and the answer to the three great questions, What is your equipment? How many lights do you furnish? How much coal do you burn?

TWELFTH CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

CONTINUED FROM PAGE 22.

It is rumored very strongly, and indeed stated as a fact, as strange as it may seem, that parent companies, not satisfied with permitting, have gone so far as to actually organize central station companies in competition with others which are abundantly able to supply all demand, strengthening, supporting and sustaining in their unholy warfare against legitimate enterprise.

Such being the case your committee would earnestly recommend either its continuance or the appointment of a new committee with power to confer and advise with any companies against whom such warfare is waged, and that through such committee the members of this association, as central station companies, pledge sympathy, assistance and protection to any company so being fought; and that such committee be instructed to represent to the various parent companies that the conduct we have above deprecated is something so fatally injurious to us and to our stockholders as to make our investments uncertain and undesirable, and that therefore we will, as one association, feel not only justified in, but required to take the strongest possible means of remedy and prevention within our power, whenever we find a parent company engaging in or permitting such a course of conduct. When it has already been started any such company so minded can readily stop it.

The report of the committee was received and the committee ordered continued.

The President—The next in order is the report of the Committee on Data, A. J. DeCamp, Chairman.

Mr. DeCamp—I am rather in an awkward position in reference to the report of this committee. I have a report here which has been formulated and I have not been able to confer with the majority of the committee as to the final presentation of it. I therefore speak mainly on my own responsibility and make the report that of progress and ask for a continuance of the committee. That is open for any suggestion any one may make.

The President—The majority of the committee have not been able to come together, owing to the pressure of business, I suppose, and determine fully on a report which has been formulated. They therefore ask you to continue them and they will report at another session.

A motion to continue the committee was carried.

The President—Topic: "Proper Care and Management of Alternating Currents," T. Carpenter Smith, Philadelphia.

Mr. Smith bids me to say that that paper was promised for the next Convention, not for this, and by error was put down on the programme for this Convention.

The President—Topic: "How the National Electric Light Association can Best Serve the Interests of Central Station Companies," G. R. Huntley.

Mr. Huntley—Mr. President, some time ago Mr. Lockwood asked me to write this paper. I felt that I was inadequate to the task. I feel so now. I think, however, that the paper or the topic might be discussed upon another heading, and better still—"How can the Central Station Men Best Serve the National Electric Light Association?" As we look about us to-day here we see perhaps thirty-five or forty central station people; in fact they are in the minority. We find a great many supply men here taking an active part in their membership, or in respect to their pocket book, to aid the National Electric Light Association as they might be. I think, to put the whole matter in a nutshell, that the National Electric Light Association should be purely a business association, and in being that, they will best serve the central station men. I have nothing more to say upon the topic.

The President—The report of the committee to nominate an executive committee for the ensuing six months, and to name a place of meeting, is in order.

Mr. T. Carpenter Smith—The nominating committee have met and they unanimously recommend as the next place of meeting, Providence, R. I., the time to be announced by the executive committee. (Applause.) They have also unanimously concluded that it is only due to the executive committee, and to the work which they have so thoroughly done, to continue that committee, the only change being made being the substitution of Mr. A. J. De Camp for Mr. Thurber, by request.

The report of the committee was on motion accepted, and the committee discharged.

The President—The election of the executive committee, I presume, must be proceeded with by ballot.

Mr. De Camp—I move that the Secretary cast the ballot for the nominees. Carried.

Secretary Foote—I announce the ballot as cast, as follows:

For members of the executive committee—G. R. Huntley, Chairman; E. R. Weeks, C. R. Wilmerding, J. J. Burleigh, M. J. Francisco, J. A. Seely, James English, A. F. Mason, A. J. De Camp.

The President—Those gentlemen are elected. Will you take any action on the place of meeting?

Mr. Armstrong—I move that the recommendation of the committee be adopted. Carried.

The President—Unless there is some other business to come before the Convention, it will be in order to adjourn.

On motion of Mr. Seely, the Convention adjourned *sine die*.

THE EXHIBITS.

The Interior Conduit and Insulation Company had an interesting display of their tubing in one of the hotel parlors which attracted a good deal of attention, and it evidently created a very favorable impression.

Mr. H. H. Eustis represented the Clark wire interests. It is said he carried some of the wire with him when he went in bathing, to ascertain the action of salt water on the insulation.

James W. Queen & Co., of Philadelphia, were ably represented by Mr. Elmer Willyoung, and the firm had on exhibition an interesting display of the electrical measuring instruments for the excellence of which the firm is justly celebrated.

Mr. W. W. Castle was the exponent of the Standard Paint Co., and showed some samples of P. & B. conduits, armature varnish and electrical compounds.

The Eureka Tempered Copper Company of North East, Pa., showed, through Mr. A. L. Daniels, some of its commutator segments, wires, brushes, etc.

Mr. W. C. McIntire represented the Eddy Motor Co., of Philadelphia and New York.

The Connecticut Motor Co., displayed a small motor finished in polished brass.

The Pumpelly Storage Battery Co., of Chicago, explained its system in a neat little pamphlet, which also gave a good deal of general information on storage batteries.

The Sperry Electric Company, of Chicago, gave a practical illustration of the valuable features of its triple carbon, single rod, 16 hour lamps. The Company was represented by Mr. Charles E. Gregory.

Mr. O. S. Platt, of Bridgeport, Conn., showed the electrical switch of which he is the manufacturer.

The Seely & Taylor Mfg. Co., of New York, had an interesting exhibit of goods made of their compound.

The display in the main corridor of Messrs. Chadbourne, Hazelton & Co., of Philadelphia, was attractive. The Wenstrom Dynamo and Motor, the Equitable Electric Railway and Construction Co., and the United Electric Equipment Co., interests were well represented by the same firm.

Mr. J. A. Wetmore displayed underground arc-light cables in the name of the Norwich Insulated Wire Company, of Newport.

The Crosby Electric Company, of New York, exhibited dry batteries and other electrical novelties manufactured by that concern.

The following named companies were represented; The Sensible Packing Company, of Chicago; the Nubian Iron Enamel Company, of Chicago; Moore and White Friction Clutches and Main Belting Company, of Philadelphia, by Mr. W. H. Shoemaker; The Brady Mast Arm Comp[illegible] of New Britain. Conn., by Mr. T. A. Brady. [illegible] Washburn and Moen Mfg. Co., the Electrical Supply Company, of Chicago and Ansonia, Conn., by Messrs. Chas. Wirt and F. B. Platt; the Shultz Belting Co., of New York, by A. B. Lawrence, and the Evans Friction Core Company, by Messrs. Conant and Burbank.

Mr. James F. Kelly the manager of the wire department of the Edison General Electric Company, 19 Dey St., was present in the name of his company, He reports much interest manifested among the members of the Association in the goods he represented, and he succeeded in making many personal and business friends, as he always does.

A beautiful souvenir in the shape of a celluloid calendar was presented to the members of the Convention by the genial representative of Lewisohn Bros., Mr. Samuel Rosenstamm.

Mr. R. W. Hood representing Paiste & Co., had a full line of that firm's well known switches and cut-out on exhibition.

P. J. Ackerman of the American Electrical works of Providence, R. I., was on deck as usual with a splendid variety of that company's goods.

The display of the Bryant Electric Co., of Bridgeport, Conn., was viewed with great interest. Double pole switch, cut-outs, also the Lewis fixture for keysockets by chain pendants, and the Orford pendants were among their novelties.

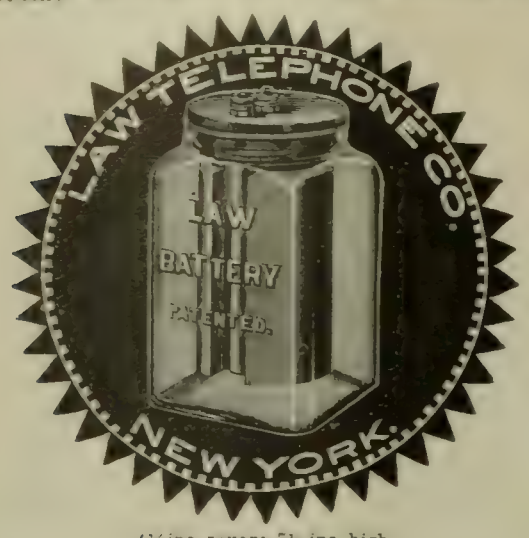
MUNICIPAL ELECTRIC LIGHTING.—The advocates of municipal electric lighting will find some highly interesting reading in the paper read by Mr. M. J. Francisco before the Electric Light Convention at Cape May. There the true inwardness of the doctrine is laid bare, and in the light of actual facts and figures it is quite probable that not many more municipalities will fall into the trap. The whole idea is political from beginning to end—political power and control. No wonder these municipally controlled lighting plants give unsatisfactory results when it is likely in most cases that the "electrician," is such only in name, but in reality is a political heeler—is "one of de boys" and has "a pull in de ward." These are the only qualifications necessary to secure political positions, and electric lighting controlled by a municipality is no exception to the rule. How these political "electricians" must laugh in their sleeves when they think how easily they pulled the wool over the taxpayers' eyes, and what a grand thing it is to say that they can light their city at much lower figures than a private corporation could. What public benefactors they are! But the reaction has already set in; the taxpayers' are learning of the trickery played upon them, and the political electrician's days are numbered. Electric lighting requires something more than political scheming and trickery to make it a success, and we hope that Mr. Francisco's telling facts will be published broadcast and read by every intelligent citizen in the land.

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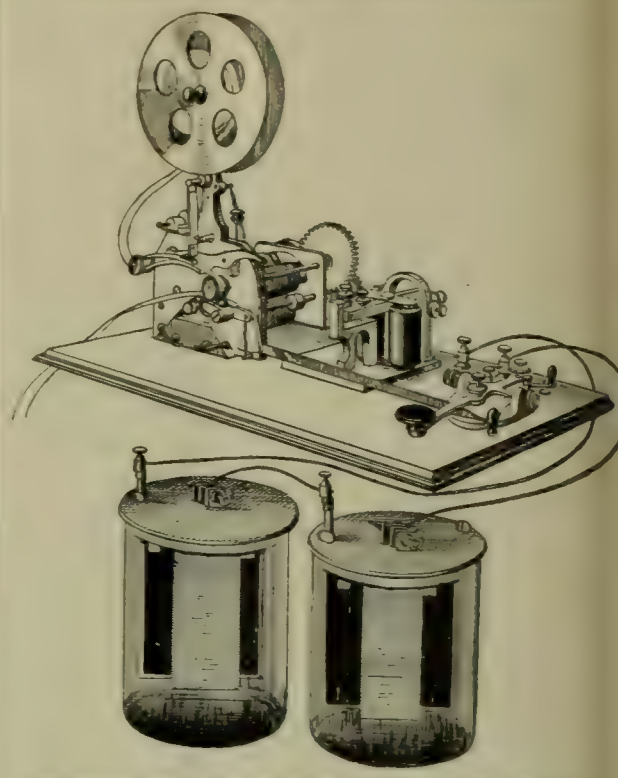
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NEW YORK, SEPTEMBER 6, 1890.

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THE TELEPHONE CONVENTION.

The twelfth meeting of the National Telephone Exchange Association will convene at the Russell House, Detroit, Mich., on Tuesday, September 9th, at 11 a. m. The Telephone and Telegraph Construction Company, which operates the Detroit exchange, has arranged a programme for the entertainment of the members of the Association outside of the time during which the business meetings are being held. The programme in outline is as follows:

Tuesday, 11 a. m., address of welcome by the Mayor of Detroit; Wednesday, 2:30 p. m., carriage ride and lunch at Belle Isle Park Casino; 8:30 p. m., banquet at the Russell House; Thursday, boat ride and lunch on board, returning to Detroit in time to take evening trains' from the city if desired. Further particulars will be given out at the meeting of the Association.

At the meeting the customary reports and several valuable papers will be read.

The badge of the Association for this year will be the same as that of last year, and last year's nickel buttons will exert as much magic power as they did last year.

The following are the present officers of the Association, the term of all of whom, with the exception of the first two members of the Advisory Committeee, will expire at the Detroit meeting; President, Wm. D. Sargent, Brooklyn, N. Y.; Vice-President, Frank G. Beach, Chicago, Ill.; Secretary, C. H. Barney, New York City; Treasurer. H. L. Storke, New York City; Advisory Committee, for three years, vacancy (Geo. N. Stone, elected last year, having resigned); for two years, Morris F. Tyler, New Haven, Conn,; for one year, Edward J. Hall, Jr., New York City. Executive Committee, Wm. D. Sargent, ex-officio, Brooklyn, N. Y.; Charles F. Cutler, New York City; Chas. H. Wilson, Chicago, Ill.; H. N. Gifford, Louisville, Ky.; Levy Sprague, Lowell, Mass.

MONOPOLY IN STORAGE BATTERIES.—Fifty thousand dollars of London capital is to be used in an effort to break down the monopoly in storage batteries held by the Electric Power Storage Company, of London. This battery is commonly known as the E. P. S. cell, and it is claimed that the monopoly can be broken in the law courts.

THE EDISON CONVENTION.

The annual convention of the association of the Edison Lighting Companies, for the year 1890, will be held at West's Hotel, Minneapolis, Minn., commencing Tuesday, September 16th. The managers of the principal stations of the country are taking unusual interest in this convention for the reason that the officials of the parent company expect to be in attendance. Mr. Thomas A. Edison, and Mr. Samuel Insull, second vice-president of the Edison General Electric Company, will be present at the convention. Minneapolis was selected as the place for holding the meeting on account of the large central station and the Sprague electric railways in operation there. The Minneapolis Industrial Exposition will be in progress during the time of the Convention, and a fine electrical exhibit is assured in view of the success of the one recently held at the Lenox Lyceum in this city.

Arrangements have been made, by which delegates can engage rooms in advance.

The officers of the Association for 1889-90 are as follows: President, J. I. Beggs; Vice-President, C. P. Gilbert; Secretary, W. J. Jenks; Treasurer, Wm. S. Howell.

ELECTRICITY IN COMPETITION WITH STEAM.—Recently we particularly noted the fact that there was greater enterprise in electric railways in the East, notably Boston, than anywhere else in the country. There are many electric railways throughout the United States, and in every section, but in Boston and vicinity there are a greater number of miles of electric road than in any other section with the same number of inhabitants. Our eastern friends are not content with electricity for street railway purposes only. They are branching out now on a larger scale. What seems to be the first case of competition between electricity and steam on an inter-urban railroad is recorded in our eastern letter this week. The proposed electric road is to be run from Providence to Pawtucket and Bristol, and will compete with steam on the Stonington and the Old Colony lines between those points. There are many electricians so enthusiastic over the power and applicability of electricity as to believe that that force will eventually supersede steam in railroad work. This venture will therefore be watched with a great deal of interest.

ELECTRICAL LEGISLATION.—The warning sounded by the committee on legislation of the Electric Light Association against the attitude of State Legislatures towards electric lighting should not be passed unheeded. The condition of legislation in the various States with reference to electric lighting shows that there is considerable animus existing towards this industry by legislators. In most cases it is all for political effect, but that does not lessen the danger one bit. All central station companies should lose no time in combining for mutual protection. The necessity for this is abundantly evident from the report of the committee, and the importance of prompt action on the part of the companies in the various States with a view to meeting the common danger which is threatening cannot be too strongly urged.

THE ELECTRICAL CENSUS.—The action of the Electric Light Association with reference to the Electrical Census was one of the most important things done by that body during its three days' session. The resolution passed urging the Census Committee of the Senate to favorably report the Electrical Census bill to that body places the stamp of national interest upon the subject, and it is hopeful that the Committee and the Senate in turn will give the matter early and favorable consideration. The importance of the investigation of electrical industries by the census cannot be overestimated.

NEW COMPANY.—An electric light company has been organized in Oakland, California, with a capital of $500,000. It is proposed to introduce the Edison system of lighting.

REVERSIBILITY OF ELECTRIC GENERATORS.

The great value of an efficient electric motor was recently demonstrated at a silk mill at Bradford, England. One of the main steam engines was being overhauled, and it was found that the repairs would take up so much time that, unless some other power could be substituted, the operation of several departments would be stopped and many hands laid off. It was then decided to use one of the two dynamos used for lighting the mills as a motor, and after the necessary changes were made in the connections, the first dynamo was started up supplying the current to run the other as a motor. The new arrangement gave entire satisfaction. The motor did remarkable work, and its self-regulation and regularity of speed under different loads was a great surprise to the principals of the firm. The whole change was made in about an hour, and the machinery was started without the slightest hitch. The current passing into the motor varied from 250 to 500 amperes, according to the different loads, at a potential of 115 volts; it was kept running for about 36 hours without one single stop or the slightest interruption whatever.

The firm was so well pleased with the new arrangements that they are now contemplating a more extended use of electricity for power.

TELEPHONE RATES.—Congress is making an effort to secure lower charges to the government for the use of the telephone, but the ground on which the argument in favor of reduction is based does not seem reasonable. The mere fact that it costs $2.50 to manufacture a telephone, is not, in itself, sufficient reason to insist on a reduction of rates. The manufacture of instruments is not the only item of expense in telephone operations. Lines have to be maintained at great expense, help is essential, and many other things combine to run the cost of maintenance of plant quite high. On the other hand it would seem that the telephone company could afford to make some reduction in rates in some places, and yet be able to declare handsome dividends, but to argue that the rates to the government should be reduced on the ground of the low cost of manufacturing elephones is not good logic.

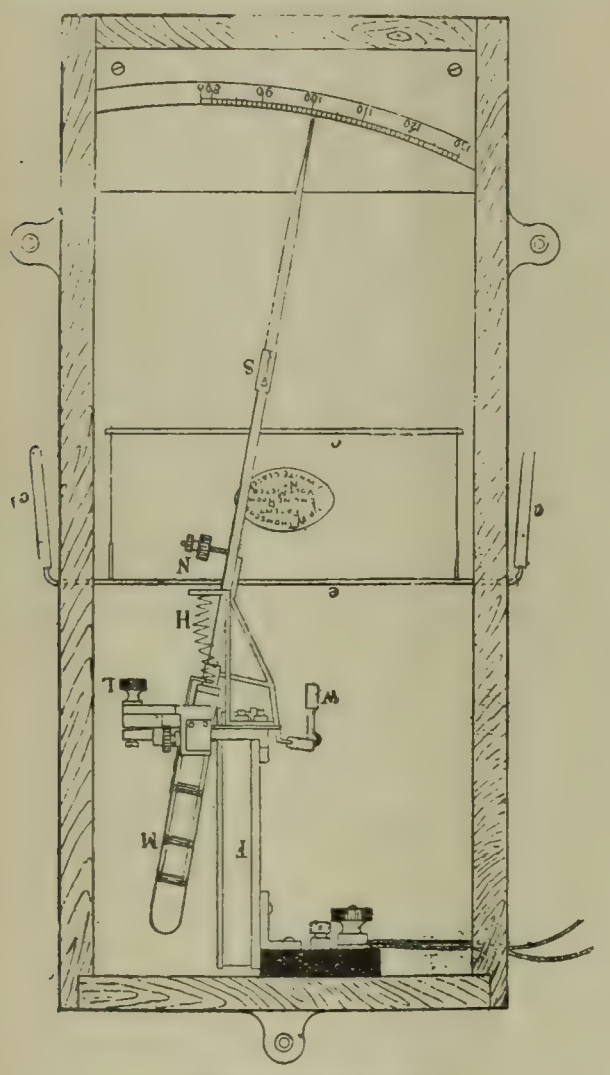
THE FIRST ATLANTIC CABLE SIGNALS.—Thirty-two years ago the first signals were sent through the Atlantic cable from shore to shore. It is hard to realize, as we lay before our readers to-day dispatches from every continent on the globe concerning to-day's events, that it is only 32 years since the genius and energy of Cyrus W. Field brought to successful completion the first ocean cable. To-day there is a network of them around the globe—except across the Pacific, and that omission will not long remain—and we take our news of the same day from London, Zanzibar or Hong Kong, as much as a matter of course as we do our news of New York and Chicago.

DO NOT WANT MUNICIPAL LIGHT.—Many of the residents of Peabody, Mass., a few days ago expressed their sentiments regarding municipal electric lighting by obtaining an injunction restraining the town clerk and board of selectmen from using any of the town money for such purposes. Politics and electricity do not combine well, as the citizens of Peabody have evidently found out, and the business-like manner in which the latter have undertaken to avoid falling into error is commendable.

ELECTRICITY AT THE WORLDS' FAIR.—Every electrician should read what Mr. J. P. Barrett, the city electrician of Chicago, has to say in his paper read at the Electric Light Convention concerning the Worlds' Fair, which is to be held in Chicago in 1893. He there points out the inferiority of electrical displays at recent international exhibitions and makes some sensible suggestions as to making the electrical department of the coming fair of primary importance.

THOMSON'S ENGINE-ROOM VOLTMETER.

We give below an illustration and description from the London *Electrician* of Sir Wm. Thomson's new engine-room voltmeter which is intended for installation work on either direct or alternating currents, where it is convenient to have a direct-reading voltmeter with large scale divisions. The instrument, as shown in the figure, depends for its action upon the repulsion of a movable coil, M, by a fixed coil, F. The fixed coil, F, bears all the other portions of the instrument attached to it, and is in its turn supported from a vulcanite block fixed to the instrument case. This vulcanite block also bears the terminals of the instrument. The movable coil is supported on knife edges, and the circuit through it from the fixed coil of the voltmeter is made by two spirals of fine copper wire. A pointer attached to the movable coil indicates by direct readings in volts the difference of potential between the terminals of the instrument. Attached to the pointer on one



THOMSON'S VOLTMETER.

side, and perpendicular to it, is a short arm, with a screw nut, N, which, together with the sliding weight, S, on the pointer, serves to adjust the balance of the movable parts. To the other side of the pointer is attached a bracketed arm terminating in a knife-edged stirrup, on which is hung the weight, W, fixing the constant of the instrument. The movable coil can be lifted from its bearings by turning the screw, L, which raises a lever passing below the knife-edged trunnions, and so fixes the movable portion of the instrument when the instrument is being removed from place to place, or is packed for carriage. A checker *c c*, is provided to facilitate the taking of readings when the circuit is for some reason being made and broken, or the potential being suddenly and largely varied.

The instrument is graduated by direct comparison with a standard centi-ampere balance. The movable portion is first adjusted to be in neutral equilibrium by means of the sliding weight, S, and the nut, N; the weight, W, is then hung on the knife-edged stirrup. This weight causes the pointer to come to zero, in which position the movable coil is pressed against the fixed one. The scale consists of very nearly equal divisions, and is usually graduated from 80 or 90 to 140 or 150 milliamperes. The coils of the instrument are wound with many turns of copper wire, and have a total resistance of about 100 ohms. An anti-inductive resistance of platinoid wire, fixed to the back of the instrument, is adjusted to make up with the resistance of the coils 1,000 ohms at a given specified temperature; thus, as the scale is in milliamperes, the instrument reads directly in volts.

THE SCHISEOPHONE.*

This instrument, as its name so clearly suggests, is intended to act as a "flaw sounder." It is a modification of Prof. Hughes' induction balance, and has been invented by Captain de Place.

Fig. 1 represents an induction coil having a reciprocating core, which can be set in motion by means of a crank, the whole being mounted on a stand with a handle.

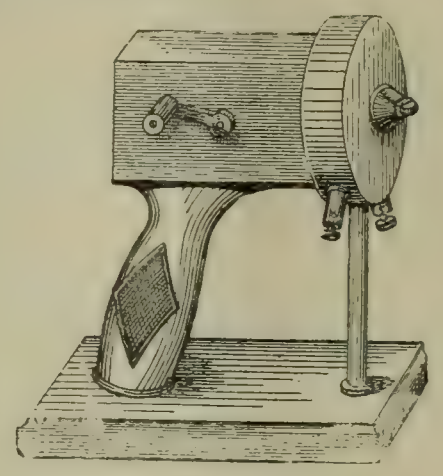


FIG. 1.

Fig. 2 is a diagram of the arrangement. B is the core which moves longitudinally in the coil C. The core is made to strike the object to be tested. A continuous current is sent through the coil C and a coil D, the latter being fixed at one end of an induction balance. A similar coil, E, sliding on a graduated rod, is connected with a telephone. When the core B strikes a

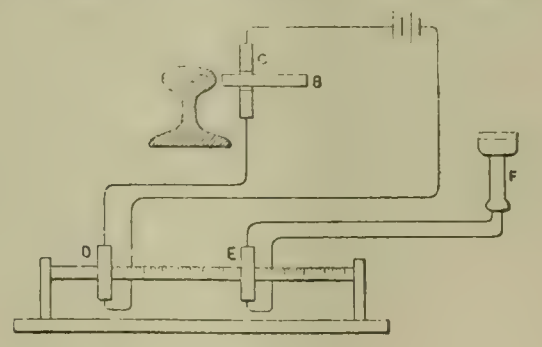


FIG. 2.

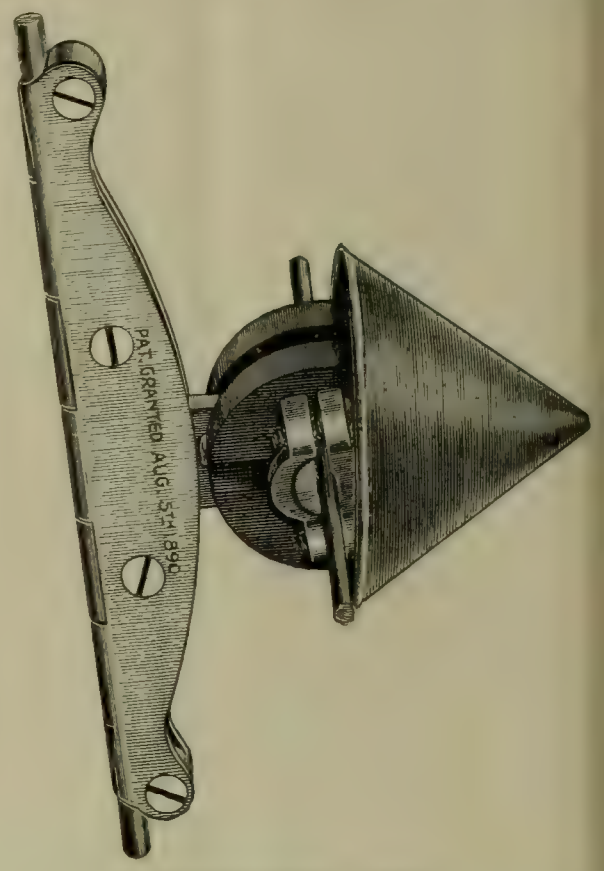
sound portion of the metal, a certain quality of click will be heard in the telephone. This noise may be reduced to a minimum, or may be extinguished by adjusting the coil E. When the core B strikes the object to be tested in the neighborhood of a flaw, the sound in the telephone is increased. The instrument is said by *La Nature* to have given very satisfactory indications of flaws in rails at the depot of the Chemin de Fer du Nord; in every instance the rail when broken showed a flaw at the place indicated.

ELECTRIC LIGHTING IN EDINBURGH.—It was agreed on July 31st, to recommend the Edinburgh Town Council to take steps to obtain a Provisional Order giving them power to control the introduction of electric lighting into the city.

*London *Electrician*.

IMPROVED TROLLEY WIRE HANGER.

A very novel trolley wire hanger styled the "Best" and which was on exhibition in Cape May is illustrated below. This hanger or support is made as a clamp in two pieces or jaws having curved lugs or ears which pass under and about the trolley wire so that when the jaws are fastened together by screws the trolley wire rests upon a firm support and is firmly clamped between the jaws, preventing the wire from falling at the points of suspension. It is provided with a hooked arm or upright adapted to engaging a span wire, but insulated therefrom by disks of insulating material fastened to the span wire. In practice this hook is fitted upon the hub of the disk of the insulator which is provided with



TROLLEY WIRE HANGER.

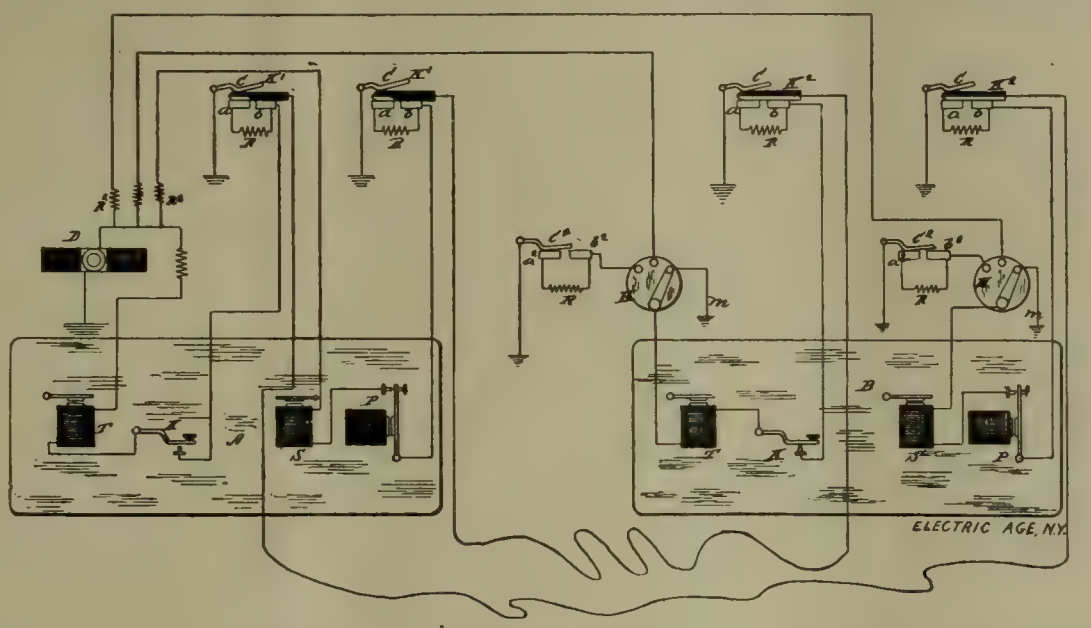
a slot by which said disk is placed upon the span wire. The hub of the disk has also mounted upon it like slotted disks which are provided on their outer side with extension hubs which are fastened to the span wire with set screws. The hanger is insulated from the span and has a pivoted movement on the same. The trolley is firmly clamped between the jaws of the hanger and is secured positively without the use of solder and can be attached in five minutes time against a half hour in the old manner. This valuable invention is owned and controlled by L. F. Jordan of the Jordan Train Lighting Company of Boston, and its rapid adoption by all the leading railroad companies is only a matter of a short time.

GAS LEAK DETECTOR.—One of the most useful of modern devices connected with underground work is the gas detector. This instrument will readily detect and localize leaks of coal gas, even if in the most inaccessible places. In addition to the visual arrangement, it may be made to give an alarm by completing an electric circuit through a bell or other telltale. A great number of these detectors are now being used in France, Belgium and Italy. There is a large inspectional instrument, having a bold and open scale; a handy pocket instrument, in a leather case, made especially for the use of those engaged in gas works, etc., and also a small metallic detector about the size of an ordinary pocket aneroid barometer. The detectors can be made so sensitive that they will detect one twentieth per cent. of coal gas when mixed with air. Instruments of this class would, or should find a ready market in New York, where gas upheavals are of frequent occurrence.

TELEGRAPH SWITCH APPARATUS.

In the use of the apparatus at a telegraph office it frequently becomes necessary to connect various local circuits, as in the case of duplex or quadruplex locals, in order that a message may be repeated from one line to another, or to connect a branch or office line to a local circuit in such a way that the leg or loop leading to the branch office shall become in effect an extension of the sending or receiving local of a duplex or quadruplex set. In the absence of any special provision these various changes would obviously be accompanied by changes in the resistance in circuit with the dynamo, and consequently damaging or troublesome changes in the flow of current in the circuit for which it is necessary to make some compensation or adjustment. Thus, for instance, the introduction of a branch office loop or wire would increase the total resistance and perhaps cut down the current below the working margin ; or if the current flows in proper amount when the branch wire is in circuit with the local sending or receiving circuit the withdrawal of the branch wire would so reduce the resistance that the current would increase sufficiently to heat the local-circuit instrument.

To overcome these difficulties Mr. Minor M. Davis, Assistant Electrician of the Postal Telegraph Company, has invented a switch apparatus which accomplishes the object desired to an eminent degree. The invention consists of the



DAVIS'S TELEGRAPH SWITCH.

combination, with the spring jacks through which the local circuits are formed, of suitable equalizing resistances, permanently connected to the normal spring jack circuits and automically cut in or out of circuit by the insertion or withdrawal of the spring jack wedge. The spring jack itself is of new design and is covered by the patent.

The accompanying diagram gives a general idea of the invention and its application to actual circuits. The spring jack wedges K^1 and K^2, have on one side as represented, a metallic, conducting surface, while the other side is composed of insulating material. The object of this will be readily understood by reference to the diagram. The withdrawal of these wedges places the compensating resistance in circuit and their insertion cuts out the compensating resistance and cuts in simultaneously the loop wire. It will be noticed that some of the wedges have but a short section of metal on the under side. The object of this will be apparent by reference to the figure.

The spring jacks without wedges are shown at C^2. This system of switching is extremely simple and efficient and it renders the combined operation of main and local, or short circuits a matter of easy accomplishment.

THE GRAMME RING.—The Gramme ring which forms an essential part in many dynamos was

GENERAL USEFULNESS OF STORAGE BATTERIES, AND THE MANY KINDS IN USE TO-DAY.

BY J. K. PUMPELLY.

Much has been written of the storage battery or accumulator within the last year, and many expensive law suits have been fought over differences in their construction, a difference so slight in every case that the general public, who are beginning to use the batteries, could scarcely recognize these differences, and experts only by examining them with a microscope. Since, in a storage battery the work sought to be done and for which the battery is purchased is performed through the mysterious action of electro-chemistry, set in action in the battery by some agency outside of itself, as for instance a current from a dynamo ; and since this action is the same in all of them, the differences can be only in their mechanical construction—the manner, indeed, in which their parts are put together—and on this method depends very much the durability of the battery. The present day finds storage batteries in use in many ways, doing work for us noiselessly, steadily, and economically, and, as confidence grows and understanding increases, many more uses can be made of them. But understanding comes slowly ; the "thing" is so full of mystery that the most advanced electrician is as likely to say even to-day : "Oh ! storage batteries. I confess I don't know anything about them ; haven't had time to look into the matter."

It would be well that the public, as individuals, should understand better than they do the uses of the storage battery, since they are the ones who are to reap the benefit and who buy them. But the public are assailed on every side by the agents of rival battery companies who claim many advantages for the especial form of battery which they represent. Even parties who are placing lighting plants and know that a certain number of storage batteries will be of economical benefit to them in aiding to distribute lights, or to continue a certain number of lights to private dwellings after the regular hours for lighting from the main dynamo circuit have run out, do not understand any difference in the batteries on the market until after several months of trial, which trial, when all is said and done, is to prove the durability of the batteries. The efficiency, that is the ability to do the work, and furnish the lights bargained for, can be known after the first twenty-four hours of use. Hence every effort is now being made to render a battery enduring. This depends upon the way in which it is put together.

We have careful scientists who have been experimenting on batteries since 1881, to find out accumulators, and what their economical work may be. The records of these tests are only now being published by W. E. Ayrton, C. G. Lamb, F. W. Smith and M. W. Woods, associates. But what the public who buy cells at high prices want to know, is that the batteries when placed in their houses will actually do the work estimated and promised by those selling them, and will do it long enough to pay for the outlay, and without expert care, or constant dread of a break down, thus leaving them in the same position they would be in when some hidden water pipe springs a leak, and the plumber has to be sent for. The "Accumulator Company's" battery is well known, much advertised, and much fought for in several law suits, and the Julien storage battery is as well known and has been immersed in as many patent law suits.

The patent lawyers seem to have made more money out of the storage battery than either the inventors or the manufacturers. The "Anglo American," or Sorby battery is another accumulator on the market, and lately two new ones have been announced, and are in actual use,—the McLaughlin battery, and the Main battery now being experimented with and used by the River and Rail Company. These last two differ somewhat in their construction, and chemical composition from the others, and may prove better, but as it needs fully a year to get any idea of how long the composition of a storage battery will bear the constant chemical changes which must go on in the molecules or atomic composition, and still longer to find out how well it endures the handling and hard knocks of daily commercial use, an opinion can hardly as yet be given. The lead plate seems thus far to bear these changes the longest, but as now the lead plate is used merely as a conductor of the electric action, and a supporter of other more easily disintegrated material, such as an oxide of lead. The method in which the plate is made in order to hold this material, is one of the difficulties in building a battery. How a purchaser, not an expert, can use common sense, and judgment in the choice of a battery, knowing that all of them are to-day of the same *working efficiency*, will be fully explained in the next article ; also what economical use they can be put to, as well as how they can be used as a luxury.

MANUFACTURE OF VERMILION BY ELECTROLYSIS.—In a wooden vat, one metre in diameter and two metres deep, circular plates 15 centimetres wide are placed against the sides, and on these the mercury is exposed, one centimetre deep. These plates are connected with the positive pole of a dynamo. At the bottom of the vat is a sheet of copper electroplated with iron, and connected with the negative pole. The vat is filled with a solution of 8 per cent. of nitrate of ammonia, and 8 per cent. of nitrate of soda. A worm pierced with holes, supplies a constant and regulated current of sulphuric acid ; the excess of gas escapes by a tube projecting from the lid. A screw agitator keeps up a thorough mixture in all parts of the liquid. When the current passes it immediately forms a precipitate of red sulphide of mercury. Attempts have been made to dispense with the current of sulphuric acid by making up the bath with:—Water, 100 litres ; nitrate of ammonia, 8 kilos ; nitrate of soda, 8 kilos ; sulphide of soda, 8 kilos ; sulphur, 8 kilos. Under these conditions one need only add sulphur and mercury to extract at the end of the operation vermilion which rivals that which can be obtained by sulphate of ammonia.

COLOGNE.—The municipal installation is being pushed on with. Owing to the ground under the streets being already crowded with gas and water mains, the lighting cables will be laid principally under the pavements. At first, the main thoroughfares only of the old part of the town are to be lighted, for which 12,000 lamps are required. For the supply of these, two steam engines of 250 horse-power and two of

ELECTRIC LIGHTING FOR BEGINNERS*

BY THE EDITOR.

Part VI.—Shunt Wound Dynamos.

120—What is a shunt wound dynamo?

A shunt wound dynamo is one in which the coils of the field magnets are placed in a shunt to the main circuit (see accompanying figure).

121—What is the meaning of a "shunt" circuit?

A shunt circuit means a circuit derived by diverting a portion of the main current over another path which is called the shunt.

122—Why is this class of dynamo called a shunt dynamo?

Because the current needed to magnetize the field magnets is shunted from the main circuit.

123—How much of the main current is usually shunted around the field magnets?

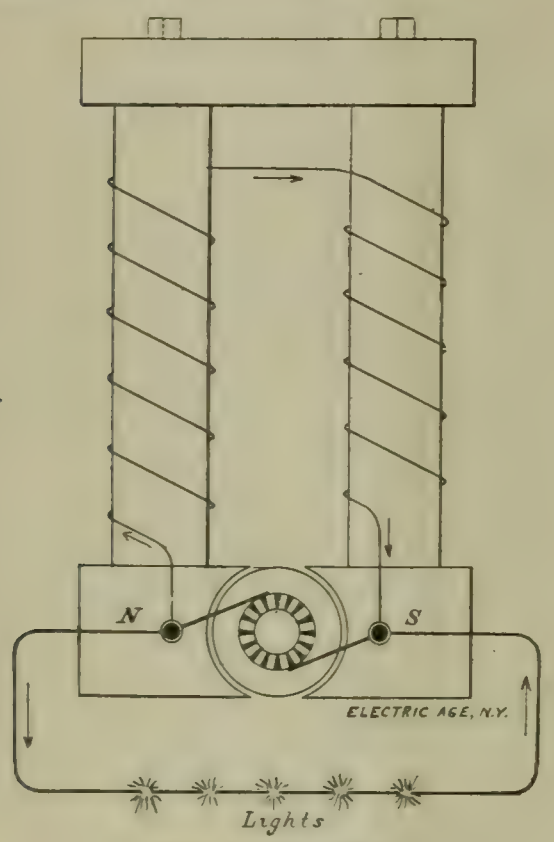
It depends upon the work to be performed by the current.

124—Is it a steady or variable quantity?

It is usually variable.

125—How is the shunt current varied?

The shunt current is varied by means of a resistance box placed in the shunt circuit.



SHUNT WOUND DYNAMO.

126—How does the resistance box vary the shunt current?

Increasing the resistance in the shunt circuit decreases the current, and decreasing the resistance increases the current, in inverse proportion.

127—When the current is generated in the armature and it reaches the brushes where there are two paths presented for its flow what takes place?

The current divides at the brushes, one portion going through the shunt and, the other going to the main circuit, the division being in proportion to the relative resistances of the two circuits.

128—Explain the division of current between two circuits?

Take, for example, two circuits, A and B, on a shunt to the other. A has a resistance of 1 and B of 2. B having double the resistance of A will get only half as much current because A offers a path twice as easy as B to the flow of the current. If the resistance of A is increased to 2, or that of B is decreased to 1, the resistance of both paths is then made equal, and consequently the current would divide equally between the two circuits. The answer to question 126 is applicable to either of the two circuits.

* *Copyrighted.*

129—Is the working current variable or steady in quantity?

Within certain limits it is maintained steady.

130—In answer to question No. 124 it is stated that the current flowing around the field magnets is usually variable; how is this statement reconciled with the last (answer to question 129)?

Question No. 129 and its answer refer to the current on the outside or lamp circuit, while question No. 124 and its answer refer to the portion of the current flowing around the field magnets.

131—Explain how it is that the current going around the field magnets may vary whi e the main current is kept up, both circuits being connected to common terminals?

The working, or main circuit, requires a certain amount of current; of the current generated in the armature a certain proportion flows through the field magnets in the shunt to maintain the current at that point. Now should there be any increase of resistance in the main circuit, as by turning on more lamps, for instance, the increased resistance diverts more of the original current through the shunt. This increased current produces a denser magnetic field which, in turn, causes an increased production of current in the armature to meet the additional demand for current. It must be remembered that this self-regulating action takes place only within certain limits.

132—In case the shunt circuit should become broken what would be the result?

The main circuit would be entirely deprived of current.

133—Why?

Because, there being no current in the shunt, no magnetic field could be produced, and in the absence of a magnetic field no current could be generated in the armature.

134—If a break should occur in the main circuit what would be the effect?

The entire current, generated by the armature, would then find a path through the shunt.

135—What would be the effect of that?

If the entire current were suddenly turned into the shunt there would be great danger of injuring the machine.

136—In what manner would the machine be injured and from what cause?

The great increase in current around the field magnets and in the armature coils would generate great heat which would burn and destroy the insulation of those parts.

(*To be continued.*)

THE ROVELLO ELECTROLYTIC PROCESS FOR EXTRACTING COPPER.—The cupriferous water obtained in the process of roasting copper pyrites in the manufacture of sulphuric acid is usually treated with iron filings, which precipitate the copper in the condition of an impure mass containing about 75 per cent. of copper, which it is necessary afterwards to compress, dry, melt, and refine. The object of M. Rovello's process is to electrolyze this cupriferous water in such a manner as to precipitate the copper in such a form as to render it immediately useful. His apparatus consists essentially of a large Daniell battery, the electro-negative elements of which are of sheet or cast-iron, instead of zinc, and are separated from the copper plates by porous partitions. The electromotive force of an element of this kind (iron-copper) being about .6 volts, a current of 200 amperes should be obtained with a battery of an internal resistance of .003 ohms, capable of precipitating (at the rate of 1.19 grammes per ampere hour) 6 kilogrammes (13lbs.) of copper per hour. In order to lower the internal resistance to .003 ohms, it is necessary to use electrodes with large surfaces and diaphragms of very low specific resistance. The electrolytic batteries are built up of a series of wooden frames separating the cathodes from the anodes by membranes of parchment. The anodes and cathodes are respectively fastened together by bars of copper. The frames and parchments are pierced by four holes, in which are inserted four tubes. Two of these tubes communicate with the even elements and a funnel, and the other two with the odd elements and a second funnel. The cupriferous liquid is poured in in narrow stream and passes through into the cathode compartments, and the solution of sulphate of iron is poured into the anode compartments. These liquids escape separately by the overflow pipes. The weakened solution of sulphate of copper may afterwards be completely exhausted in a second apparatus. The operation is carried on without help from any source of electricity other than the baths themselves, which are short-circuited.

THE FRANKFORT ELECTRICAL EXHIBITION.

We are informed that boilers and engines with a capacity of about 2,200 horse-power have already been put down at this Exhibition says the London *Electrician*. The dynamos are also in position. These will supply 1,000 arc lights and about 10,000 incandescents. It is expected that the lighting will far surpass anything that has hitherto been accomplished, and several novel and surprising effects will be shown. Besides showing the great advance which the electrical trades have made since the Vienna Exhibition, an endeavor will be made to arouse more public interest in this industry. The Elektriziteits Maatschappij, Systeem de Khotinsky, Gelnhausen, besides accumulators and a collection of apparatus for installation work, will also during the time the Exhibition is open show the exceedingly interesting method by which incandescent lamps are manufactured. Visitors will thus be able to watch the details of the processes for making the carbon filaments and turning out the completed lamps.

With regard to the projected transmission of 175 horse-power from Lauffen-on-the-Neckar to the Exhibition, and the use of a potential of 30,000 volts for the purpose, Herr Popp writes to the *Finanz Herold* as follows:—

"I have for some time past experimented with currents at tensions up to 20,000 volts, and have arrived at the conclusion that the use of pressures of over 15,000 volts must always be attended by very heavy losses partly due to the leakage from one conductor to the other by way of the insulators, and partly by direct loss through the air. At 15,000 volts these losses in damp weather assume very important magnitudes. Leaving these, however, entirely out of the question, I find that the resistance of the conductor itself will occasion a fall of potential of over 4,000 volts, when a pressure of 15,000 volts is used, so that 15,000 volts at Lauffen will only give 11,000 volts available at Frankfort. Moreover, the difficulties of working out in an efficient manner so vast a project will certainly prove insuperable. I therefore regard it as absolutely incredible that the Berlin Allgemeine Elektricitäts Gesellschaft are seriously contemplating the undertaking. I am confirmed in this view by the demand which the company makes for a copper conductor 350 km. long (outgoing and return) and 5 mm. diam. to be provided them. Such a conductor would, as you have remarked, cost quite 100,000 marks (£5,000), and there is also the possibility that the necessary poles could not be obtained. Even if some firm would furnish this free of cost by way of an exhibit, I am still convinced that the local authorities would refuse to allow the conductor to cross their land, either on the ground of danger or of interferences with telephone and telegraph lines, and that the Allgemeine Elektricitäts Gesellschaft relied on something of this kind happening when they made their offer."

THE GAS OF CORK.—In the course of a judgment at the recent Cork Assizes, on a dispute about some gas burners Mr. Justice Gibson said, "Cork gas appears to be a peculiar article, odoriferous, and giving a sickly and insufficient light."

WORKING EFFICIENCY OF SECONDARY CELLS.

BY W. E. AYRTON, C. G. LAMB, E. W. SMITH AND AND M. W. WOODS.

(*Continued from page 3, issue of August 23d*).

Curves 12 and 13 show the potential difference curves when the cells had acquired a steady state, and on integrating them we find :

	Discharge.	Charge.	Percentage working efficiency.
Ampere-hours	91	96.8	....
Watt-hours per cell	176.7	213.2	....
Quantity	....	....	94.1
Energy	....	....	82.8

We see, then, that a week's continuous charging and discharging of these cells is unable to compensate for the harm produced by their being left for 12 days fully charged. The two rests of 10 days and 12 days respectively, although followed in each case by a week's continuous charging and discharging, have reduced the discharge ampere-hours by 10 per cent., the discharge watt-hours by 12 per cent., the quantity efficiency by 3 per cent., and the energy efficiency by 5 per cent.

Third Rest.—The cells having been fully charged, a third rest of 16 days took place. On the first discharge, at the normal rate of 10 amperes, the ampere hours were only 75. After, however, the charging and discharging at the normal rates had been continued for three days and nights, the times of discharging and charging became steady.

TIMES OF SUCCESSIVE

Discharges.	Charges.
8 h. 12 m.	9 h. 28 m.
8 h. 17 m.	9 h. 35 m.
8 h. 19 m.	9 h. 35 m.

and curves 14 and 15 show the working values of the potential difference in discharging and charging. Integrating the curves, we obtain:

	Discharge.	Charge.	Percentage working efficiency.
Ampere-hours	82.6	86.2	....
Watt-hours per cell	161.3	190.5	....
Quantity	....	....	95.8
Energy	....	....	84.7

Fourth Rest.—The cells, having been fully charged, were allowed to rest for 16 days. Curve 16 gives the values of potential difference obtained at the *first discharge*, and curve 17 the values of the potential difference obtained immediately afterwards in charging. Integrating the former curve, and comparing its area with the area of the charge curve 15 obtained just before the rest, we find :

	First discharge after rest.	Last charge before rest.	Percentage efficiency
Ampere-hours	56.5	86.2	....
Watt-hours per cell	110.5	190.5	....
Quantity	....	....	65.5
Energy	....	....	58

If, however, we compare the result of the first discharge after the rest with the first subsequent charge, shown in curve 17, we find :

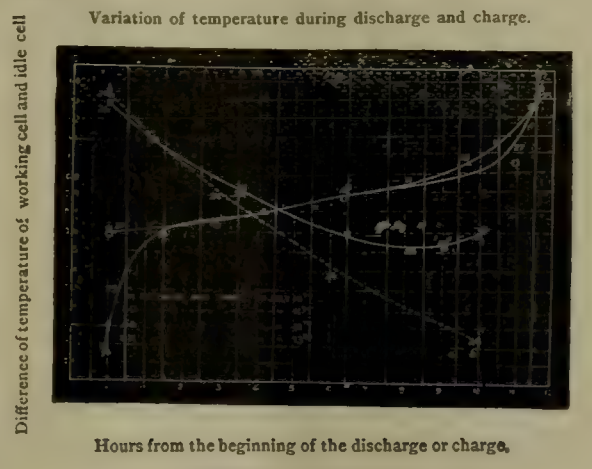
	First discharge after rest.	First charge after rest.	Percentage efficiency.
Ampere-hours	56.5	71.1	....
Watt-hours per cell	110.5	158.3	....
Quantity	....	....	79.6
Energy	....	....	69.6

The cells were now continuously, without intermission, charged with the normal current of 9 amperes, and discharged with 10 ; the discharge, as before, being automatically stopped when the potential difference per cell had fallen to 1.8 volts, and the charge when it had risen to 2.4 volts. The following give the successive times in hours and minutes in which the cycles were completed :

First discharge after rest,			5h. 40m.		
				First charge,	7h. 54m.
Second	"	"	7h. 6m.		
				Second "	8h. 30m.
Third	"	"	7h. 31m.		
				Third "	8h. 51m.
Fourth	"	"	7h. 29m.		
				Fourth "	8h. 52m.
Fifth	"	"	7h. 43m.		
				Fifth "	9h. 17m.
Sixth	"	"	8h. 0m.		
				Sixth "	9h. 24m.
Seventh	"	"	8h. 5m.		
				Seventh "	9h. 17m.
Eighth	"	"	7h. 57m.		
				Eighth "	9h. 20m.

From the last three discharges and charges we see that the cells have arrived at a steady state, and curves 18 and 19 show the steady, or working values of the potential difference for these three discharges and charges. Integrating the areas of these two sets of curves, we find :

	Discharge.	Charge.	Percentage working efficiency.
Ampere-hours	80	83.8	....
Watt-hours per cell	156.9	184.6	....
Quantity	....	....	95.5
Energy	....	....	85

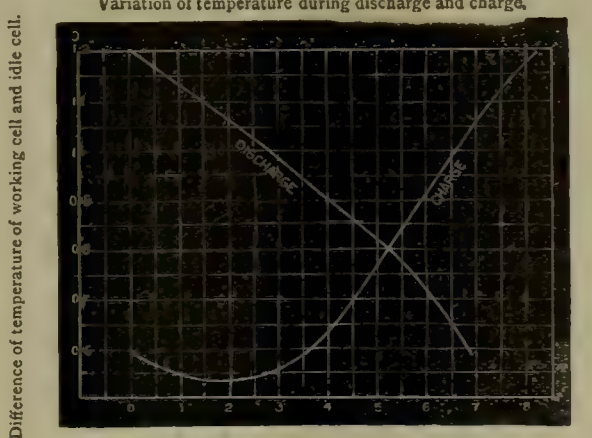


CURVES 14 AND 15.

Fifth Rest.—The cells were now left charged for a further period of 16 days. Curve 20 gives the values of the potential difference obtained at the first discharge after the rest, and curve 21 the values of the potential difference obtained immediately afterwards in charging. Integrating the areas of these curves, we have :

	First discharge after rest.	Last discharge before rest.	Percentage efficiency.
Ampere-hours	53.3	83.8	....
Watt-hours per cell	104.1	184.6	....
Quantity	....	....	63.6
Energy	....	....	56.4
		First charge after rest.	
Ampere-hours	....	58.5	....
Watt-hours per cent	....	128.3	....
Quantity	....	....	91.1
Energy	....	....	81.1

Continuous charging and discharging with the normal currents between the normal limits of potential difference per cell gave the following times for completing the cycles :



CURVE 17.

First discharge after rest,			5h. 20m.		
				First charge,	6h. 30m.
Second	"	"	6h. 18m.		
				Second "	7h. 29m.
Third	"	"	6h. 42m.		
				Third "	7h. 59m.
Fourth	"	"	6h 54m.		
				Fourth "	8h. 19m.
Fifth	"	"	7h. 15m.		
				Fifth "	8h. 20m.
Sixth	"	"	7h. 16m.		
				Sixth, "	8h. 30m.
Seventh	"	"	7h. 23m		
				Seventh "	8h. 41m.
Eighth	"	"	7h. 34m.		
				Eighth "	8h. 44m.
Ninth	"	"	7h. 40m.		
				Ninth "	8h. 47m.

It was concluded from the time of the last three charges and discharges that the cells had acquired a steady state, and curves 22 and 23 show the time fall and the time rise of potential difference. Integrating the areas of these curves, we have :

	Discharge.	Charge.	Percentage working efficiency.
Ampere hours	76	78.3	....
Watt-hours per cell	149.5	173.2	....
Quantity	....	....	97.1
Energy	....	....	86.3

A table is then given showing a *resumé* of these results, all the discharges being made with 10 amperes until the potential difference cell to 1.8 volts per cell, and all the charges being made with 9 amperes until the potential difference per cell rose to 2.4 volts. Before each rest the cells were charged until the potential difference per cell was 2 4 volts.

From the table it is seen that in spite of the continued charging and discharging at the end of each rest, there is a steady fall ing off in the quantity capacity from 101.9 ampere-hours at the beginning to 76 ampere-hours at the end, and in the energy capacity from 201.7 watt-hours to 149.5 watt-hours. The quantity and energy efficiencies, 97.1 and 86.3 per cent. respectively, at the end are the same as at the beginning. Comparing the first discharge after each of the 16 days' rest with the last charge before the rest, there appears to be a loss of about 36 per cent. in the ampere hours, and about 43 per cent in the watt-hours ; or, since the normal quantity and energy efficiencies for a discharge immediately following a charge are respectively 97 and 87 per cent., it follows that the rest of 16 days causes a loss of about 33 per cent. in the ampere-hours, and about 30 per cent. in the watt-hours, in addition to the losses that normally occur on a charging immediately followed by a discharging.

From all that precedes, it follows that the previous history of an accumulator produces an enormous effect on its efficiency. If, for example, an E. P. S. accumulator be over and over again carried round the cycle of being charged up to 2.4 volts per cell and discharged down to 1.8 volts per cell, the charging and discharging currents being the maximum allowed by the makers —viz., 0.026 ampere per square inch in charging, and 0.029 ampere per square inch in discharging—the "*working efficiency*" thus obtained may be 97 per cent. for the ampere-hours and 87 per cent. for the watt-hours. If, on the contrary, the cell be constantly charged up before being tested, then for the first few charges and discharges between the above limits, and with the same current-density in charging and discharging, even the *energy* efficiency may be as high as 93 per cent.; whereas, if the accumulator has been left for some weeks, then, although it was left charged, the energy efficiency for the first few charges and discharges will be as low as 70 per cent.

While, on the one hand, our tests show that continued rests of a charged accumulator appear to be far more serious for the accumulator than we had previously imagined, the working efficiency appears to be higher than has hitherto been supposed, since we believe that about 84 per cent. efficiency in the watt-hours is all that the advocates of accumulators have claimed for them.

The smallness of the first discharge after a rest might be due either to a kind of electric short-circuiting and dissipation of the energy, or to some change in the character of the active material converting the energy perhaps directly into heat, or to some of the active material having become disconnected from the plates during the rest, and having fallen down to the bottom of the cell. The smallness of the first *charge* subsequently to the first discharge after the rest, shows that mere electrical leakage during that time has not been the cause of the loss of energy, while the steady increase in the storage capacity brought about by a series of charges and discharges tends to show that rest brings about some change in the nature of the active material.

In all the tests in which the results are given in the preceding table, the charge and discharge were, as already stated, terminated when the P. D per cell reached a fixed value; it is, therefore, possible that the apparent falling off in the capacity of the cells to store energy may be due to a change in the resistance of the cells produced by the rest. For a change in the resistance of the cells will change the terminal P. D. for a given current flowing through the cells without there being any necessary change in the storage capacity.

It is, therefore, interesting to study the variations in the shapes of the P. D. curves, 8 to 23. First, as regards the charge curves, 9 and 11 are convex everywhere to the axis of time, except just when the charging is commenced; whereas 13, the steady working charge curve after the second rest, rises much more rapidly when the P. D. cell is about 2.3 volts than is the case in the other two curves, then bends over and becomes concave to the axis of time. This peculiarity in curve 13 is, we notice, not very striking in the small reproduction of this curve in the text, but in the original curves, as plotted on large sheets of squared paper from the results of the tests, the difference between curves 11 and 13 is very noticeable.

The following list gives the time in hours and minutes from the commencement of the charging when the P. D. per cell reaches 2.2 volts:—

Curve 9, 7 h. 14 m. Steady working charge before rests.
" 11, 7 h. 32 m. " " " after first rest.
" 13, 7 h. 10 m. " " " " second rest.
" 15, 5 h. 36 m. " " " " third rest.
" 17, 3 h. 54 m. First charge after fourth rest.
" 19, 5 h. 43 m. Steady working charge after fourth rest.
" 21, 4 h. 50 m. First charge after fifth rest.
" 23, 4 h. 40 m. Steady working charge after fifth rest.

It is clear, then, that the effect of a series of rests is to cause the P. D. to rise much more rapidly in subsequent charges, and the time curve rise of P. D. still remains unusually steep, although at the end of every rest there was a prolonged and uninterrupted series of charges and discharges.

Curves 16 and 20, which give the values of the P. D. for the first discharges after the fourth and fifth rest, show that for the first hour from the beginning of each of these discharges the P. D. rises instead of falling, as is the case in normal discharges.

If the rapid fall of potential difference at the commencement of a discharge be due to a disappearance of gases occluded in the plates, as some have supposed—or if, as Dr. Gladstone and Mr. W. Hibbert imagine, the charging of a cell causes the acid round the positive plate to become denser than that round the negative, and the mixing of the denser and less dense acid at the commencement of the discharge causes the potential difference to fall—then the absence of this fall at the beginning of a discharge after a long rest would be explained; but neither of these theories would apparently explain the rise of the potential difference obtained by us at the commencement of a discharge after a long rest. Indeed, the fact that it required two discharges and two charges after a long rest before the discharge curve (the third after the rest) acquired its normal form, tends to show that this rise of potential difference at the commencement of the first discharge after a long rest is due to some other cause.

Again, Prof. Duncan and Mr. H. Wiegand have shown in their communication that the diffusivity of the sulphuric acid into the plugs is greatest at the end of the charge, and least at the end of the discharge. Hence, if it be the diffusing out of the strong sulphuric acid from the plugs of the positive plate that causes the rapid fall of E.M.F. on breaking the charging circuit at the end of a charge (see Figs. 3, 4, and 11), one would hardly expect that it would be at the *end* of a discharge, when the diffusivity of the acid in the plugs was a minimum, that the rise of E.M.F. on breaking the discharge circuit would be most rapid, but that numerous experiments have shown us to be the case. In fact, curve No. 8, Fig. 11, shows that towards the end of the charge the E.M.F. falls from 2.298 to 2.274 volts in 20 seconds, after breaking the charging circuit, and similar curves that we have drawn from our experiments on the time rise of E.M.F. on breaking the discharging circuit show that towards the end of the discharge the E.M.F. rises from 1.951 to 1.970 volts in 20 seconds, the latter rate of rise being almost exactly equal to the former rate of fall.

All the rests already referred to occurred when the cells were fully charged; but before these long rests took place the cells, when in their normal state, were on one occasion allowed to remain discharged for 34 minutes, with the following result:

Cells in Normal State.

Time taken to complete—
Charging 11h. 38m.
Discharging 10h. 10m.
Next " 11h. 37m.
Next " 10h. 12m.
Next " 11h. 37m.
Next " 10h. 11m.
Cells here remained discharged for 34 minutes.
First charging after rest, 11h. 50m.
First discharging after rest, 10h. 15m.
Next charging after rest, 11h. 42m.

These results emphasize the fact that accumulators are damaged if left discharged, even for a short time; and it was for this reason that during the whole of this investigation the cells were never left discharged for a longer time than was necessary to change over the connections from discharge to charge, except on this one occasion, when it was desired to ascertain the magnitude of the change produced by leaving the cells discharged for a short time.

It is interesting to notice that the effect of discharging cells too low, or of leaving them discharged, is to increase the times required for the subsequent chargings, whereas the effect of leaving them charged is to diminish the times required for the next chargings.

VIII.—*Chemical Action.*

Dr. Frankland has shown that probably the discharge of an ordinary accumulator is accompanied by the formation of one or other, or both, of the new lead salts which he has isolated, and which have the formulæ ($Pb_3 S_2 O_{10}$) and ($Pb_5 S_3 O_{14}$) respectively. And he concludes that, in view of the great difficulty of electrolytically splitting up the well-known white sulphate of lead ($PbSO_4$), this sulphate is not formed in the ordinary discharge of the accumulator, and is only produced when the cell begins "to sulphate."

Prof. W. Kohlrausch and C. Heim show in their paper already referred to that the observed variations in the specific gravity of the liquid during charge and discharge agree well with the very simple chemical actions—

Charge.

Positive Plate—
$$PbSO_4 + 2H_2O + SO_4 = PbO_2 + 2H_2SO_4$$
Negative Plate—
$$PbSO_4 + H_2 = Pb + H_2SO_4$$

Discharge.

Positive plate—
$$PbO_2 + H_2SO_4 + H_2 = PbSO_4 + 2H_2O.$$
Negative plate—
$$Pb + SO_2 = PbSO_4.$$

It is to be noticed, however, that the falling off in the specific gravity during discharge is merely a test of the amount of H_2SO_4 that is converted into H_2O, and affords no criterion as to what sulphate of lead is formed by the SO_3 liberated.

During our investigation we observed the variation in the specific gravity of the liquid during about 100 charges and discharges, and the mean of this large number of the fairly consistent results that we obtained showed that, with the accumulators we were testing, the variation in density per ampere-hour was about 0.000.232. This result is probably right to within 5 per cent., for our hydrometer would read accurately to about 0.001, which is about 5 per cent. of 0 03, the total change in specific gravity observed during the discharge; and, therefore as each result is correct to something like 5 per cent. the mean of a hundred results will certainly be correct to within 5 per cent.

On referring to tables of the density of dilute sulphuric acid, we find by plotting the results that between the limits we are concerned with —1.2 and 1.17—the change of density is directly proportional to the amount of SO_3 taken from the solution; and, further, that to produce a change in density of 0.01 at 15° C., it requires that 1 gramme of dilute sulphuric acid of density 1.2 should give up 0.01268 of a gramme of SO_3. And as the liquid in each cell weighed about 10.490 grammes when the cell was charged and the density 1.2, it follows that the weight of SO_3 liberated per ampere-hour in each cell, when calculated from the variation in the specific gravity, must equal—

$$\frac{0.000232}{0.01} \times 0.01268 \times 10{,}490 \text{ grammes},$$

or *3.086 grammes.*

Further, the electro-chemical equivalent of SO_3 is 0.000414 grammes per coulomb; and since lead sulphate is formed on both the positive and negative plates during the discharge, the weight of SO_3, taken out of the liquid per ampere-hour, when calculated from the electro-chemical equivalent of SO_3, must be

$$2 \times 3{,}600 \times 0.000414 = 3.041 \text{ grammes.}$$

These two results show a close agreement. At the same time, it is to be noticed that not merely does the amount of SO_3 liberated per ampere-hour come out somewhat higher when calculated from the *mean* change in the specific gravity than when calculated from the chemical equivalent, but the same result is obtained for each separate set of tests.

Mr. G. H. Robertson, working in Dr. Armstrong's laboratory, was so good as to analyze the sediments that fell to the bottom of the cells during the early part of the investigation, when in the discharges the potential difference was allowed to fall to 1.6 volts per cell. The mixture was found to contain—

An indication of uncombined metallic lead,
A trace of antimony,
40.95 per cent. of combined lead, 6.35 " " oxygen } *i. e.*, 47.3 per cent. of PbO_2
34.63 " " lead, 5.56 " " sulphate, 10.75 " " oxygen } *i. e.*, 50.74 " " $PbSO_4$
98.04

so that 1.96 per cent. consisted of metallic lead, antimony, and dirt.

The composition of the sediment showed a close approximation to PbO_2, $PbSO_4$, which consists of—

44.08 per cent. of PbO_2
55.92 " " $PbSO_4$

PbO_2, $PbSO_4$, in fact, contains—

76.33 per cent. of Pb.
5.91 " " S
17.76 " " O

and the sediment contained—

75.58 per cent. of Pb
5.37 " " S
18.05 " " O

Dr. Frankland's salts may be represented as PbO_2 $2(PbSO_4)$ and $2(PbO)$ $3(PbSO_4)$ respectively, whereas the analysis of the deposit in our cells showed that it was certainly neither of these lead salts, but, instead, had almost the exact composition of PbO_2, $PbSO_4$.

In spite of the accumulators with pasted plates having been in use now for nine years, the chemical action that takes place during the different stages of the charge and discharge has only been conjectured, and, odd as it seems, no decisive experiment appears to have been made to settle this much debated question. Various analysis have been made by different chemists of salts of lead acted on in certain ways with sulphuric acid, but apparently not of actual accumulator plates in action.

To be Continued.

NEW YORK NOTES.

The Interior Conduit and Insulation Company will conduit the old Court House at East Cambridge, Mass., for the reception of light wires.

The Interior Conduit and Insulation Company's factory at 541 West 34th street, was gutted by fire early on the morning of August 27th. The factory was running night and day to fill the orders for the conduits, and the hands were eating their midnight lunch when the fire broke out on the basement floor. In less than five minutes all four floors were ablaze, and the building was completely gutted. The damage is about $25,000 which is entirely covered by insurance. The factory of the Bergman Electric and Gas Fixture Company which adjoins that of the Interior Conduit and Insulation Company, was damaged to the extent of about $2,000. The origin of the fire is as yet a mystery.

The fire which partially destroyed the 34th street factory of the Interior Conduit and Insulation Co. started in the drying rooms and after burning many thousand feet of green or untreated underground tube and effecting the destruction of the underground curing apparatus was checked so that the output of underground conduits will only be temporally restricted. The company having kept the original factory in West 27th st. on Interior Conduit Work this branch of the business will not be interrupted and with the aid of additional temporary factory facilities secured in that neighborhood the company will be enabled to aid the underground department materially. The burned building will be immediately rebuilt and a new structure seven stories high will be added. This will more than double the present accommodations and enable the company to keep pace with the extraordinary demand made upon it.

The Western Union Telegraph Company, at 195 Broadway, are now using 1,500 cells of Edison-Lalande battery. The phenomenal success of the Edison-Lalande battery in all its applications has led to the production of another type of cell, for small light plants. A few weeks ago we mentioned the fact that experiments were being made in this line at the Edison laboratory, and the special lighting cell is the outcome. The new cell will give a 1,300 ampère-hour current, and 12 or 14 of these cells will give a beautiful and brilliant light for house use. These battery plants are not intended to take the place of other methods of house illumination, but for temporary work, such as the lighting of halls, closets, stables, etc. A special pamphlet on electric lighting by means of these cells is in course of preparation, and will give every fact in connection with the same.

Mr. James F. Kelly of 19 Dey St., manager of the Wire Department of the Edison General Electric Company, is in Chicago on company business.

The Board of Electrical Control has officially declared that subsidiary subway ducts mean ducts to connect a building with the main wire ducts on the same street. On the part of the United States, the Brush, and the Mount Morris Companies an application was made to the Board of Electrical Control for subways in the same streets where room has been assigned to the Edison Company. This was ordered, and ducts will also be provided for such other companies as apply before Sept. 4. Orders for subways were issued to the Construction Company in Old slip, Exchange place, South st., Front street, Water street, Worth street, Park street, Centre street, Elm street, Duane street, William street, North William street, New street, Pearl st., Stone street, Forty-third street, and Fifth avenue.

Reports of violations of the rules by ticker and telephone companies, which have been stringing unauthorized wires, were followed by an order by the Board of Electrical Control that they explain or have their wires cut down and their privileges restricted.

R. J. G.

ELECTRIC ROAD.—Allentown and Bethlehem, Pa., are warm on the subject of constructing an electric road between the two points.

A CHINESE TELEPHONE.—A recent dispatch from San Francisco is calculated to bear Bell telephone stock, but as the stockholders do not yet show any signs of going to the poorhouse soon, the stay may reasonably be set down as based on very unstable ground. It is to the effect that a Chinaman has perfected a telephone which is not an infringement on the Bell patents. The telephone company discovered its existence while looking into the cause for so many requests for the removal of their instruments. The description of this new telephone is very meagre and unsatisfactory, but the report states that Wah, which is the name of the Chinaman, is rushed with orders, and as soon as they are filled the telephone company is requested to remove their instruments.

ELECTRICITY AND CLAMS.—The annual clambake of the American Electrical Works, of Providence, R. I., took place on August 23d. This event is becoming quite an institution in the East, and more and more electricians patronize it each year. The programme on this occasion consisted, besides eating clams, of a banquet, base ball, foot ball, target shooting, and many other forms of out-door sports. Many well-known electrical peop'e attended the festivities, among them being P. H. Alexander, of New York; A. V. Garratt, Boston; J. J. Carty, New York; George L. Bowen, Elgin, Ill.; Robert Stewart, of Elizabeth, N. J.; and O. E. Madden, New York. Many prominent telegraph officials were also present, including Captain Trott, of the Commercial Cable Company's steamer, "Minia."

SEEN AT THE CONVENTION.—Mr. Wm. A. Cunningham, of Philadelphia, exhibited at the recent Electric Light Convention, some fine specimens of a mineral for insulating purposes. In appearance it resembles black marble, but we are informed it can be worked into any shapes such as brass covers for switches, switch boards, cut-outs, etc., and will take the place of porcelain, being much cheaper. The above gentleman controls the market for this article, and took some good orders from prominent electrical people in attendance at the convention.

CENSUS OF STREET RAILWAYS.—The Superintendent of Census issued a bulletin which presents some interesting figures about the street railways in the cities having a population of 50,000 each or over. Fifty-six cities have been included in this census. In 1880 these cities had a mileage of 1,689 while in 1889 they had 3,150. The total track mileage assigned to the five leading cities is: New York, 368; Chicago, 365; Boston, 329; Brooklyn, 324; Philadelphia, 324. The motive power of the total mileage is distributed thus: Animal power, 2,351; electricity, 260; cable, 255: steam (elevated roads), 61; steam (surface roads), 221; total, 3,150. Scranton, Pa., is the only town in the list that has nothing but electricity. Boston, however, has four electirc lines, with 49 miles for Scranton's 23. San Francisco leads in cable lines, with 47 miles.

BRESLAU.—The Town Council has decided to grant 1 million marks ($250,000) for the erection of a central station. The project of Messrs. Siemens and Halske will probably be accepted. The central station will at first have a capacity of 8,000 lamps, to be afterwards increased to 30,000. Continuous currents will be used, and the lamps within a radius of 1,200 metres will be fed directly from the machines. Outside the limit, the system will be supplied by accumulators charged during the day.

ELECTRIC RAILWAYS IN TOLEDO.—After a good deal of hesitation an electric road has been established in Toledo, Ohio. The line covers 16½ miles of streets, and the entire system will be in full operation by October 1st.

ELECTRIC RAILWAYS.—On August 1st there were 223 electric railways in operation and under contract in the United States and 4 in Canada. There are 44 Cable roads in the United States.

ELECTRIC TRACTION IN SWITZERLAND.

A correspondent of a London contemporary gives the following description of a very interesting electrical tram line for the conveyance of passengers to the summit of the Rönchberg, which was recently opened at Salzburg.

To an almost perpendicular declivity of the Rönchberg there is affixed a cable line, worked by electricity, with an exactly vertical track of the cars. The considerable height of the installation (75 metres) and the extensive arrangement for the electric working, secure for the undertaking a significance, though in its nature and outward form the name "passenger conveyance," in the sense of the lifts at hotels, would be most suitable.

As far as the shore of the Salzbach the spectator perceives the slender iron framework of the line, with a double track for an ascending and a descending seat. The lower station contains, in addition to the entrance and departure platforms, the battery chamber, containing 126 accumulators of large make, supplied by the Swiss Oerlikon firm, and which supply the electrical energy required for the ascent. The electricity for charging the accumulators is supplied by the dynamos of the Salzburg electrical works, which have been in operation for some years. For this purpose a special cable lead has been laid down, so that the accumulators can be charged during the daytime, when the dynamos are not required for the supply of light. It is therefore hoped that this installation will considerably increase the remunerative character of the works.

At the upper station is the electromotor which acts by a simple transfer to rollers placed in juxtaposition, over which runs the bearing rope of the traveling seats.

The entire installation has been executed by the firm Siemens & Halske, who constructed the Salzburg electrical works, and then handed them over to a limited liability company. The height of the lift, as already signified, is 75 metres, the weight of a travelling seat is 1,200 kilos. Each seat can accommodate 12 passengers, who in a few moments can be raised to the summit of the Rönchberg.

The fare proposed is 20 kreuzers each person for the ascent and 10 for the descent, which, with regard to the small distance traversed, cannot be regarded as very moderate. A restaurant and an extensive park are projected on the level of the upper station.

ELECTRICAL INDICATOR OF EXPLOSIVE GASES.—Mr. Eduard Stern, of Cologne, has brought out an apparatus, which indicates with safety the accumulation of explosive gases in the atmosphere of rooms. It consists of an external porous clay cylinder which contains a thin metal membrane capable of upward movement. Just above the membrane is a contact screw. When explosive gases begin to accumulate, they pass through the porous cylinder and gradually raise the membrane until it comes into contact with the screw. This completes an electric circuit and sets in operation a set of electric bells. The contact screw is very sensitive and may be adjusted to any degree, according to local circumstances. The apparatus is also applicable as a fire alarm and may be fitted in any convenient spot.

AN EXPLANATION.—In our issue of August 2d, last, we published an article entitled "A method of Localizing Partial or Dead-Earth Faults in Insulated Conductors," and erroneously gave credit for the same to another paper than the right one. The article was taken from the London *Electrician*, for which that paper should have received the credit.

BURNED TELEPHONES.—St. Joseph, Mo., recently suffered a loss of 300 telephones during a thunderstorm. There is such a cry against electric light and railroad wires, because when telephone wires become crossed with them the telephones are burned out. Why don't some raise a cry against lightning?

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED AUGUST 12, 1890.

433,948. Electric Conductor Terminal. Charles A. Lieb, New York, N. Y. Filed May 5, 1890.

433,981. Telephone. Edward Davis, Cambridge, Mass., assignor of one-half to E. B. Welch, same place. Filed Nov. 19, 1885. Renewed Feb. 14, 1887.

434,007. Machine for Covering Insulated Conducting-Wire with Lead. Lewis W. Tracy, New York, N. Y., assignor of one-half to James E. Granniss, same place. Filed May 28, 1890.

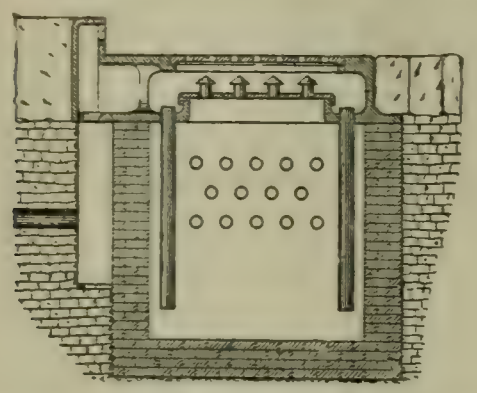
434,008. Machine for Covering Insulated Conducting-Wire with Lead. Lewis W. Tracy, New York, N. Y., assignor of one-half to James E. Granniss, same place. Filed May 28, 1890.

434,011. Vertically-Adjustable-Dynamo Support. Thos. Wrigley, Oak Park, assignor of one-half to Francis B. Badt, Chicago, Ill. Filed May 8, 1890.

434,017. Method of Welding Metals by Electricity. Herbert E. Fowler, New Haven, Conn., assignor of one half to D. T. Hedges, Sioux City, Iowa. Filed Nov. 15, 1889.

434,024. Electro-Therapeutic Appliance. Gustav Monrath and William M. Gibbons, Chicago, Ill., assignors, by direct and mesne assignments, to said Gibbons and Charles C. Bateson, same place. Filed Dec. 3, 1887.

434,030. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor, by mesne assignments, to the Thomson-Houston Electric Company, Boston, Mass. Filed Oct 4, 1886.



434,165.—SUBWAY FOR ELECTRIC CONDUCTORS.

434,032. Ammeter and Voltmeter. Gustav Pfannkuche, New York, N. Y., assignor to the Bush Electric Company, same place. Filed May 5, 1886

434,036. Trolley for Electric Railway. Joseph H. Wehrle, Newark, N. J. Filed Oct. 9, 1889.

434,038. Automatic Electric-Lamp Hanger and Switch. Oscar B. White, Cleveland, Ohio. Filed Feb. 15, 1890.

434,076. Underground Electric Conduit. Franz G. C. Zöpke, Berlin, Germany. Filed Dec. 21, 1889.

434,087. Electric Rail-Connector. Charles A. Lieb, New York, N. Y. Filed May 5, 1890.

434,096. Rotating Part of Dynamos and Motors. Elmer A. Sperry, Chicago, Ill., assignor to the Sperry Electric Company, of Illinois. Filed Sept. 9, 1889.

434,133. Method of and Apparatus for Burning Holes in Metal. William P. Kookogey, Brooklyn, N. Y, assignor to the Kookogey Electric Company. Filed Apr. 25, 1890.

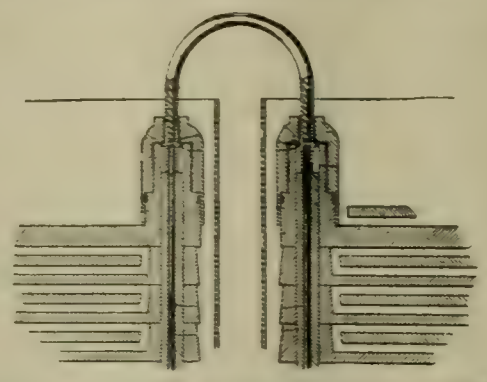
434,144. Electric Insulator. John K. Dunbar, Austin, Tex. Filed Feb. 6, 1890.

434,147. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Original application filed June 9, 1886. Divided and this application filed Apr. 11, 1890.

434,148. Electrically Propelled Vehicle. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed Apr. 28, 1886. Divided and application filed May 22, 1889. Again divided and this application filed July 16, 1890.

434,149. Cut-Out and Connection for Electrical Apparatus. Charles S. Klein, New York. N. Y. Filed June 6, 1890.

434,151. Switch for Electric Circuits. Philip Lange, Pittsburg, and Oliver B. Shallenberger,



434,199.—CONNECTOR FOR SECONDARY BATTERIES.

Rochester, assignors to the Westinghouse Electric Company, Pittsburg, Pa. Filed Sept. 1, 1887. Patented in England, France, Belgium, Italy.

434,152. Switch for Electric Circuits. Philip Lange, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed Sept 1, 1887. Patented in England, Belgium, Italy, and in France.

434,154. Electric Indicator. Philip Lange, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed May 15, 1890.

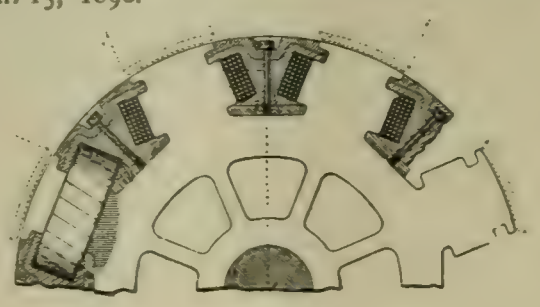
434,159. Incandescent Electric Lamp. Albert L. Reinmann, Allegheny, assignor to the Westinghouse Electric Company, Pittsburg, Pa. Filed Nov. 14, 1889.

434,162. System of Electrical Distribution. Oliver B. Shallenberger, Rochester, and Henry M. Pyllesby, Pittsburg, assignors to the Westinghouse Electric Company, Pittsburg, Pa. Original application filed Jan. 21, 1888. Divided and this application filed Apr. 9, 1888.

434,163. Protector for Electric Machines. Lewis B. Stillwell, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed Sept. 2, 1889.

434,164. Case for Electrical Apparatus. Charles A. Terry, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed June 28, 1889.

434,165. Subway for Electric Conductors. George Westinghouse, Jr., Pittsburg, Pa. Filed Mar. 15, 1890.



434,206.—ARMATURE FOR DYNAMOS.

434,166. Electric Arc Interrupter. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed Dec. 7, 1889.

434,167. Lightning Arrester. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed Jan. 16, 1890.

434,168. Safety Fuse for Electric Circuits. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed May 12, 1890.

434,169. Electric Safety Fuse Box. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed May 12, 1890.

434,170. Lightning Arrester. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed May 15, 1890

434,175. Electric Arc Lamp. William F. Cady, Corry, Pa. Filed Mar. 27, 1890.

434,180. Electro Motor. Theodore M. Foote, Boston, Mass. Filed July 18, 1889.

434,199. Connector for Secondary Batteries. James K. Pumpelly, Chicago, Ill., assignor to D'Estaing S. Covert, same place. Filed Mar. 19, 1889

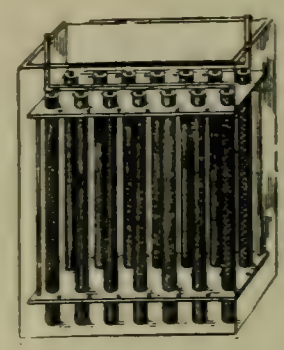
434,206. Armature for Dynamos. Albert Schmid, Allegheny, assignor to the Westinghouse Electric Company, Pittsburg, Pa. Filed Dec. 7, 1889.

434,224. Secondary Battery. Henry Woodward, Toronto, Canada. Filed Apr. 11, 1890.

434,261. Printing Telegraph. Theodore M. Foote, Boston, Mass., assignor of one-half to Charles J. Pillsbury, same place. Filed July 27, 1889.

434,275. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed July 14, 1885. Divided and this application filed Sept. 11, 1889.

434,276. Current collecting Device for Electric Cars. Rudolph M. Hunter, Philadelphia,



434,224.—SECONDARY BATTERY.

Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Dec. 17, 1889.

434,301. Method of Making Electrodes for Secondary Batteries. Paul Schoop, Zurich, Switzerland. Filed Mar. 10, 1890.

434,363. System of Transportation by Electricity in Mines. Elmer A. Sperry, Chicago, Ill., assignor to the Sperry Electric Company, of Illinois. Filed April 12, 1889.

434,371. Lightning Arrester. Alexander Wurts, Pittsburg, Pa., assignor to the Westinghouse Electric Company, same place. Filed May 12, 1890.

434,376. Secondary Battery. George W. Cochran, New York, N. Y., assignor of one-half to Benjamin Franklin, same place. Filed Dec. 14, 1889.

434,382. Electro-Magnetic Clutch. Stanley C. C. Currie, Philadelphia, Pa., assignor, by mesne assignments, to the United Gas Improvement Company, same place. Original application filed Apr. 11, 1890. Divided and this application filed May 16, 1890.

434,389. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed Apr. 28, 1886. Divided and this application filed May 22, 1889.

434,390. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. Original application filed Jan. 26, 1887. Divided and this application filed May 15, 1890.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Aug, 30, 1890.

Mr. C. C. Harris, of Dallas, Tex., has been in town the past few days.

Supt. Rice and Prof. Thomson, of the T-H Works in Lynn, are on a trip to the White Mountains.

On Septembor 1st the Malden Electric Company commences running an all night incandescent service.

The West End Railway Company will start the running of its new electric line to Egleston Square next Thursday.

As usual the orders for the Brown Electric Protector are far ahead of the supply although they are being turned out in large quantities.

The "Willows" branch of the Naumkeag street railway was formally opened at Salem a few days ago with electricity as the motive power.

The Globe Street Railway Company in Fall River contemplates equipping its line with electric power. Probably the overhead system will be adopted.

The Essex Electric Street Railway, after several trials' have abandoned the idea of the vertical double trolley system, and will adopt the horizontal double trolley.

By the new contract the City of Lowell will pay 40 cents instead of 50 cents per night for electric light of 2,000 candle-power. The hours are from one-hour after sunset to half an hour before sunrise.

Work was commenced on the new brick electric light and power station in Beverly, last Monday morning. When completed it is expected that this station will be one of the finest in New England.

At a special meeting of the stockholders of the Connecticut Motor Company it was voted to increase the capital stock from $30,000 to $40,000, the present stockholders to be given the preference in subscribing for the increase until October 1.

A car on the Beverly and Danvers Electric Storage Battery Street Railway took fire from the motor car in East Danvers last Thursday evening. The damage was small, no one was injured, and the fire was extinguished with a few pails of water.

The Reading Electric Light Power Co. has been formed with a capital of $12,000. Wendell Bancroft, President; L. M. Bancroft, Treasurer; the same and J. W. Richardson, J. A. Horton and E. A. Hunt, Directors.

The Thomson-Houston Electric Co. is about to erect a new factory on Federal street, in West Lynn, 190 x 80 feet, three stories high, for heavy machine work, in connection with their large dynamos. The building is to be provided with a large travelling crane equipped with three motors for handling the heaviest products.

The special committee of the City Council of Providence have prepared a favorable report on the petition of the Union Railway Company for the erection of a trolley system on its lines in that city. The vote on the question is likely to be close on account of the strong opposition from the electric light and telephone companies.

The Farmington River Power Co. are having the route for the wires which are to convey the power developed by the Farmington River to Hartford, Conn., a distance of about five miles, surveyed, and it is expected that the entire plant will be in operation about November 1. The turbine wheels which will give 800 horse power, are already on the ground.

The new electric power plant for the Lynn and Boston Railroad, will probably cost about $75,000, and, although no definite action toward securing a site for the location has been taken, it is not improbable that it will be located on Broad or Beach street, Lynn.

The Citizens' Gas Company of Wakefield has ordered the material, including a 1,500 horse-power boiler, for its electric light plant, and the town will have electric lights some time next month. This company will furnish power for the Wakefield and Stoneham Street Railway, the building of which will be started in the near future.

A company of Providence and out-of-town capitalists have been formed to construct a trolley road from Providence to Pawtucket and on the east side from Providence to Barrington, Warren and Bristol. The new company intends to run the double trolley system, and in connection with a regular train of cars at Pawtucket a ferry is proposed that will carry passengers and trains. The road will be in competition with the Stonington railroad on the west side and the Old Colony on the east.

The Eastern Electrical Supply and Construction Company has been organized with a capital of $50,000. This company will locate at 74 Federal street and are to deal in electrical supplies for electric light, electric railway, telephone and telegraph companies. They are to be the sole New England agents for J. H. Bunnell & Co., of New York and have the rights for the maintenance of the Auxiliary Fire Alarm in Massachusetts; they will also do a general construction business.

Mr. E. C. Bibber of the Holtzer-Cabot Electric Company has returned from his vacation. Mr. Bibber says he "feels like a new man and that the new man will do more business than ever the coming year."

Mr. B. F. Merritt, the popular electrician of the New England Printing Telegraph Company, was married at Jamaica Plain, on Wednesday last, to Miss Alice Walker. After an extensive wedding trip, Mr. and Mrs. Merritt will reside in Jamaica Plain.

Herman Lemp, electrician of the Thomson Electric Welding Co., has patented an electric welding clamp, which has a combination with the clamping devices having means for applying initial lateral pressure to the work of a clampjaw adapted to tighthen automatically an endwise movement of the work under it.

Edgar Mix, meter expert of the Thomson-Houston Electric Company, Lynn, Mass., is en route to Paris. He took with him several of the new Thomson voltmeters. These meters will be entered in a competitive test with others to be entered by electricians everywhere, the testing committee being composed of prominent French electricians.

The first meeting of those interested in the projected electric road at Rockland will soon be called, and a company formed. As soon as a charter has been obtained the work of raising the necessary $100,000 will be commenced. The part of the road first built will be from Hanover to Rockland, and from thence to South Weymouth and Abington.

The Merrimac Valley Street Railway having petitioned the Lawrence Board of Aldermen for new locations and the right to operate all its lines by electricity, was given a hearing last Monday night. They propose to use the single trolley system. The only remonstrance came from the New England Telephone and Telegraph Company, which sent a written protest. The board reversed its decision.

A communication from Mayor Hart to the Board of Aldermen indicated his disapproval of the board to the effect that the superintendent of streets appoint inspectors for superintending the work of the New England Telephone and Telegraph Co., the inspector to be paid by the company, on the ground that the public statutes provide that the regulation of a city for the erection and maintenance of all telegraph and telephone lines shall be made by ordinance, and an order passed by the aldermen is not an order of the city

C. J. Van Depoele of Lynn, has patented a closed conduit for electric railways, which seems to be a good thing. The claims cover a closed slotted conduit, comprising a slotted exterior casing, enclosing an electric conductor, and electric cushions fitting in the slot and normally in contact to close the slot. There are flexible or yielding slot-closing strips of fibrous material normally in contact. These being elastic, are forced apart by the plough, and close after it. This is designed for use in cities where the streets are muddy or for wet weather, being of rubber the strips will throw out water as the plough comes along.

C. J. Van Depoele, of Lynn, Mass, has just taken out four new patents for an electric railway system covering a source of current of relatively high potential and supply conductors, a moving vehicle provided with motor generator. These patents are in the direction of electrically equipping trains. At present 500 volts are a good potential for street railways, but it would not do for large railroads as it would be necessary to use enormous copper conductors. So Mr. Van Depoele generates a thick potential current at the station and supplies this current to the trolley wire. On the engine or car is located an apparatus for transforming the current to one of lower potential and greater volume, which is supplied to motors on the cars. In case it is desired to place motors on each car of a train, which is advantageous because it utilizes the extra weight of the train in its propulsion, it would be undesirable to carry the high potential on trolley line current to the different cars, as the passengers or men might get shocks, but in the low potential, or transferrent current, there is no danger.

Professor Thomson has patented this week a system of electric power transmission, covering the combination of an alternating current-supply main, feeding the armatures of alternating current motors, an undirectional supply-main, feeding the fields of said motors, and a common return for the alternating and indirectional mains. He has also patented an electric power system, the claims covering, in a system of electric distribution, the combination of mains of approximately constant potential, supplied from a suitable generator, translating devices connected to and supplied from such mains in multiple arc and compensating electric-storage devices constantly connected across such mains at or near the point of consumption or connection of the translating devices where variations of load or potential are immediately felt with variations in the demand of the translating devices.

Professor Thomson has also patented an induction discharge protector for welding apparatus, which claims the combination with a transformer or converter for electric welding or other metal-working operations of an induction discharge protector in a short circuit between the terminals of the primary, whereby on rupture of the secondary circuit damage to the primary may be prevented; also another patent for improvement in electric welding, which consists in applying lateral compressing or condensing force to the weld during the application of the endwise pressure or force which tends to upset the metal so as to form a lateral expansion at the joint.

W. J. P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, Aug. 30, 1890.

MR. G. A. EDWARD KOHLER, western representative of the Eddy Electric Manufacturing Company, mentions the sale of a No. 3 electrotyping machine to Rand, McNally & Co., the publishers.

ARC LAMPS.—The activity in the lamp department of the Sperry Electric Company, Chicago, since the advent of their new "Triple" carbon lamp, is evidence of its popularity. They are receiving letters of inquiry concerning it from all parts of the country, and claim they have "struck oil."

THE ELECTRICIANS' TIME CO., Chicago, are now well established in their quarters at 167 Dearborn street, and are doing much in the line of supplying electrical people with anti-magnetic watches. They also handle all kinds of jewelry, and are introducing the electrician's button mentioned in our last number.

THE ILLINOIS ELECTRIC MATERIAL COMPANY, Chicago, are placing a new line wire upon the market which they designate by the unique title of "Canvas Jacket." The fire-proof and moisture-turning covering, saturated in an insulating compound, is woven direct upon the wire, making a firm insulation. An excellent test record is claimed for this wire as to insulation, abrasion and tensile strength. As to the latter point the No. 2 insulation is said to add over twenty-nine per cent. to the tensile strength of the bare wire.

MR. CHAS. G. ARMSTRONG, as manager of the house-goods department of the Great Western Electric Supply Co. during his recent trip through the East arranged for the handling of some very choice lines of goods. Among these are the Samson Batteries so well known to our Eastern readers, which have not been given a fair trial in the West. These will undoubtedly be sold in large quantities, on their own merit, along with some fine styles of Annunciators and burglar alarms. The same firm also has a complete line of the Electric Gas-Lighting apparatus made by the Electric Gas Lighting Co. whose patents have again been sustained by the recent circuit court decision.

ELECTRIC FIXTURES FOR STREET CARS.—A noticeable feature in the display rooms of the Great Western Electric Supply Co., Chicago, is their handsome line of electric lighting fixtures for use on electric cars. They have designed a number of styles in clusters for the centre of the car and single lamps for the end, which when in place in the cars of a "Broomstick Train" will add much to the beauty of the furnishings. Mr. E. R. Crolius has designed some fixtures for electric cars which are far more handsome than any yet put on the market. The contrast between the clusters in general use and these compact and artistic electroliers is remarkable, and has led to a number of orders. These car fixtures are made exclusively by the Great Western Electric Supply Co., of Chicago, who are also putting out many new styles of brackets and pendants. Mr. F. W. Cushing is President of this new company in which Mr. E. A. Sperry, the electrical engineer, and Mr. Fred Degenhardt, the underground cable man, are also interested.

ORGANIZATION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.—It may not be known to some of the present members of the National Electric Light Association that the organization of that body was due chiefly to the efforts of Chicago electricians, and that the first meeting was held in Chicago. In a conversation with Mr. Elmer A. Sperry your correspondent incidentally learned that Mr. Sperry was chairman of the committee which called the first meeting of the Convention. It was in the Fall of 1884 that the idea of forming a national association of those interested in electric lighting first began to take shape, and steps were taken looking to the calling of a meeting in the following spring. A meeting of representatives of different electrical interests in Chicago was held February 3, 1885, at the Grand Pacific Hotel to complete arrangements, and a call was issued for the first meeting to be held at the Grand Pacific Hotel, February 25. A printed copy of this call has been furnished to your correspondent through the kindness of Mr. Sperry, and from it the following facts are gleaned. The officers chosen at the meeting of February 3, were C. A. Brown, president; J. H. Reid, secretary; W. A. Kreidler, treasurer. The following committees was also appointed—Arrangements: Geo. S. Bowen, C. C. Warren, E. B. Palmer, C. A. Brown, George L. Crossman, Wm. A. Hammett. Invitation: E. A. Sperry, F. S. Terry, George S. Bowen. Finance—M. H. Knapp, S. S. Badger, M. A. Buckley. The invitation set forth the benefits to be derived from the meeting, and announced as subjects to be discussed the following: Switching and different systems of switch boards employed; General care of electrical apparatus—1st, dynamos; 2d, lamps; 3d, lines; construction and maintenance of lines; ærial and underground lines; the fuel and carbon questions; complaints of consumers, and any and all other questions which may properly come before such a meeting. According to the circular there were at that time several hundred electric lighting companies in existence. From a carefully prepared table in a recent number of *Electrical Industries* it is learned that there are now in actual operation in this country 1,379 central electric lighting stations, employing a capital of over one hundred millions of dollars. That the National Electric Light As-

sociation has contributed its share towards the great growth of this industry cannot be doubted. At the first meeting representatives came to Chicago from all sections of the country, from the far east, and from the far west. The experiment was successful, and since then the meetings have been held regularly and with what interest they are now looked forward to the late gathering at Cape May bears witness.

F. M. I.

CONVENTION NOTES.

Owing to the pressure on our columns last week we were compelled to omit many Convention notes. We now give them herewith.

Mr. Fred Whipple was present and explained the value of his electrical directory and reports.

The affairs of the Electric Mutual Insurance Company of Boston were looked after by Capt. Wm. Brophy.

Mr. George B. Prescott, Jr., was on hand in the interest of the Kerite wire, for which he is the general agent.

Mr. F. E. Degenhardt of Chicago, represented the interests of the Standard Underground Cable Company.

Mr. T. McCoubray and Mr. H. L. Lufkin represented the C. & C. Motor Company, and the company's interests were well looked after by these gentlemen.

The Consolidated Electric Storage Company, of New York and Philadelphia, manufacturers of the Julien Storage Battery, had an interesting display of their batteries.

The Standard Carbon Co., of Cleveland, was represented by Mr. J. B. Crouse. This company sold 21,000,000 carbons last year, and its factory has a capacity of 2,000,000 per month.

One of the most interesting displays was that of the Crocker and Wheeler Motor Company. Both Professor Crocker and Dr. Wheeler were present, and the display of their motors attracted a great deal of attention. One of those machines was shown in connection with the Gould triplex pump, the plant suggesting a valuable combination for domestic work.

Mr. Benjamin R. Western, the genial representative of the Manufacturers' Advertising Bureau of New York, was in attendance and made many new acquaintances among the electrical people. Mr. Western is a veteran in the advertising service and is one of the best posted men in such matters in the United States. He returned to New York with a good share of the new business created at the Convention.

The Edison General Electric Company was well and ably represented by those two well-known gentlemen, Mr. H. Ward Leonard and Mr. Wilfrid H. Fleming, both of whom made many business and personal friends.

The Okonite Company had on exhibition an attractive display of Okonite and Candee wires of all sizes, Okonite and Manson tape, and a large variety of ærial and submarine cables. The goods of this company are so well and favorably known, that an extended description of them here does not seem necessary.

The Sawyer-Man Electric Company had a very interesting and attractive display of lamps, ranging from 10 to 150 candle power. The globes for the same were of various colors, and gave a beautiful effect. The company also exhibited an arc lamp. Another feature of this company's display was of the new compound "Alexite. This substance can be made to imitate marble, wood, etc., etc., and is especially valuable for this reason and the fact that for electrical work it is fire proof, water proof and acid proof. The mercury cut-out which has recently been introduced by the Sawyer-Man Company attracted a good deal of attention. General Manager P. H. Alexander, and Treasurer Gen. C. H. Barney represented the Sawyer-Man Company at the Convention.

NEW INSULATING MATERIALS.—A series of new insulating materials have been discovered by Mr. G. E. Heyl, of Charlotenburg. To one of them he has given the name, Heylit: it is made in three grades, melting at 60 deg., 100 deg., 120 deg., and 180° C, respectively. A sheet of the last grade, 10 cm. square, and 1 mm. thick, has a resistance of $19{,}300 \times 10^6$ ohms, as shown by tests made in Munich laboratory. It is claimed that the new insulating material gives a lower capacity and higher insulation than any of the ordinary insulators. It is also much cheaper, and is unaffected by acids or chlorine.

ELECTRIC LIGHT STATIONS. — According to Whipple's Electric Reports for August, there were then in the United States 1174 central electric light stations; 101 in Canada and 9 in Mexico. Of the 966 gas companies in the United States, 274 operate electric lights.

LIGHTS IN CALIFORNIA.—Sacramento and Los Angeles are two of the best electrically lighted cities on the Pacific Slope.

TELPHER LINE AT EDINBURGH EXHIBITION.—At the Edinburgh Exhibition a telpher line is exhibited by the Electric Engineering Corporation, Limited. The line is ¼ mile in length and travels over undulating ground, the highest point being 30 feet from the ground, and the lowest 15 feet. There are two trains, each consisting of a locomotive and four cars. The speed maintained is five to six miles an hour and the trains are prevented from any possibility of collision by the employment of a dead section in the conductor. The current is derived from the D. M. dynamo exhibited at the stand.

RELATION OF LIGHT AND POWER.—It is an interesting question what amout of light can be produced by the expenditure of a given amount of power in driving a generator of electricity—that is how much light can be obtained from one horse power. The question is not easy of general solution for the reason that the results vary materially with the kind of apparatus employed.

A NEW LAMP WANTED.—When the time arrives for the introduction of the electric light at the polar regions of this planet of ours, the arc lamps will have to be of a different make to ours. They will have to give a steady light for six months at a time. The lamp trimmers will have an easy time, as they will have to trim their lamps but once a year.

GAMBLING BY ELECTRIC LIGHT.—Everything that is brilliant and magnificent of course must enter into the make up of a first-class gambling place. Electricity is to play an important part in producing delightful effects at a second Monte Carlo, which is to be established on the Bosphorus at Scutari, near Constantinople.

EXPOSITION.—Spokane Falls, Wash., will hold An industrial exhibition in October, at which electrical apparatus will form a special feature. It will not be long before every county fair in the land will have its electrical department.

LINEFF UNDERGROUND SYSTEM.—In the Lineff system of propulsion for electric cars a conductor is placed in a conduit closed mechanically, but accessible magnetically through an iron covering. The bare wire is laid in a small conduit, and contact with the contact rail which is laid in the centre of the track, and which acts as the top of the conduit, is made by lifting a loose iron strip against it by means of magnets. The contact with the motor is established by means of cast steel wheels attached to the magnet, which runs along on the contact rail. The magnet underneath the car induces magnetism in the iron rail, which picks up the loose strip of galvanized sheet iron and holds it there while the magnet is above it. The strip of iron in connection with the conductors receives the current, transmits it to the rail from which it is taken by the wheels on the magnet, carried to the motor and thence through the tram wheels to the rails. It is necessary to carry a battery of some kind to excite the magnet, which requires, it is said, sixty volts to hold the strip against the rail, though in the experiments 100 volts were employed. On the experimental car a hinged board is provided at either end which, on meeting an obstacle, yields, reverses the motor and sets resistance to give low speed. The part of the contact rail, therefore, that is charged is only that directly under the car. It is said that the car can be stopped in nine feet when running at full speed. The claim of the owners of the system is that but one-half the steam power necessary to run a storage battery station is required to operate a road of this kind.

ELECTRICITY IN SUGAR MAKING.—Some sugar works in Havana have recently availed themselves of electrical applications in the manufacture of sugar. The juice of the cane is poured into the middle compartment of a series of troughs which are divided into three very porous partitions. The outside compartment contains water, in which are placed blocks of carbon connected to the negative pole of the dynamo. The positive pole of the machine is connected with carbon plates in the middle compartment. The sugar juices are purified from the salts they contain, which are taken up by the water. The addition of the current assists the osmotic transfer across the porous partitions. This method affects a marvelous saving in time, and is said to produce superior sugar.

CELEBRATING ELECTRIC LIGHTING.—The turning on of the electric light current for the first time in Delaware, O., recently was celebrated with a jubilee.

ELECTRIC RAILWAYS.—The electric railway in Shreveport, La., is about ready to be put into operation. The electric railway between St. Paul and Minneapolis, Minn., will probably be put into operation about November 1st.

WANT DAMAGES.—The Fire Commissioners of Newark, N. J., claim damages from a local electric light company, for the destruction of several fire alarm boxes by the crossing of an electric light wire and the fire alarm wires.

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THE TELEPHONE.

It is a little over 14 years ago since the public saw the first speaking telephone. It was at the Centennial exposition at Philadelphia, and at that time very few indeed foresaw the wonderful part it was destined to play in the affairs of the world. After the Centennial the telephone at once jumped into prominence and its use has been expanding ever since, until now it is hardly possible to compute the number of instruments there are in daily use throughout the world.

The telegraph, the telephone and the electric light are the three great inventions, but the telephone stands unique in that it is the most universally used of the three. No special talent, nor trained operators are necessary to operate the telephone—almost every child that can talk can use it. Not so with the telegraph and the electric light. Both of these inventions require specially trained employés to operate them, and for this reason the public is not so familiar with them as it is with the telephone.

It is safe to say that no other invention in the history of the world has accomplished as much as the telephone in faciltating the transaction of the worlds business. It is brought into requisition in business transactions between parties hundreds of miles apart and it is equally useful in ordering chops for breakfast from the neighboring butcher. It is just as reliable a medium of communication when millions of dollars are involved as it is under the most ordinary circumstances. The telephone is, moreover, as we have already stated, the most universally used of all electrical inventions. It is found in every civilized country on the face of the globe, and in many places without telegraphic communication with the outer world the telephone is fonnd. It is not to be wondered at, therefore, that telephone people are proud of their vocation, when it is remembered that is all for the benefit and happiness of mankind.

The telephone, as perfect as it is to-day, is a growing institution. There is nothing so perfect that cannot be made still more perfect, and the telephone is no exception. When the telephone attains perfection there will be no need of holding conventions once a year to discuss new things. but so long as improvements are being made in the art these conventions will serve an excellent purpose in affording means for dissemination of the newly acquired knowledge for the general good of the service.

It is not many years ago since long distance telephony was generally considered impossible; now cities hundreds of miles apart converse with each other with as great facility and distinctness as conversation between two points in the same block can be carried on, and we all remember how recently it was that European electricians figured it out theoretically and conclusively that conversation by telephone over the English Channel cables was impracticable. Yet, while they were busy figuring, the very thing they decided could not be accomplished was done, and successfully too. It may seem like rash prediction, but in the light of what has been done in telephony in the past it would be reasonable to assume that conversation over the longest submarine cables will be an accomplished fact in the near future. The thought of two persons conversing over an Atlantic cable between America and Europe seems wonderful now, but who knows but that before long it will have ceased to be a wonder and become a familiar fact.

The telephone has a yet greater future in store, and it is in good and intelligent hands.

MR. EDISON'S PREDICAMENT.—We trust that Mr. Thomas A. Edison will lose no sleep when he learns the cause of the coolness of the German court towards him. It seems that he promised to send the German Emperor a phonograph, and in due time telegraphed that it was on the way to Berlin. On the strength of this announcement the Emperor invited a large party to hear the talking machine, but it did not appear and the party separated in disgust, and mentally vowing vengeance on Mr. Edison for the disappointment. Then to add what our German friends regard insult to injury Mr. Edison failed to answer letters of inquiry as to the whereabouts of the phonograph, for all which delinquencies, so says the press despatch from which these facts are taken, Mr. Edison will not be received at Court in case he ever visits Berlin. The United States may have a *casus belli* on her hands if Mr. Edison does not hurry up with that phonograph, and answer those letters.

TELEPHONE.—In England and France there are many small places which have no telegraphic communication, and in order to send a telegram to some distant point considerable expense was entailed in taking the same to the nearest telegraph office. The telephone, however, has been extended to these isolated places, and now it is possible to communicate verbal messages by telephone to the nearest telegraph office, from whence the dispatch is forwarded to its destination.

ELECTRIC LIGHT IN PARLIAMENT.—Efforts have recently been made to light the chamber of the House of Commons of the English Parliament with the electric light, but the results were not satisfactory. Members complain of the heat and glare of the gas lights on long winter nights, and asked to have the electric light put in so as to resemble sunlight as near as possible. The gas light is used as part of the ventilating apparatus, hence it would be inadvisable to dispense with it.

WORKING EFFICIENCY OF SECONDARY CELLS.—In the present issue we concluded the paper read at the Edinburgh meeting of the English Institute of Electrical Engineers on the working efficiency of secondary batteries. The paper, although lengthy, was a very important one, and gives a great deal of valuable information and many practical suggestions regarding this important branch of electrical science, and no doubt it will be accepted by storage battery investigators as a standard of reference.

WESTINGHOUSE RAILWAY.—The first Westing house electric railway outside of Pittsburgh was started last week in Lansing, Mich., and all reports indicate that it is entirely successful.

MORE PATENTS FOR MR. EDISON.—Mr. Thomas A. Edison has received a patent on a process and apparatus for generating electricity, which consists, essentially, in producing dry chemical reaction in a closed chamber and charging or acting upon the two electrodes or terminals of the electric circuit respectively by the products of such reaction. He has also received letters—patent on an improved method of making armatures for dynamos—electric machines, and on a method of charging and using secondary batteries.

A GENEROUS GIFT.—At the Deaf and Dumb Convention, which was held in this city recently, a gift of $25,000 from Alexander Graham Bell, the inventor of the telephone, was announced. The money is for the use of the Hudson Institute for the promotion of special teaching.

INCANDESCENT STREET LIGHTING.—The streets of Grunewald, a suburb of Berlin, Germany, are to be lighted by incandescent 12 ampère lamps. The cost of the installation will be $75,000.

ELECTRIC WELDING.—The wire for covering the tube of the new ten-inch gun, now in course of construction for the United States army is being joined by the electric welding process.

BURYING ITS WIRES.—The Bell Telephone Co. is laying its wires in Montreal underground. Popular sentenient is in favor of all electric wires going under the surface.

TELEPHONE NOTES.

The Telephone Convention which takes place at Detroit this week promises to be well attended.

The Law Telephone Co. is building the largest switchboard ever constructed for telephonic work, for the Philadelphia Exchange.

Mr. A. S. Hibbard's telephone distributing board is declared to be one of the best improvements ever devised for good and safe telephone work.

President Sargent of the Telephone Assn., who is general manager of the New York and New Jersey Telephone Company contemplates erecting a telephone building in Brooklyn.

Secretary Barney is the right man in the right place. Everybody who ever dabbled in electricity to the slightest extent has the General on the "good friendship list." Secretary Barney is everybody's friend and a good one he is.

Among the well-known old time telegraphers now in the telephone business are W. D. Sargent of Brooklyn, J. P. McKinstry of Cleveland, F. G. Beach of Chicago, Thos. D. Lockwood of Boston; W. J. Denver and his brother of Springfield, Mass., Thos. Doolittle and a large number of others. Mr. Sargent, during the war, held trusted positions and rendered valuable telegraphic service. Mr. Frank G. Beach was, twenty yearsago, superintendent of the Atlantic and Pacific Telegraph Co., at Cleveland, Ohio, and among his operators was the present editor, and among his messenger boys the business manager of this paper. Mr. Beach is vice-president of the Association and president of the Chicago Electric Club. These two trusted positions indicate his popularity. Mr. Thomas D. Lockwood, now of Boston, is too well known to need any "turning over" at our hands. His works are his reputation. A gentleman recently told us that Mr. Lockwood's writings read as smoothly as glass. This language may be "off" color, but it expresses very forcibly and correctly the sentiment of all of Mr. Lockwood's friends.

Mr. Fred. W. Whipple, the general manager of the St. Louis Electrical Exhibition has certainly made a great success of his undertaking. Both display and number of exhibits are excellent.

THE TELEPHONE CONVENTION.

The following is the official programme of the annual meeting of the National Telephone Exchange Association, at Detroit, commencing September 9th, as announced in the News Letter of that Association of August 30th :

The twelfth meeting of the National Telephone Exchange Association will convene at the Russell House, Detroit, Michigan, on Tuesday September 9th, 1890, at 11 A. M., and will probably continue in session during Tuesday, Wednesday, and possibly on Thursday morning.



W. D. SARGENT, PRESIDENT NATIONAL TELEPHONE EXCHANGE ASSOCIATION.

The Russell House is conducted on the American plan. It is requested that members of the Association intending to be present at the meeting, engage their rooms at an early date, so that the most desirable locations may be secured. Messrs. W. A. Jackson and F. A. Forbes, of the Telephone and Telegraph Construction Company,



GEN. C. H. BARNEY, SECRETARY NATIONAL TELEPHONE EXCHANGE ASSOCIATION.

of Detroit, have kindly consented to act as a committee on quarters, and a note addressed to either of them will receive prompt attention.

The customary reports will be presented, and the usual number of papers will be read.

Delegates are requested to register promptly at the Secretary's office on arrival in Detroit, in order that it may be known who is present, and that an accurate roll of the meeting may be prepared.

The badge of the Association will be the same as last year, and delegates who have preserved the little nickel button which proved so useful last year in "dead heading" telegraph messages, are requested to bring them to wear at this meeting.

The following are the present officers of the Association, the terms of all of whom, with the exception of the first two members of the Advisory Committee, will expire at the Detroit meeting; President, Wm. D. Sargent, Brooklyn, N. Y.; Vice-President, Frank G. Beach, Chicago, Ill.; Secretary, C. H. Barney, New York City; Treasurer, H. L. Storke, New York City; Advisory Committee, for three years, vacancy (Geo. N. Stone, elected last year, having resigned); for two years, Morris F. Tyler, New Haven, Conn,; for one year, Edward J. Hall, Jr., New York City. Executive Committee, Wm. D. Sargent, ex-officio, Brooklyn, N. Y.; Charles F. Cutler, New York City; Chas. H. Wilson, Chicago, Ill.; H. N. Gifford, Louisville, Ky.; Levy Sprague, Lowell, Mass.

The Telephone and Telegraph Construction Company which operates the exchange at Detroit, proposes to offer certain courtesies to the Association, and have furnished the following outline of the entertainment which may be expected :

Tuesday, 11 a. m.—Welcome address by the Mayor of Detroit.

Wednesday, 2:30 p. m. — Carriage ride and lunch at Belle Isle Park Casino; 8:30 p. m.— Banquet at the Russell House.

Thursday—Boat ride and lunch on board; returning to Detroit in time to take the evening trains from the city if desired.

Further particulars of these entertainments will be made known at the meeting of the Association.

NEW FIRM.

Three gentlemen, well-known in the electrical trade, have just combined in a business enterprise and propose to engage in the sale of general electrical supplies in this city. The gentlemen referred to are P. H. Alexander, Gen. C. H. Barney and Chas. E. Chapin, who are all well and favorably known through their connection with the Sawyer-Man Electric Company, and held the positions of general manager, treasurer and purchasing agent, respectively, in that company. The announcement of their separation from the Sawyer-Man Electric Company to engage in a similar business on their own account was a surprise to the trade, and it was universally conceded that the new combination would likely meet with prosperity from the very start.

The headquarters of the new firm will be at No. 20 Cortlandt Street, in the Telephone building, where a large and commodious store is now being fitted up for the business.

Mr. H. P. Alexander is to have charge of the selling in the new firm, and is a natural salesman. He has been engaged in the electrical field from the early days, beginning with central station work, installing plants, etc., in connection with the business of the Thomson-Houston, Sawyer-Man and Westinghouse Electric Companies in New England. As a reward of his efforts he was appointed general manager of the Sawyer-Man Electric Company, and the phenomenal success of that company in the past few years attests his able management. Outside of the regular work, Mr. Alexander has been interested as President of the New England Electric Exchange, of Boston, Mass., in harmonizing the insurance and electrical interests in New England. The rules and regulations made by the insurance and electric light men have been a great benefit to the public. Mr. Alexander is now a member of the National Electric Insurance Bureau, who are framing rules for the United States, to be observed by those installing machinery, etc., for electrical purposes. With hosts of friends and a varied experience from constant activity, Mr. Alexander is well fitted to be at the head of the firm, whose success we predict.

General C. H. Barney began in the telephone business in 1879, resigning for that purpose his position as treasurer of the Providence Gas Burner Company, with which he had been connected for ten years. After two years' experience in Providence and Boston, during which time he constructed the first long-distance telephone line between those cities, in December, 1881, he was called to the management of the New Jersey Telephone Company, which position he held until his resignation in 1886, at the organization of the Sawyer-Man Electric Company, of which he is now treasurer. He was one of the charter members of the New York Electric Club, and is a member of the board of managers of the same. He has been since 1885 the secretary of the National Telephone Exchange Association. The General, with Mr. Alexander, has a large acquaintance with electrical men, and is a genial fellow to meet. As treasurer of the Sawyer-Man Electric Company, he has had experience in the management of finances, which will be of value to the new firm.

Mr. Charles E. Chapin entered the electrical fields as Secretary of the Waterhouse Electric and Manufacturing Co., of Hartford. Conn. On the sale of that Company to the Westinghouse Electric Co., and the removal of the work to Pittsburgh, Mr. Chapin was transferred to New York and became the Purchasing Agent of the Sawyer-Man Electric Co. The rapid growth of the business of that company, both in the supplies furnished to central stations and the innumerable wants of a large factory, has required activity in the purchasing department, and Mr. Chapin has proved himself to be a successful buyer.

Messrs. Alexander, Barney and Chapin will occupy the same positions in the new firm as they filled in the Sawyer-Man Company and start with a large experience in their respective departments. The new store will be ready about October 1st, and the firm will represent manufacturers in goods adapted to the electric trade as well as keeping in stock a line of general electrical supplies. In representing inventors and manufacturers, the new firm, from their wide experience, are particularly able to place the goods in the channels of the large trade of the country. The new insulating material, which is now receiving great attention, called "Alexite," will be under the control of Alexander, Barney and Chapin. This material can be made into any shape and has the properties required for cut-outs, switches, etc., etc., being fire-proof, water-proof and acid-proof. Any color of wood, paper or marble can be imitated, so that harmony of the attachments in wiring with the color of the materials in the room is attained.

This is an advance in the right direction. We shall hear of more novelties in electrical supplies from Alexander, Barney and Chapin, and we wish them abundant prosperity in their new venture.

ELECTRIC COAL-CUTTING MACHINERY.—In referring to the electric coal-cutting machinery patented by Mr. C. J. Van Depoele, of the Thomson-Houston Company, the London *Electrician* thinks that reciprocating action of the cutting tool is the wrong way to produce motion on a large scale by electricity.

DOUBLE CYLINDER PHONOGRAPH.—Mr. James P. Magenis, of North Adams, Mass., is the inventor of an improved phonograph, which takes a record on two cylinders simultaneously. This phonograph is said to be capable of many valuable applications in the transactions of business correspondence.

STRIKE ENDED.—The strike of the employees of the Westinghouse Company at Pittsburgh, Pa., was terminated on Sept. 3 by the capitulation of the strikers, who requested their old places.

THE CONNECTICUT MOTOR.

The economical generation, distribution and application of power are subjects that are now engaging the attention of both mechanical and electrical engineers more than ever before, and the electric motor has done more to solve the problem than any other machine ever invented. The electric motor is superior to the steam engine in two important respects; 1st, it can be more conveniently placed with reference to the location where the power is needed, and 2nd, it occupies little space.

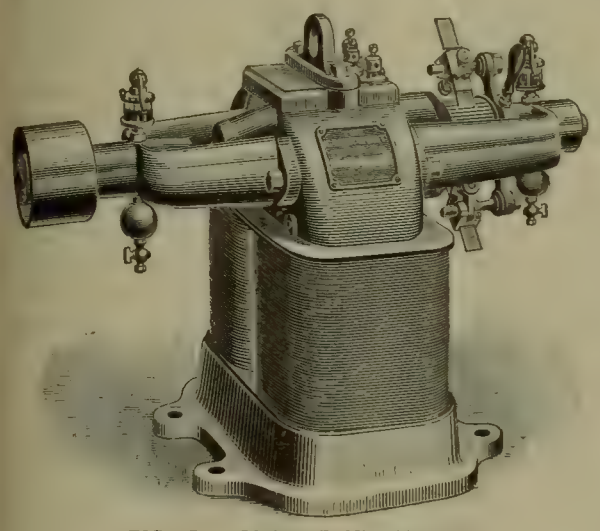


FIG. 1.—CONNECTICUT MOTOR.

As is well known the motor can be taken anywhere, where the power is needed, and long lines of shafting in many instances are entirely displaced by these machines. It is no wonder then that the electric motor is becoming so popular with manufacturing firms, and that it is becoming popular is evident from the great number of motors that are to be seen now-a-days in manufacturing establishments—large and small.

The demand for electric motors has given birth to many machines of this class, and much

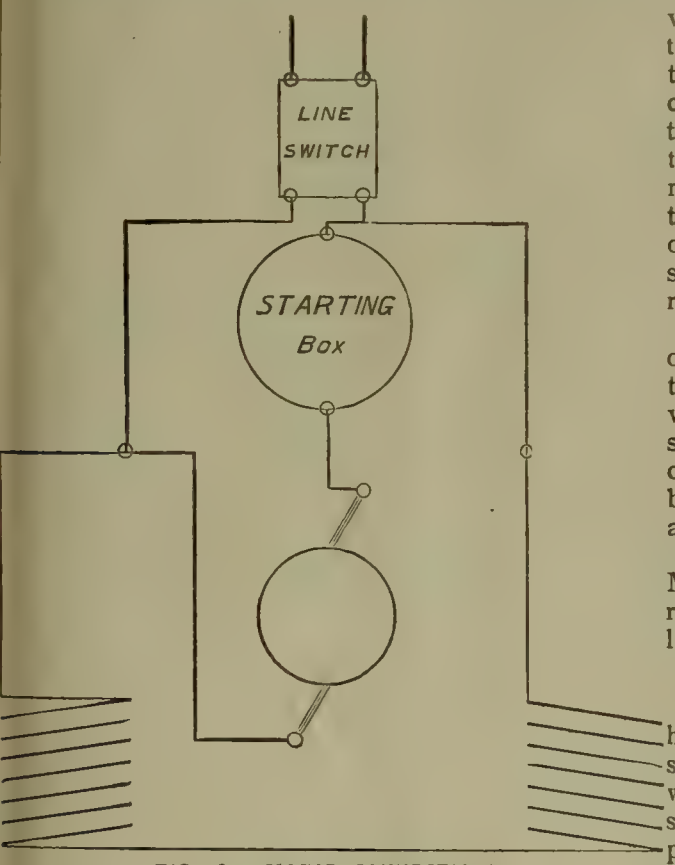


FIG. 2.—MOTOR CONNECTIONS.

attention has been given by electrical engineers to making them of the highest attainable efficiency. The Connecticut motor may be classed as one of those representing the highest degree of efficiency yet attained in the construction and operation of electric motors, and of that machine the following is a description of the main features:

Figure 1 gives a general view of a Connecticut motor and generator. The simple horseshoe magnet has been adopted for stationary work, as affording a powerful magnetic field with the least waste of exciting wire. The poles are turned upwards in order to avoid the leakage of magnetic lines of force which otherwise would occur through the bed-plate, while at the same time the breech or neutral portion of the magnet becomes a solid base on which the machine rests.

The length of the magnetic circuit is short, and its cross-section large. There are no magnetic joints, the whole field being in one casting of soft pig iron. The armature proportions are medium, the length being about two diameters. The turns of wire on the armature are few and of ample area. The air gap is small, the windings on the armature being absolutely symmetrical, and revolving close to the polar surfaces. The shafts are of the best crucible machine steel. The journals are in all cases self-lubricating. In all machines the journals have a greater bearing surface per h. p. than is usually adopted. The brush holders are of a new and improved pattern having a particularly light and fine spring adjustment.

The starting boxes are of iron having slate tops, and are therefore uninflammable. This device has been adopted in lieu of using any arrangement whereby the armature current is, at starting, sent round the field coils; firstly, because in the latter arrangement the field coils are liable to be burnt out and the whole machine rendered useless until returned to the factory for repairs; secondly, because a better opportunity is thus afforded for building this important part of desirable materials and in a reliable manner.

The same attention to finish and detail which characterize this Company's motor manufacture has been extended to their more recent manufacture of generators. These machines are plain "shunt wound," or "compounded," to meet the exact resistance of particular circuits when so ordered. In practice, owing to a strong field and low armature resistance, the latter winding is seldom necessary. Generators, like motors, are wound for potentials of 110, 220, ond 500 volts. The diagram (fig. 2) shows the connections of the motor to the circuit. On starting the motor the main line switch must first be closed—thus securing full field excitation *before* the current is passed through the armature. Next the starting-box lever is moved slowly to the right, and under no circumstances is it allowed to remain on an intermediate stop. This box is of the nature of a current-reducing valve for starting purposes only, and is in no sense a speed regulator.

To stop the motor, the main switch is first opened, and then the starting-box lever is turned to the end stop on the left. A safety fuse is invariably placed in the motor circuit, and is of such size as to blow in the event of current exceeding the normal working value, which may be taken as 8 amperes per horse for 110 volts, 4 amp. for 220 volts, and 1¾ amp. for 500 volts.

The office and works of the Connecticut Motor Company are at Plantsville, Conn., and by reason of the efficiency of their machines the latter are constantly growing in favor and demand.

TELEPHONE ON BEN NEVIS.—Mr. Erskine Mudehead has offered to erect, at his own expense, a set of "Ader" telephones on Ben Nevis. These will connect the summit and the low-level observatories, but at present the telephone company block the way. It often happens that for two months communication with the summit of Ben Nevis is cut off, so that the new method of intercourse between the occupants of the observatory and Fort William will be very welcome.

FLOATING TELEPHONE STATION—A floating telephone station is to be established in the harbor at Manila, the capital of the Phillipine Islands, to admit of communication between vessels in the harbor and shore. This will be of great benefit to shipping interests and to passengers.

ELECTRIC TRAMWAY IN BREMEN.

The following particulars of the electric tramway which was opened in Bremen on June 22 last, are taken from the *Elektrotechnische Zeitschrift*, and will be read with interest by American electrical engineers. The system used is that of the Thomson-Houston Company, and this is that company's first railway installation in Europe. The length of the line is nearly one mile. The conductors, which are carried overhead, consist of copper wires 8.25 mm. in thickness, and are suspended from insulators attached to steel cables arranged transversely across the streets on steel and cast iron posts. The engine house is situated about 220 yards from the starting point of the tramway and to the left side of the park entrance. It contains at present a Pétry-Déreux boiler, and a steam engine of 150 I.H.P. This drives a dynamo having an output of 62,500 watts, at an E.M.F. of 500 volts at the terminals. There is also installed a 70 H.P. high speed Armington-Sims engine, and an arc light dynamo. Another dynamo, similar to the first, will shortly be erected. Current from this generating station is used for several purposes; for the working of the tramway; for operating a 15 H.P. electromotor placed in the Vienna Bakery in Exhibition-place, where the motor actuates several kneading machines, and a dynamo which supplies current to a number of arc and incandescent lamps; and for the lighting of many arc and glow lamps arranged on the tramway route, etc.

The current from the first dynamo goes from the positive brush to the main conductor, which is arranged at a height of 20 feet over the middle of the track and passes along it until it reaches a contact roller carried by the car. The current is collected by contact rollers, from which it passes to the two motors, then through the car wheels to the rails and thence back to the negative brush. It branches its course along the main conductor and is collected by the contact rollers on other cars in the same manner. The single rails are connected by copper wires riveted to them. On the top of each car is erected, at an angle of 40 degrees, an iron supporting rod which carries a grooved contact roller pressing against the underside of the conductor. Suitable leading devices are arranged at crossings so that the contact rollers keep in position. There are two 10 H.P. motors to each car and they are fixed in a specially built framework. Each motor drives one of the two axles, and each car is fitted with brakes, track brushes for removing obstacles off the rails, and safety appliances. Throughout the line there are numerous curves most of which are of small radius, but these are all traversed with great facility. At present there are in service five to six passenger cars, to each of which a separate car can be attached according to the requirements of the traffic. A car depot has been erected in the rear of the gas works and several pits have been dug in order to render the motors readily accessible.

ELECTROMOTORS AND WEAVING.—MM. Chaize frères, weavers, of St. Etienne, have been awarded a gold medal by the Société d'Encouragement pour l'Industrie Nationale for an ingenious application of electromotors, which they have been using in their workshops for some time. The Société has also conferred a similar honor upon M. Monchère for an ingenious application of electricity to the reeling, weighing and making up into balls, of silk and similar woven fabrics. A silver medal of the same Société has been awarded to M. Radiguet, of Paris, for his electric knitters for use in the hosiery trade.

THE TELEPHONE IN THE WEST INDIES.—The Spanish Minister of the Colonies has received authorization to grant concessions for establishing telephonic communications in the Islands of Cuba, Puerto Rico and the Philippines.

WORKING EFFICIENCY OF SECONDARY CELLS.

BY W. E. AYRTON, C. G. LAMB, E. W. SMITH AND AND M. W. WOODS.

(Concluded from page 6, issue of September 6th.)

We are therefore now, with the assistance of Mr. Robertson, making a complete investigation of the chemical state of the plugs of both the positive and negative plates at all stages of the charge and discharge of an 1888 E.P.S. type of an accumulatorin good condition. As this investigation, however, involves the chemical analysis of a large number of specimens, it will take some time yet to complete.

In order to observe what changes took place in the temperature of the cells during charge and discharge, the temperature of one of the cells under test was observed from time to time, as well as the temperature of the air and the temperature of an adjacent cell through which no current was being passed. The above temperature results, which were obtained during the steady discharges and charges after the first rest of ten days (curves 10 and 11), are a sample of the observations taken. The discharge in each case commenced directly the potential difference, in charging, had reached 2.4 volts per cell, and the charge in each cell commenced directly the potential difference, in discharging, had fallen to 1.8 volts per cell.

A table prepared by the authors shows that while during the charge the cell rises in temperature; during discharge, on the contrary, it actually falls; hence, they continue, in spite of the production of heat due to resistance, the cell is actually cooler at the end of a discharge than at the beginning—a result possibly due to the splitting up of the sulphuric acid during the discharge. This cooling of accumulators during discharge, which we noticed early in our experiments, was observed at about the same time by Prof. Duncan and H. Weigand in America and described in their joint investigation already referred to.

From the table we see that the rise of temperature of the cell during charging may, after allowing for changes of temperature of the room, be either about 1.3° C. or 0.77° C., while the fall of temperature during discharging may have either of the two preceding values. In is further interesting to notice that the rise of temperature during the charging has the higher or the lower of these two values according as the fall of temperature during the previous discharge had the higher or the lower value.

On plotting the differences between the temperatures of the working and the idle ceil and the corresponding times given in the last table, we obtain the dotted line 24 (fig 8) for the time fall of temperature during the first and third discharge, curve 25 for the time rise of temperature during the first and third charge, curve 26 for the time fall of temperature during the second and fourth discharge, and curve 27 for the time rise of temperature during the second and fourth charges. 24 is dotted, since temperature readings were only taken at the beginning and end of the first and third of these discharges. In the case of the second and fourth of the discharges here referred to, as well as in all the four charges, several observations of temperature were made. From the curves it appears that towards the end of the discharge and at the beginning of the charge one or other of two things may happen—either the temperature in the discharge may go on falling, as in the dotted line 24, or it may begin to rise again, as in 26; whereas in the charge, either the temperature at the beginning may rise considerably, as in curve 25, or it may only increase slightly, as in curve 27.

It would therefore appear that during the latter part of the discharge one or other of two chemical actions can take place; and these two actions have, for some reason or other, taken place alternately in the four discharges under consideration. But, curiously enough, these four discharges—which took place on July 10th, 11th and 12th, 1889—occurred with extreme regularity; so that when time curves were drawn, even on a large scale, for each of these discharges, they coincided exactly and produced a single curve, which is shown, greatly reduced, as curve 10 on the sheet of curves given in the earlier part of the paper. And, similarly, for the four corresponding charges the four time curves all coincided exactly, producing a single curve, which is shown greatly reduced as curve 11 on the same sheet. It, therefore, seems as if one or other of two chemical actions might take place during the latter portion of the discharge and during the earlier part of the charge, and yet, curiously enough, when the current is kept absolutely constant the time variation of the potential difference is exactly the same, no matter which of these two chemical actions takes place.

About a year later another set of *continuous* temperature observations was made for many days and nights with the same cells, the current in discharging and charging being as before, 10 and 9 amperes respectively. The higher potential difference limit was, as before, 2.4 volts per cell, but the discharge was in each case in this second set of continuous discharges and charges stopped at 1.9 instead of 1.8 volts per cell. As the regulation of the current day and night was in these latter experiments in 1890 effected by hand it was not kept quite as constant as when the automatic regulator was employed. Hence the time curves for the excess temperature in

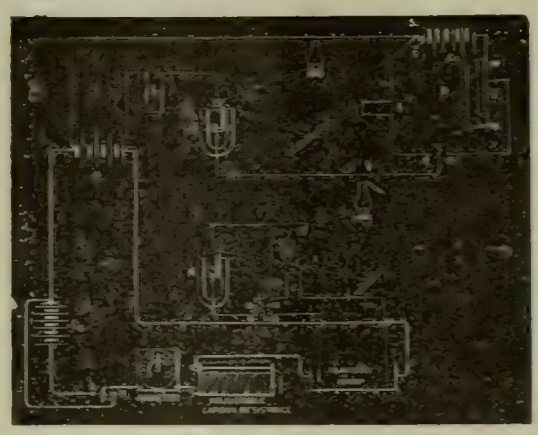


FIG. 10.—APPARATUS FOR MEASURING THE RESISTANCE OF THE ACCUMULATORS C_1

discharging and charging, when plotted, were not found to be as regular as in the previous case. But they were quite regular enough to give the general shape of the seats of temperature curves for discharge and charge which are shown in Fig. 9.

It will be observed that in these experiments not merely does the excess of the temperature of the working cell over that of the idle cell fall during the discharge, but it actually continues to fall at the commencement of the charge.

The times of discharging and charging are less than those given for curves 10 and 11, partly because the potential difference was not allowed to run down lower than 1.9 volts per cell in the later observations, and partly because the times of discharging and charging had been diminished by the continued experimental rests to which these cells had been subjected in a charged state during 1889.

The mean temperature of one of our cells is during charging and discharging, roughly, 0.7° C. higher than that of the air; and experiment shows that if one of the cells experimented on be warmed up by a portion of the ordinary dilute sulphuric acid being replaced by warm sulphuric acid of the normal density, the cell will, after all parts of it have acquired a uniform temperature, fall in temperature by 0.2,443° C. per hour per 1° C. excess of temperature. Of course, during such an experiment no current is allowed to pass through the cell, nor should any current have passed for hours before the heat emissivity of a cell is determined, otherwise a wrong value of the emissivity may be obtained by local action in the cell generating or absorbing heat during the experiment.

Hence, if K be the heat capacity of the cell, $0.7 \times 0.2443 \times K \times 21\frac{1}{2}$ calories (gramme, Centigrade) will be lost by radiation and convection during the $2\frac{1}{2}$ hours of charging and discharging. Now the weights and specific heats of the component parts of one of the cells under test are:

	Weight in Grammes.	Specific Heat.
Dilute acid, sp. gr. 1.9	10,490	0.792
Lead and lead oxide	12,987	0.0315
Glass	3,402	0.198

Hence, 0.2443 K equals 2.295 calories, and the loss of heat in charging and discharging equals 34,520 calories. The total watt hours given to a cell in charging was 228.2 (see Curve 11 for the *working* results obtained with the cells after the first rest of 10 days), therefore the energy in calories given to the cell was $0.24 \times 228.2 \times 3{,}600$, or 197,200 calories. Hence, in consequence of the cell being slightly warmer than the air during charging and discharging, there is a loss of energy from radiation and convection equal to about 17 per cent. of the energy put into the cell, and this is more than sufficient to explain the total loss observed in the energy efficiency experiments, which amounts to only about 13 per cent. Indeed, it would almost seem as if a portion of this heat radiated must be supplied by an actual slow consumption of the material of the cell; so that, in addition to the reversible oxidation and deoxidation of the material, which is the characteristic of the secondary cell, there was a certain amount of non-reversible oxidation, which is the characteristic of the primary cell.

The loss of energy in consequence of the current having to overcome the resistance of the cell is of far less importance than the loss of energy due to the actual continuous radiation and convection from the cell, which is slightly warmer than the air. For the mean resistance during discharge of one of the cells experimented on may be taken as 0.004 ohm (see Section IX., Resistance, Figs. 12 and 13), and the mean resistance in charging as 0.0045 ohm. Hence, during the normal 10 hours of discharge with 10 ampères there will be generated, $0.24 \times 10^2 \times 0.0004 \times 10 \times 3{,}600$, or 3,456 calories, and during the normal $11\frac{1}{2}$ hours of charge with 9 ampères, $0.24 \times 9^2 \times 0.0045 \times 11\frac{1}{2} \times 3{,}600$, or 3,621 calories.

Only, therefore, 3,456 calories need be dissipated during the discharge of a cell, and 3,621 during the charge, in consequence of the heat produced by the current overcoming resistance; and to dissipate this amount of heat it would only be necessary that the mean temperature of the cell should exceed that of the air by about 1.14° C., or only about one-fifth of the actual mean excess. Whereas what actually takes place is that during discharge about 16,060 calo; ries are dissipated by radiation and convection-and, further, the cell cools down, possibly in consequence of the splitting up of the sulphuric acid, and from 6,000 calories in some experiments to 12,000 in others are thus absorbed. During the charge these 6,000 or 12,000 calories reappear warming up the cell, and in addition, about 18,460 calories are dissipated by radiation and convection.

In order, then, to improve accumulators, what has to be especially sought for, and, if possible, then prevented, is that chemical action which keeps the mean temperature of the cell about 0.7° C. above that of the air. This chemical action is very possibly quite distant from the reversible one which necessarily accompanies the storing up of the electric energy and its subsequent liberation.

IX.—*Resistance.*

The resistance in ohms of an accumulator when charging and discharging is given respectively by

$$\frac{V-E}{A}, \text{ and } \frac{E-V}{A},$$

where V is the potential difference in volts at

terminals when a current of A ampères is passing, and E is the E.M.F. of the accumulator at the moment V is measured. To measure E the main circuit is broken, and the potential difference observed as quickly as possible. On breaking the circuit, however, the deflection of the voltmeter does not sharply change from the value that measured V to another definite value that measures E; but on the contrary, as seen from Fig. 4, in consequence of the fall of the E.M.F. of an accumulator on breaking the charging circuit, and in consequence of a similar rise in the E.M.F. on breaking the discharging circuit, the voltmeter deflection continues to vary for several minutes after the circuit is broken. Hence the value of E, measured by a voltmeter which is not infinitely dead-beat, must be too small during charging, and too large during discharging; and consequently, since the above formulæ for the resistance are only true when V and E are the simultaneous values of the potential density at the terminals of the accumulator and of its E.M.F. it follows that the resistance has hitherto been measured too large both in charging and discharging.

The magnitude of the error that has been thus made in different experiments depends, of course, on how dead-beat a voltmeter was employed, and, consequently, on how long a time was allowed to elapse between the breaking of the main circuit and the taking of the reading. For example, we find that towards the end of the charge with the normal current of 9 ampéres the E.M.F. varies about one per cent. in 20 seconds after the circuit is opened. Now, as the difference between V and E which measures the resistance, is only of the order 0.1 volt when it has its maximum value during the normal charge or discharge—that is, of the order four per cent. of E—it follows that an error of one per cent. in the measurement of E would make an error of about 25 per cent. in the measurement of the resistance.

To measure the resistance accurately we ought to be able to measure the difference between V and E to one-thousandth of a volt, and, therefore, as E is about two volts, the voltmeter must be very sensitive with a long, open, scale, and the needle must move through a considerable angle; whereas, in consequence of the rapid variation in E, the voltmeter must be very dead-beat—a condition almost incompatible with a long range and great sensibility.

These two conditions, however, we have fulfilled by the employment of the following device, by means of which the difference between the values of V and of E was measured to the one-thousandth of a volt at identically the same moment that the values of V and A were measured. The process was as follows:—

1st. The sensibility of the voltmeter was adjusted so that 12 volts produced a deflection of 600 divisions, and V, the potential difference at the terminals of the four accumulators under test, was measured.

2d. A compensating E.M.F. was introduced into the circuit just sufficient to bring the spot of light to zero.

3d. The sensibility of the voltmeter was increased to 60 times.

4th. The main circuit was broken, and the time variation of E, the E.M.F. of the accumulators under test, observed by noting the position of the spot of light at the successive ticks of a metronome, whose rate of going was before each experiment carefully adjusted by comparing the metronome with a chronometer.

5th. A time curve for the values of E was drawn, and by producing it back until it cut the line passing through time 0— that is, the time when the main circuit was broken—we obtained the value of E at the same moment that the values of V and A were measured.

The apparatus employed is symbolically shown in Fig. 10. C_1 are the four accumulators under test; when they were being charged by means of the accumulators C_2, a bridge-piece was placed so as to join the mercury cups 7 and 8; whereas, when C_1 were being discharged, mercury cup 7 was joined to 9 instead of to 8. In both cases the current passed along the thick lines through an A. and P. magnifying spring ammeter, whose indications furnished an approximate measure of the current, through an adjustable carbon resistance and a platinoid strip which could carry the maximum current, 10 amperes, used in these tests, without its resistance being perceptibly altered. To two points of this strip were soldered two wires going to the mercury cups 10 and 13; these were joined respectively to 11 and 12 in charging, and to 12 and 11 in discharging, so that the current always went through the D'Arsonval galvanometer A in the same direction. This galvanometer then measured the charging or discharging current, its sensibility being such that for a current of 9 amperes passing through the circuit a deflection of 600 scale divisions was produced when the resistance in *d* was 185 ohms, that of the galvanometer A itself being 52 ohms.

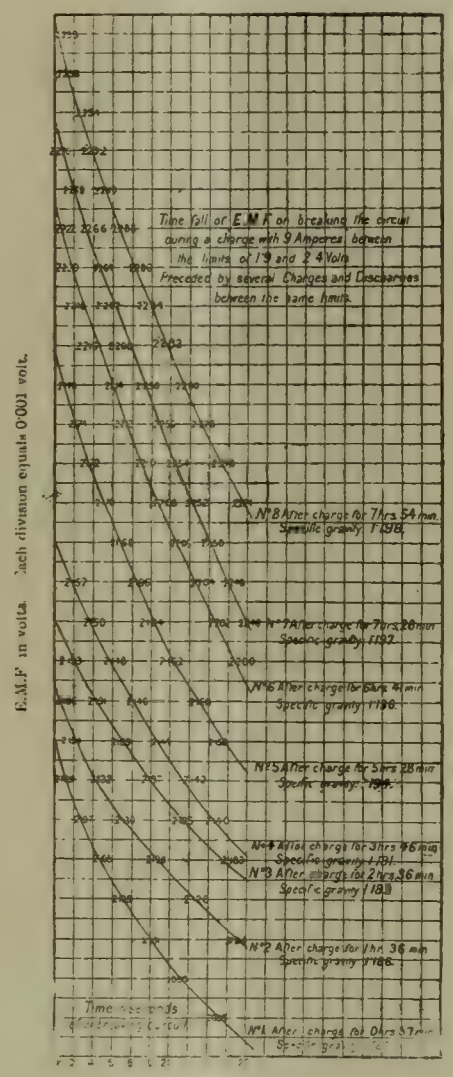


FIG. 11.

By joining the mercury cups 1 and 2 with a bridge-piece, the potential difference between the terminals of the accumulators under test, C_1, could be measured with the voltmeter V; the sensibility being such that with a resistance of 791 ohms in *a*, and 63,696 ohms in *b*, a deflection of 600 scale divisions corresponded with a potential difference of 12 volts. By connecting the mercury cup 1 with 3 instead of with 2, the resistance *b* was cut out of the circuit, and the sensibility of the voltmeter V was increased 60 times. If now 4 were connected with 5 or with 6, and the sliding contact S moved along the thick wire WW, a point could be found such that no current passed through the voltmeter V. Next, the main circuit indicated by the thick wires was broken, when the spot of light would move quickly across a portion of the scale, and then continue moving right across the rest of the scale. The first part of this motion was of course due to the sudden variation of the potential difference at the terminals of the accumulators C_1 on the current through them being stopped, while the continuation of the motion was due to the subsequent variation of the E.M.F. of these accumulators after the current was stopped. And the value of the E.M.F. at any moment was equal to

$$v \pm \frac{0.2\,d}{600},$$

where *d* was the deflection of the voltmeter spot of light at the moment in question, and v was the P.D. between the terminals of the cells, C_1, just before the main circuit was broken and was measured by the voltmeter deflection when mercury cup 1 was connected with 2. In discharging the + sign was, of course, used and in charging, the — sign.

This P.D. at the terminals of the four accumulators under test, C_1, and which had to be balanced by the E.M.F. of the accumulators C_2, approached 9.6 volts towards the end of a charge, while it fell to 7.6 volts at the end of a discharge. In the former case the E.M.F. of four cells and a portion of the fifth of the compensating accumulators, C_2, was employed, while in the latter the E.M.F. of three and a portion of the fourth sufficed. Hence, during the charge mercury cups 4 and 5 were connected together, while during the discharge it was 4 and 6 that were connected together. The portion of the E.M.F. of the last of the compensating cells was, as shown in the figure, obtained by shunting this cell through a platinoid wire, w w, of about two ohms resistance, and making contact with a point of this wire farther from, or nearer to, the positive pole of this cell. This adjustment of the position of s caused very little change in the resistance of the voltmeter circuit, because the resistance of w w was but a small portion of the entire resistance in the voltmeter circuit.

This method of measuring the resistance of accumulators was applied by three of the students of the Central Institution—Messrs. Muller, Stephens, and Wightman—to determine the variation of the resistance during the entire discharge of the cells with 10 ampères, and charge with 9; further, during May and June of this year, Mr. Muller has, with great perseverence, been making an uninterrupted series of observations day and night, to determine the resistance during the entire discharge and charge for various currents. For each of these currents the cells are being brought to a steady working state by many discharges and charges being successively and without interruption made with each current. In the case of the small current the time of a charge or discharge is tediously long, the example, with 3 ampéres requiring 40 hours to rise the P.D. from 1.9 to 2.4 volts per cell, so that several weeks have to be spent obtaining the resistance for this current. This investigation of resistance is not yet completed, and therefore we do not propose in this paper to refer to the variation of the resistance of a cell with different currents when the cell is brought to a *steady working state for each current.* Such an experiment has not, as far as we are aware, ever before been attempted with accumulators, former observers having contented themselves with merely observing the variation of the resistance when the current during the discharge or charge was abruptly changed from one value to another. This is a very different thing from ascertaining how the resistance of an accumulator varies with the current when *each* of the different currents employed is steadily used for some weeks in the discharging and charging of a cell, until the cell has arrived at a steady working state for the current in question.

We give in Fig. 11 an example of the time fall of the E.M.F. on breaking the current for eight periods of 20 seconds during the charge. The curves are all drawn to the same scale, but, in order to get the curves into a reasonable space, a different zero line has been employed in drawing each curve. The actual E.M.F. in volts per cell is given for several points on each curve, so that the time rise at any period of the

charge can be easily seen. The E.M.F. at the moment of breaking the circuit in each case is, as already explained, obtained by seeing at what point the curve cuts the vertical line through the time 0. The value of this point in volts is, in fact, what an infinitely dead-beat voltmeter would indicate immediately after the circuit was broken.

The top curve in Fig. 12 gives the P.D. at the terminals of one accumulator, charging with 9 amperes; while the second curve gives the *simultaneous* values of the E.M.F., being, in fact, the curve drawn through points whose abscissæ are the times—0 hours, 37 min., 1 hour 36 min., &c.—for which the eight curves on Fig. 11 are drawn, and whose ordinates are the values of the points where these curves cut the vertical line

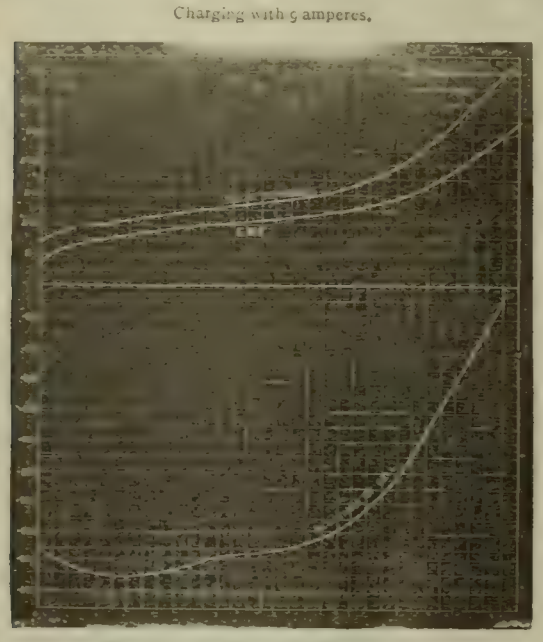


FIG. 12.

drawn through the zero of time in Fig. 11, or time when the charging circuit was broken. The lowest curve on Fig. 12 gives the resistance of the cell at any moment during the entire charge with 9 amperes, the ordinates of this curve being calculated from the formula

$$\frac{V - E}{9},$$

where V and E are values of the P.D. and the E.M.F. of the cell at the same instant.

As the charging proceeds the resistance of the accumulator at first falls, and reaches a minimum; it then increases, at first slowly, but as the charging approaches the finish the resistance rises very rapidly, so that when the P.D. per

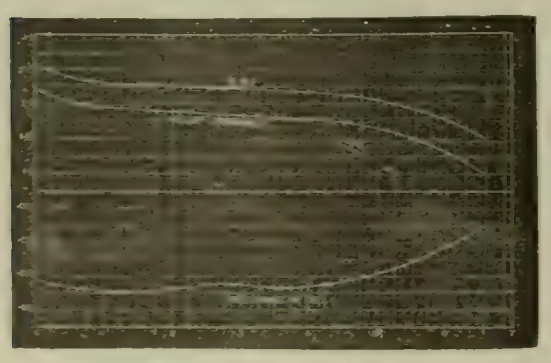


FIG. 13.

cell is 2.4 volts the resistance is five times as great as its minimum value, which is reached shortly after the commencement of the charging. Taking 0.045 ohm as the average resistance during charging, and remembering that there are in these cells two positive plates each surface of which is 9¼ into 9¼ inches, and that all four surfaces are equally active, it follows that the mean resistance of the 1,888 E.P.S. type of cell while charging with the maximum current-density allowed—viz., 3.787 amperes per square foot—is about 0.11 ohm per square foot of positive plate.

Fig. 13 gives the P.D. at the terminals of one of the cells during the whole of a discharge with 10 ampères, the simultaneous values of the E.M.F. and of the resistance. The resistance at the commencement of the discharge is a little higher than at the commencement of the charge, and the minimum value to which it diminishes is not as low as the minimum attained by the resistance in charging. At the end of the fifth hour of discharge and charge the resistance is practically the same. After that, however, there is a marked difference: the resistance in discharging does not rise as rapidly as in charging; and hence, since, in addition, the time of a discharge is necessarily less than of a charge, the resistance never reaches as high a value in discharging as in charging.

If we take 0.038 ohms as the mean resistance during a discharge with 10 ampères, then it follows that the mean resistance of the 1,888 E.P.S. type of cell while discharging with the maximum current-density allowed—viz., 4.208 ampères per square foot—is about 0.09 ohm per square foot of positive plate.

Both in charging and in discharging with constant currents, the greater part of the time variation of the potential difference at the terminals of an accumulator is due to an actual variation in the E.M.F. itself; and it is only towards the end of the charge and of the discharge, when the resistance of the cell becomes relatively large, that the slope of the potential difference curve becomes practically different from that of the E.M.F. curve.

We may mention, in conclusion, that the results which we have obtained with accumulators made to go for long periods through definite cycles in charging and discharging, have been so interesting that we are now engaged on the design of an apparatus which will automatically keep the current constant for any time at any pre-arranged value, which will automatically change over from charge to discharge, or from discharge to charge, when the P.D. per cell reaches any pre-arranged limit, and which will record the P.D. at the terminals of the cell and also its E.M.F. during the whole period.

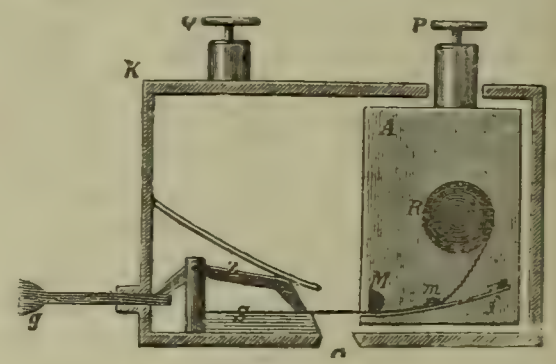
We hope, therefore, at some future period, to be able to present a graphical record of the life history of accumulators, from their first formation to their death.

THE SIEMENS-VIOLLE STANDARD LAMP.

The forms up to the present suggested for obtaining the unit of light passed by the Paris Congress have all of them many inconveniences, being both difficult to manage and most of them costly, says Dr. E. Liebenthal, in *Elektrotechnische Zeitschrift:* That illustrated in the accompanying figure has been specially designed to overcome these difficulties. A stand some 4in. high carries a box, K K, shown full size in the figure. On the bottom of the box is an insulated metal plate, A, on which is a small drum of platinum strip, R, a movable half cylinder, *m*, a larger fixed one, M, and a terminal, P. The strip passes under M and *m*, against which it is pressed by the spring *f*, and thence to the plate S. where it is clamped by the claw Z. The strip is now stretched by turning *m* backwards, and on passing a current through the instrument the platinum strip is melted, the light being observed through the aperture D. The handle *g* is now pressed, pushing S and Z forward, and at the same time lifting Z. On pulling *g* back, Z falls again, clipping the end of the platinum, and drawing on a fresh piece for the next reading.

The lamp does not absolutely fulfil the requirements of the Congress, as the source of light is platinum just melted, instead of melted platinum on the point of solidification; but, if it should be found necessary, a correction factor may be ascertained once for all. The cost is infinitesimal compared to that of the original standard, one gramme of platinum, costing about 2s. 6d., being sufficient for 50 readings. The metal is also obtained pure without difficulty, as there is, of course, no fouling due to the source of heat.

Preliminary trials with the lamp showed several small defects in the means of making contact on the right-hand side; these, however, were overcome by covering M with platinum, and abolishing *m* altogether, the strip being tightened by manipulating *g*. It was found also that more or less tension had but very slight effect on the results obtained. The current used varied from nine ampères to as much as double, due to variation in the gauge of platinum supplied. The strip used was about 5.5 mm. broad and .011 mm. (.44 mils.) thick. A very large number of comparisons were made against the amylacetate standard, the current being slowly augmented, and the grease-pot carrier slid along the photometer bar as the light increased, the point at which the carrier stood when the coil fused being taken up as the reading. The results obtained do not agree perfectly among themselves, the mean error in 180 readings being 2.9 per cent. whereas the same observer made two amylacetate lamps agree within 0.95 per cent. The errors are attributed both to variation of the platinum standard itself, and also to the fact that just before melting the light is considerably whiter than the amyl standard.



SIEMENS-VIOLLE STANDARD LAMP.

As the final result Dr. Liebenthal gives the value of the amylacetate standard as .569 Congress unit.

Herr v. Siemens originally gave the figure as 0.7 legal unit, but thought that this was probably too high owing to impurities in the platinum.

From previous experiments the value of the English standard candle had been found to be 1.169 that of the amylacetate lamp which makes the legal value of the candle .665 legal units. On the other hand, Herr Violle himself has made the value .54, a difference of over 20 per cent.

In conclusion Dr. Liebenthal says that owing to the color the platinum lamp is best suited for arc-light determinations, and recommends that the platinum should only be about .2 to .3 mils. thick.

Robbery of Electric Cables.—An extraordinary story of the robbery of underground cables comes from Paris. Recently 6,000 metres of cable disappeared from the Champ-de-Mars, and about the same time a like length of cable was stolen at the other end of the city. Two workmen were arrested. It is supposed they descended into the drains at night with dark lanterns and abstracted the cables. They were both sentenced to long imprisonment.

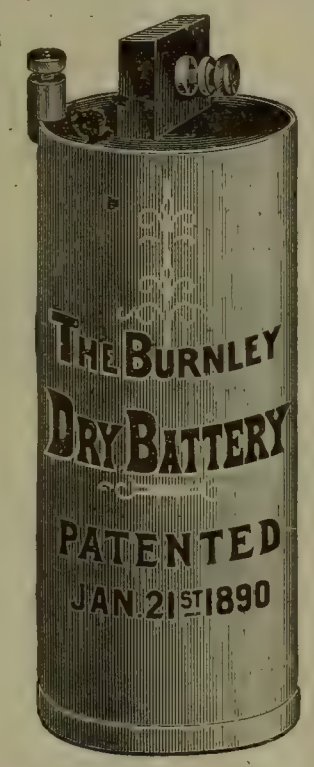
Electric Railway in Sweden.—The first electric railway in Sweden is in process of construction at Boxholme. It is intended for the carriage of manufactured articles from the ironworks to the storehouses. The motive power will be a 50 h. p. turbine, working two Wenström dynamos.

New Spanish Cable.—The *Official Gazette* of Madrid publishes an official announcement inviting tenders for the construction and laying of cables between Tarifa and Tangier, Tarifa and Centa, Almeria and Melilla, and other Spanish possessions on the coast of Morocco.

THE BURNLEY DRY BATTERY.

That there is a great field for dry batteries is attested to by the enormous number of cells placed upon the market, and the great sale which has accorded them all. Sometime ago, J. H. Bunnell & Co., of New York, began the manufacture of what is now known throughout the world as the Burnley Dry Battery. Recently a very complimentary testimonial in regard to this battery was received by them from Mr. Robert Hope Jones, late chief electrical engineer of the National Telephone Co., of Liverpool, England. Mr. Jones made a comparison with a Silvertown Dry Cell with the following results :

"Its internal resistance (.1 of an ohm) was very much lower, while the E.M.F. was considerable higher. It maintained its potential well when at work, and quickly became depolarized when allowed to rest. The Burnley cell seems in every particular to be electrically superior to any of the others tested, and, in fact, to any battery of the class my experience has brought me in contact with, while it and the Silvertown dry cell have the merit of being mechanically stronger and more portable than the ordinary glass contained. The Burnley dry cell is also very much superior as a secondary battery. After passing a current of 2½ amperes from a dynamo for 1½ hours through an exhausted cell,



THE BURNLEY DRY BATTERY.

and finding it then to be capable of doing even more work than when perfectly new, I am inclined to wonder whether this form of sealed cell cannot be charged and recharged more or less indefinitely at trivial cost, and so become of far greater value then even its inventors anticipated.

"The internal arrangement of the two Burnley cells sent is good, the zinc stout and fairly pure, the quality of the carbon excellent, the agglomerate well compressed, and the whole effectively sealed.

"An improvement is made in the manner of contact with the carbon plate, whereby the old lead cap with its constant liability to electrical fault (with which all large users of the old Leclanché cells are so familiar), is done away with."

From the above statement of facts, it would seem that rapid progress has been made in placing upon the market what proves to be the most perfected dry battery ever offered to the public. It has an immense field for telephone aud telegraphic work, as well as for electric bells and electro-medical uses. The firm's claims for it, that it is strong, clean and durable, are well supported by those who have given the battery a trial. Our engraving gives an excellent illustration of the appearance of the battery.

"TRIPLE" CARBON LAMP.

We illustrate herewith the lamp referred to in our issue of August 23. This lamp is the production of the Sperry Electric Company of Chicago and is styled by them the "Triple" Carbon Lamp. It is said to be far superior to the double carbon lamp in use owing to the fact that but a single mechanism is required for its operation. Two ordinary 7/16 carbons are used in one of the carbon holders and a special flat carbon is used in the other. These carbons are found to last about sixteen hours continuous burning.

This system of operation as compared with the



"TRIPLE" CARBON LAMP.

use of two flat carbons is found far superior from the fact that the two carbons which are in one holder tend to localize the arc, rather than allow the same to move to and fro upon the edge causing thereby a constant glimmering and flickering. This has been entirely overcome in the triple carbon lamp.

NEW YORK NOTES.

The Long Island Railroad is going to equip its passenger and freight terminals in Long Island City with an electric-light plant.

Three weeks ago somebody climbed the poles of the Hudson Electric Light Company in Jersey City and cut down three miles of wire. The wire was found in a junk shop. It had been sold for $50. A former lineman for the company, has been arrested for the theft. The wires were new, and had just been strung on the poles.

There is a great scarcity of telephone officials in this city this week. The Detroit convention has called them away, and they are all glad of the opportunity to get away for a change and rest.

Mr. E. H. Johnson, president of the Interior Conduit and Insulation Company was, on September 2d, granted letters-patent on three inventions. Two related to electrical controlling and operating devices, and the third was on an electric current regulator. The two first were assigned to the company of which he is president.

Mr. William F. Z. Desant has received letters-patent on his railway electric signal system which we fully described some time ago. The system is owned by the Desant Electric Company, of Columbus, Ohio. The New York office of the company is at 45 Broadway.

The Knickerbocker Electric Light and Power Company has spacious quarters at 24 Beekman st. Mr. Frank K. Irving is the electrician, Fred. K. M. Hill, chemist, and W. S. Williams, superintendent. The plant at the above address supplies a one h. p. motor, besides fan motors, and a number of incandescent lamps and one arc lamp. The current is furnished by a storage battery, which in turn is fed by the primary battery of their own make. The battery is said to be the best on the market, and the severe tests to which it was put in the presence of a representative of this paper corroborate the statements made by the gentlemen who have charge of the business. A number of batteries suitable for furnishing power to run sewing machines and for portable electric lights are being prepared for the market.

The 8th annual meeting of the Street Railway Association of the State of New York, will be held at Powers Hotel, Rochester, N. Y., Sept. 16th. The meeting will be especially devoted to electricity. A report on the subject of an electric street railway motor will be presented by Mr. John W. McNamara, President of the Albany Railway. The subject of the electrical propulsion of street cars being of so much concern at the present time to the street railway and municipal communities of the state, it was decided by the executive committee to invite representatives of the overhead electric systems to the meeting to present the merits of their several sysems of propelling cars by electric motor power. R. J. G.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Sept. 6, 1890.

At the meeting of the Salem board of aldermen, last Tuesday, a petition from the Essex Electric Street Railway Company, asking for an extension of tracks to the Willows, was referred to the Committee on Streets.

Parties representing the East Side Electric Road Company of Brockton have been in consultation with the representatives of the Whitman Electric Road in regard to the purchase of the franchise recently granted the company by the selectmen. If the deal is consummated it will become part of the general plan to connect Brockton and Boston via Weymuth and Quincy.

Prof. Thomson has just patented a device whereby large quantities of power can be transmitted long distances by means of alternating currents. By the use of this water-power can be utilized at long distances. The potential of the current is made very high in the wires, thereby reducing the cost of wire to minimum. He has also patented a sort of electrical tow-horse for street railways. It is often necessary at curves or on grades to exert large quantities of power for a moment in starting or moving cars. When a car is quite a distance from a station or on a grade, it takes a tremendous current to move it. This momentarily creates a great drop in potential. To meet this emergency the professor places storage batteries at different points along the line. These batteries are made to be capable of quick discharging and are of rather limited capacity, the object being merely to supply a large volume of current for a few moments in the starting of the car. After using they are immediately recharged againby the current.

The linemen of Boston and vicinity are contemplating the establishment of a lodge of the United Order of Linemen in this city.

The new station of the Lowell Electric Light Company, work on which was commenced about the middle of April, is progressing very rapidly.

Mr. F. O. Rusling, late of the construction department of the Thomson-Houston Company, has joined the service of the Connecticut Motor Company, at Plantsville, Conn.

Mr. F. A. Hanaford has resigned his position as superintendent of the Pulsion Telephone Co. and in the future will be identified with the Jordan Train Lighting Company.

The Brown Electric Protector Co. are making a fine display of their protector at their rooms which are constantly visited by many interested people in and out of the electrical business.

The Lynn and Boston R. R. has been granted permission to equip its lines for electric cars on Chatham, Empire, Timson and Essex streets, and Iresen avenue in East Lynn, and Summer, Cottage and Boston streets, in West Lynn, to the Saugus line.

The Shaver Telephone Company, of Sullivan County, N. H., has recently been organized with Ex-Congressman H. W. Parker, President; C. B. Spofford, Treasurer; and F. R. Vogl, Clerk. This is the fifth sub-company operating the Shaver Molecular Telephones in New Hampshire.

The New England Phonograph Company is experiencing more than a little difficulty in supplying the demand for the new "nickel in the slot" phonograph. This company is placing them in hotels, places of amusement, and everywhere, and the public is getting so much fun out of them that the orders for them are rapidly piling up.

The outlook for business with the Eastern Electrical Supply and Construction Company is so promising that instead of locating on Federal street as was intended they have leased a larger store at 65 Oliver street which they will occupy immediately. Mr. G. H. Buckminster who has for the past four years been connected with the Electric Gas Lighting Co. has been engaged as salesman.

The new factory of the National Electrical Manufacturing Company, which is located at Milford, Conn., and presided over by Mr. William Lane, who acts as Superintendent, is said to be one of the best equipped establishments in the United States for the manufacture of general electrical goods. It is needless to say the shop is kept busy filling orders from early Monday morning till Saturday night. Since this company severed its connection with the New Haven Clock Concern, business has almost doubled.

The new office of the New England Telephone and Telegraph Company in Lynn is nearly completed and will be ready for occupancy about October. This company are soon to open a new office in Brighton, Mass., about 50 subscribers being assured. There will be no grounded circuits in this office, everyone will be metallic. This company is also erecting a new pole line from Boston through Brighton, Watertown, Waltham, Concord and Ayar Junction to Fitchburg. Mr. D. W. Leedom has been appointed auditor of the above company vice, F. J. Boynton who takes the position vacated by Capt. Bonney.

The annual meeting of the New England Printing Telegraph Company was held at the executive office of the company, 113 Devonshire street, yesterday afternoon. The following board of directors were elected: Frank B. Dole, Boston; John R. Reed, Westfield; P. S. Jennings, New York; Abner McKinley, New York; James B. Cook, Boston; George W. Slade, Fall River; Maybin W. Brown, Boston. Frank B. Dole was elected president, R. H. Waters treasurer, H. B. Humphrey secretary, Maybin W. Brown general manager, C. F. Hutchinson general superintendent, executive committee. F. B. Dole, Abner McKinley, James P. Cook, George W. Slade. The company are now building a two wire line through to New York from Boston which is expected to be finished about the middle of December.

Electrician C. J. Van Depoele has patented a generator for electric engine circuits. It consists of the combination, with a sectional commutator and a source of current, of stationary commutator brushes on the line of commutation, a moveable brush or brushes, and means for imparting to the moving brush or brushes a spasmodic movement toward and away from the stationary brushes. He has also patented a structure for supporting and insulating suspended bare conductors, comprising double transverse rods or wires, a connection of insulating material attached to and uniting said rods, and a conductor sustained by the insulating connection. He has also patented an electric railway conduit, with tubular conductor and fixed contact devices, extending from the exterior to the interior. The exterior of this conductor is insulated, and running along on its upper side are contact pins with springs attached, which the contact device on the cap touches. Another device of Mr. Van Depoele's is a reciprocating electric hammer, having a variable stroke and means for increasing and decreasing its length and power.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, Sept. 6, 1890.

MR. FRANCIS W. PARKER, patent attorney of 1,005 Opera House Block, returned this week from a two months' sojourn in various parts of Europe.

THE CENTRAL ELECTRIC COMPANY are exhibiting a handsome line of anti-magnetic watches, and have completed their arrangements with the Electricians' Time Company for handling the same.

BURT'S ELECTRIC LIGHT, FUEL AND POWER COMPANY has been formed at Chicago, to manufacture arc light and incandescent dynamos, lamps, motors, etc.; capital stock, $5,000,000; incorporators, Jennie L. Bennett, Allan S. Bennett, and Martin C. Burt.

A COMPANY, composed of E. T. Weber, of Denver, Colo.; and C. F. Fisher, T. B. Catron, J. J. Shumann, and N. B. Laughton, of Santa Fé, N. M., has been formed to furnish the latter city with electric lighting. The capital stock of the company is placed at $25,000.

GILLETT ELECTRIC LIGHT COMPANY has been formed at Chicago, to manufacture and vend electric gates for drawbridges, railway crossings, etc.; capital stock, $1,000,000; incorporators, Harleigh Gillett, Ernest L. Prussing, Benjamin Stickney, and Robert H. Gillett.

THE CITIZENS OF LANSING, MICH., are enthusiastic over their new electric line, which started last week. Four cars are running, and, judging from the reports published in local papers, are giving perfect satisfaction. One prominent citizen sent in a check for fifty dollars to the company, stating it was to pay for his first ride. This check the company have had framed as a memento. This road is the first the Westinghouse Company have started outside of Pittsburgh, and they are in good spirits over the results.

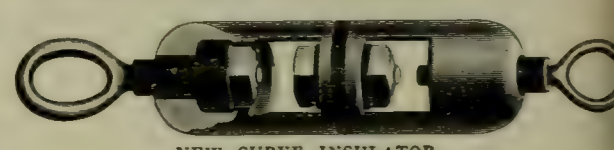
The Electric Merchandise Company, 11 Adam street, Chicago, Ill., has just issued a very complete and artistic catalogue of their goods, which include general electric railway supplies for all systems. The company is composed of gentlemen familiar with the electric railway field and understand the requirements of that rapidly growing industry. The concern is well equipped to fill any orders that may be sent them. Copies of the catalogue may be procured free upon application.

MR. FRED. W. HORNE, of the Thomson-Houston Railway Department, is being congratulated by his friends on securing the contract for the Davenport, Rock Island and Moline Electric Railroad. This contract amounts to over $300,000, and is one of the largest that has been let in Chicago. The Central Electric Company have secured the order for supplies on this contract. This is probably the largest electrical supply order ever placed in this city, amounting to upwards of $40,000.

F. M. I.

A NEW CURVE INSULATOR.

The successful and economical operation of electric railways depends on the proper line construction, *i. e.* on ample strength of all the parts put under strain, and thorough insulation of the trolley wire from the ground. Owing to the weight of the trolley wire the supporting device must be very strong, yet they must insulate the trolley line from the supporting wires. This is the more true at curves, where the strain which is too much for an ordinary iron pole, is put on the single center curve insulator. It is not surprising that some of the forms now in use, have not withstood so severe a test in practice, and have either lost their insulating properties or have partly crumbled up. Such a fate seems impossible for the new form which we illustrate herewith, the "Treble" Center Curve Insulator designed by Mr. Wm. Sharp for the Great Western Electric Supply Co. of Chicago.



NEW CURVE INSULATOR.

This is made of iron pieces bolted together and insulated from each other by hard rubber washers and bushings. As the cut shows, the three rubber bushings are in series, giving a treble insulation. A rubber sleeve fitting snugly over the insulator keeps this dry, so that the three-fold insulation is obtained in all kinds of weather.

The sleeves by enclosing the insulation also prevents any possible deterioration of the same. The cut does not show this sleeve, but it shows the disposition of the iron and rubber parts, which are made unusually strong and promise to withstand the severest practical tests. Besides the saving in fuel owing to the increased insulation will be quite an item against the forms heretofore used.

THE ST. LOUIS ELECTRICAL FXPOSITION.

The Electrical Exhibition was successfully inaugurated September 3d. The displays are numerous and elaborate. Among those most prominently located are Crocker & Wheeler Electric Co., Okonite Co., Leclanchè Battery Co., River & Rail Electric Co., Washburn & Moen, New York; Jas. W. Queen & Co., Philadelphia; Simplex Electric Co., Municipal Signal Co., Johnson Electric Train Signal Co., Russell Arc Lamp Co, Boston; Shay, Stephens & Co., Chicago; Armington & Sims, of Providence; Russell Engine Co., Massillon, O.; Buckeye Engine Co., Salem, O. The Edison Companies, the Westinghouse, the Brush, Thomson-Houston and other large interests are all fully represented.

Alfred Stevens, Thos. Connolly, sr. and Thos. Connolly jr. of London, are visitors in this city.

The Rae system of electric street car propulsion has been successfully established at Kansas City for the Vine street line.

ELECTROLYTIC THEORIES.

BY PROFESSOR G. F. FITZGERALD, F.R.S.

Electrolysis has been explained on two different theories by Grotthüs and Clausius. As generally received they differ. Grotthüs' theory, as generally given, assumes that the molecules in an electrolyte are both polarized and moved by the electric forces within the liquid. This seems so far untenable that it would appear that double the electric force would double both the polarization and the motion of the molecules, and so should produce four times the electrolysis. The objection, however, assumes that we know the causes resisting the motion, and with proper, and not very improbable assumptions as to the resistance to motion depending on it and on the polarization, a linear relation between current and electro-motive force, *i. e.*, obedience to Ohm's law, seems possible. A modification of Grotthüs' hypothesis in the direction of Clausius' is, however, possible. Suppose that when polarized the molecules *drew one another apart* at a rate proportional to the polarization. This at once makes the relation between electric force and the decomposition a linear one, and so satisfies Ohm's law in the case of small currents. It also so far agrees with Clausius' hypothesis that it explains electrolysis and double decomposition as properties of the same kind. The molecules in a liquid will occasionally be arranged by accident in the proper polarized condition in a closed circuit for drawing one another apart; and if the circuit includes molecules of different kinds, there will result double decomposition. There seem to be very serious difficulties in supposing that uncombined atoms are for any finite time free in the liquid; and the supposition that it is a particular arrangement that is required before exchanges take place of their own accord, seems to explain electrolysis and double decomposition without supposing free atoms to exist within the liquid. I have not assumed Prof. Armstrong's suggestion that the proper arrangement for double decomposition is a double molecule; but it seems a likely hypothesis, and one that should be investigated from the chemical rather than the physical side.

There are some other phenomenon that have been explained upon the supposition that free atoms are gadding about in a liquid. Such are the lowering of the boiling and freezing points by solution of salts, and their effect on osmotic pressure. If dissociated atoms are going about in a liquid as in a gas, it seems impossible but that they must diffuse at different rates; and that this is not observed seems conclusive against the hypothesis, no matter what else the hypothesis may explain. Consider solution simply. Why does chloride of sodium dissolve in water? There must be some strong affinity between the two of a chemical or semi-chemical nature to break up the cohesion of the crystal; and it seems reasonable to assume that this same affinity keeps the molecules of NaCl moving about among the water molecules, so that they diffuse about. Now if the forces drawing them about be independent of the nature of the molecule, most of the phenomena explained by gaseous laws are explained. Pressure of a gas depends, at any temperature, on the number of molecules, and not on their kind. This is Avogadro's law, by which molecular weights are calculated; and if the forces drawing a molecule about in a liquid are independent of the kind of molecule, the very same law of pressure would hold, the pressure forward of molecules of different kinds would depend on their number only, and in the same way as Avogadro's law would enable molecular weights to be calculated. In this connection it is well to state that some bodies may, nevertheless, be much better able to produce pressure than others, because of their being more easily polarized, *i. e.*, turned into an effective direction. A molecule which could be easily turned into an effective direction would be about twice as effective as a molecule which went about in a higgledy-piggledy way; and one would consequently expect electrolytes to produce more, nearly double, the osmotic pressure that other bodies did. As to the changes of boiling and freezing points, they seem explicable by exactly the same hypothesis. The reduction of vapor pressure by molecular affinity of dissolved salt would depend only on the number of molecules of salt if all salts have the same molecular affinity for water; and the same would apply to the change in freezing point. Hence all these phenomena are explained without assuming free atoms, and they are all explained by what can hardly avoid being a *vera causa*, namely, whatever affinities they are that cause solution, which latter is an unexplained phenomenon on the dissociation hypothesis. That it is reasonable to think that the forces keeping the molecules of salt moving about in the water are independent of the nature of the salt, appears from various considerations. In the first place, these forces are in all probability due to the residual affinities of the non-metallic elements. These same forces are probably the cause of crystallization. These are old suggestions. That these residual affinities should be nearly the same for different combinations does not seem at all unlikely.

If a rather shaky argument in favor of its likelihood on mechanical grounds is desired, the following may deserve attention. Suppose a molecule of NaCl, for instance, at rest, or nearly so, in a crystal. Subject it to this affinity. Its velocity, after it has gone a distance, s, will be given by some such relation as $fs = \frac{1}{2} m v^2$. Now, for the sake of temperature equilibrium, with molecules of somewhat similar structure, $\frac{1}{2} m v^2$ must be the same in all. It seems likely that, at least approximately, the kinetic energy of motion is proportional to the total energy, and that this is the same for each molecular group; if so, the kinetic energy must be approximately the same for different groups. Now, with very dilute solutions s must be nearly the same for different molecules, and if so we get that for temperature equilibrium f must be independent of the nature of the molecule. How this equalization of f for different kinds of molecules comes about may be as follows: Molecules in a liquid move about one another, but are well within the sphere of one another's attraction, as is evidenced by superficial tension and by the tension to which a liquid can be subject. A very small change in the distance apart of the molecules means, however, a very great change in the forces between them, as otherwise they would be extensible and compressible like gases. It seems likely, then, that when a salt dissolves in a liquid it requires for temperature equilibrium that the distances of the molecules should change by the very small amount required in order that f may become the same for all substances. This very minute change in distance would not sensibly affect s.

* Communicated by the Secretaries of the Electrolysis Committee of the British Association.

SAMPLE ITEM FROM THE NEWSPAPERS OF FIFTY YEARS HENCE.—Considerable anxiety prevails over the non-arrival of the steamship "Electric Impulse" which left Liverpool for this port 47 hours ago. She is now 19 minutes over due. Her owners say, however, she is a slow boat; and it may be possible that she was detained at Cable station No. 10, in mid-ocean where the African mails for America are transferred from the boats en-route to Greenland. She was last reported from ocean station No. 6. Her electric motors of which she has 20, are of 10,000 horse power each, and are of old pattern. This boat, as slow as she is, is a wonder compared with the slow craft that ploughed the ocean 50 years ago, when steam was the motive power. The only part electricity played on steamers in those days was to light the boat, and the lamps gave a very feeble light as compared with the present system.

RENARD'S VOLTAIC CELL. *

This cell, the invention of Commandant Renard, will, it is claimed, give a considerable amount of energy in a very short space of time, or it will yield the same total amount of energy, gradually decreasing, with a duration of discharge proportionately increasing. The arrangement is of the bichromate of potash type, and its novelty consists in:

(*a*) The substitution of hydrochloric acid for some of the sulphuric acid.

(*b*) The suppression of the alkaline base, the bichromate being replaced by chromic acid.

Each cell consists of an elongated tube made either of glass or ebonite. The positive electrode is furnished by a very fine platinized silver tube (a *carbon* electrode is found to be unsuitable), and the negative electrode is a thin rod or wire of zinc.

The liquid used in this cell is composed of a mixture of two liquids, A and B, each of which is itself a mixture.

(*A*) consists of chromic acid and water, 0.530 of acid to 0.770 litre of water.

(*B*) consists of a mixture, in variable proportions, of hydrochloric acid and sulphuric acid.

If commercial hydrochloric acid be employed, it must be brought to a certain strength (18° Beaumé) by the addition of a little water. The requisite strength of sulphuric acid is obtained by mixing 0.450 kg. of acid at 66° with 0.800 litre of water, and the result should show 290° Beaumé.

The symbol, B, may be conveniently used in order to indicate the strength of the liquid, B, in percentage of sulphuric acid, thus B_{20} indicates that the liquid contains 20 per cent. of the acid.

It is stated that the total electric capacity of the cell does not vary or behave in any erratic way, and that many experiments show that the available energy per second is practically quintuple of that which can be obtained with the same apparatus charged with the bichromate of potash and sulphuric acid liquid of the ordinary bichromate battery.

The following are figures given by Renard in support of these contentions:

Strength of the liquid.	Maximum current.
Mixture of liquid A with B_0	8.50 ampéres.
" " " B_{20}	7.40 "
" " " B_{40}	6.80 "
" " " B_{60}	5.20 "
" " " B_{80}	3.50 "

Instead of sulphuric acid, sulphate of soda may be employed in liquid B, but the effect of the use of this salt is to reduce the total available energy per litre of liquid.

It is unnecessary to amalgamate the thin zinc rod or wire which forms the negative electrode. By reducing the diameter of this electrode, the density of the electricity at its surface is increased, and at the same time the consumption of the metal per second and per unit of surface is reduced.

The great activity of these cells necessitates the provision of a considerable cooling surface, for there is a large amount of heat generated; this fact has determined the adoption of the tubular form of cell.

MINES.—An exhibition of machinery used in mining and metallurgy is now being held at the Crystal Palace, London. Among the many exhibits is one of Mr. Lars Bristöl, showing several of his miners' lamps having accumulator cells. The main feature of these is the fact that the glow lamp is covered by an external thick glass dome which, if accidentally broken, throws the lamp off its holder and interrupts the circuit. It is claimed that by this means the possibility of any explosive gases being ignited is entirely removed.

* London *Electrical Review*.

MEASUREMENTS OF ILLUMINATION.

In an article on measurements of illumination, the London *Electrician* says: A unit of illumination may be conveniently expressed in terms of a length and of a unit of light, being the illumination produced by unit light at unit distance. Mr. Preece pointed out at the beginning of 1884 that a carcel-metre is equivalent to a British standard candle at 12.7 in.; and the name "lux" was suggested for it. The name has not been used, if for no other reason than that measurements of illumination have very seldom been made. M. de Nerville, Director of the Central Laboratory of Electricity, has recently made a number of such observations in Paris. He has employed as a unit a bougie-metre, the bougie being a "*bougie décimale*," the tenth of a carcel burning 42 grammes of oil per hour. This is equivalent to a standard candle at 3.34 ft. distance, which is a more convenient expression than one-tenth of a candle at 12.7 in. The .7 in. cannot be neglected, since it amounts to a difference of about 12 per cent., a quantity which can be easily distinguished, and a greater difference than between yards and metres. The bougie-metre is a unit of very convenient magnitude. It is the same as the deci-lux of Mr. Preece, and is practically the illumination at the foot of an gas street lamp, say 13 candles at 12 ft.

The relations of the candle-power and the distance are, of course, very simple for light falling perpendicularly, the bougie-metre or deci-lux unit illumination being equal to 1 candle at 12.7 inches, or 1,058 foot, or n candles at 1,058 candles at $1{,}058 \times \sqrt{n}$ feet, as shown in the following table:—

BOUGIE-METRES.

Candle-power.	Feet.	Candle-power.	Feet.
0.1	1.058	8	9.45
0.5	2.37	10	10.58
0.8	3 0	20	14.95
1.0	3.34	50	23.7
1.5	4.1	100	33.4
2	4.73	200	47.3
3	5.8	500	74.8
4	6.69	1,000	105.8
5	7.48	2,000	149.5

M. de Nerville communicated on July 2d to the Société Internationale des Électriciens the results of photometric determinations which have been made with the photometer of M. Mascart at the Opera, the Hippodrome, in the salons of the Hôtel Continental, at the Central Post Office and at the Halles Centrales at Paris. He refers to several general observations which he had communicated at a previous meeting on similar measurements made at the Exhibition. Tables are given showing the results obtained. They are expressed in bougie-metres. The screen of the photometer was 1m. 50 (4ft. 11in.) above the ground. Red and green glasses were used, and the readings of both are given.

At the Opera House, where the first series was taken, the auditorium has 450 Edison lamps of 10 candle-power, and 144 of 16 candle-power. Thirteen measurements were made in various parts of the house, with the screen of the photometer pointing in different directions, which are described in full in M. de Nerville's Paper. The average is 10 bougies metres for the red, and 9 for the green glass. Again, in the *grand foyer*, there were 524 ten-candle lamps. The average of seven measurements was 12 bougies-metres; or, omitting two sets taken under the arcade, 14 bougies metres, the figures for the red and for the green being almost identical.

Two sets of measuremeats of the illumination of the Hippodrome were taken. There were 20 Jablochkoff of 4mm. in thick opal globes; 16 Gramme arcs of 25 amperes, in clear globes; 3 Gramme arcs of 45 amperes, and 8 Brockie-Pell of 12 amperes. Full details of each measurement are given, but, taking the average of six sets, we find that the red gave 44, and the green 70 bougies-metres respectively. The ratio of green to red for the glow lamps was unity in one case, and 9 to 10 in another; but for the arc lighting it is 7 to 4 or 1.75 to 1, showing the larger proportion of red and yellow rays from the glow lamps. The Petit Salle des Hommes of the Central Post Office is lit by 13 Cance lamps of 8 amperes. The red gives an average of 13, and the green 18 bougie-metres—a much large proportion of red than in the larger arcs at the Hippodrome. One of the other rooms was lit with gas, with Cromartie burners, and gave an average of 9 with the red and 10 with the green, being a whiter light than that of the Edison lamp at the Opera House.

To compare artificial lights with daylight, several measurements were made at different times of the year, and in different states of the weather. The highest reading given is 1,110 bougies-metres with the green glass, and 326 with the red, giving a ratio of nearly 3 to 1. This was observed at four o'clock in the afternoon of May 1, 1890. The windows of the room in which the measurements were made were provided with white blinds, and in this case the sun was shining directly on them. On the same day a reading of 740 with the green, and 228 with the red glass was taken at 10:30 in the morning, the window not being directly facing the sun. The ratio here is 3.24 to 1.

At five p. m. on the same day the ratio was 3.44, but the total illumination was about one-half of that of the morning observation. It may be assumed, then, that for pure white light, of which the sun is our standard, the ratio of the glasses in this particular photometer is about 3.5 to 1. The arc lighting at the Hippodrome, where the ratio was 1.75 to 1, therefore has a double proportion of red and yellow rays, compared with a pure white light, while the glow lamps and gas have 2.85 times the proper quantity of red light.

A reading was taken with the photometer turned towards the full moon, and the value was found to be about one-third of a bougie-metre.

For interior lighting the production of illmination is almost invariably the only object of artificial lights, but out of doors it is otherwise. A lighthouse, for example, is not intended to illuminate a surface, but merely to be seen as a brilliant image. Other signal lights on railways and on carriages are intended chiefly to act as beacons, though a good carriage-lamp illuminates the road as well. Street lighting must be considered from both points of view. The mere illumination produced by the full moon, say one-fifth of a bougie-metre, would be sufficient for most purposes in the streets if this could be carried out uniformly by any artificial means, but street lamps act also as beacons. Even an arc lamp of 1,000 candle-power produces very little actual illumination at a distance of 150 ft., say one-half of a bougie metre on a surface turned to face towards it; but such a lamp would be very useful in a street as a beacon. The lighting of Cheapside, in 1884, by Brush lamps was of this character. The lamps with their globes in the ordinary condition, gave about 400 to 500 candle-power. At the foot of each post, which was about 15ft. high, the illumination would have been about 20 bougie-metres had there been no shadow. Midway between two lamps, the illumination on the ground was less than half a bougie-metre.

NEW FORM OF GAS BATTERY. *

At one of the meetings of the Royal Society, a short time ago, a new form of gas battery was described by Messrs. Ludwig, Mond and C. Langer. There are several forms of gas battery already known, but the peculiarity of this latest modification is that it is a *dry* gas battery.

The new battery may be thus briefly described:—A diaphragm of some porous non-conducting material, such, for example, as plaster of Paris, is saturated with dilute sulphuric acid, or with some other common and suitable electrolyte. This diaphragm is covered on both sides with thin platinum foil, which has been finely punctured, and which contains about 1,500 perforations per square centimeter. The foil is overlaid in its turn by a thin film of platinum black.

The internal resistance is reduced to a minimum by placing the foil in contact at short intervals with strips of some good conductor.

A number of such diaphragms having been prepared in the manner described, they are placed side by side, or one above the other, with non-conducting frames intervening; this arrangement forms chambers through which the gases employed are passed. One side of each diaphragm is exposed to the action of air or hydrogen, whilst the alternate sides are exposed to the action of hydrogen gas, and the spaces which exist between the diaphragm are so connected that the gases pass through the whole series each in its own proper way.

Experiments were made in order to estimate the electromotive force of such a battery as this, with the result that it (the E.M.F.) was found to vary considerably with the quality of the platinum black.

The best result obtained was:

$$\text{E.M.F.} = 0.97 \text{ volt},$$

and this was yielded when platinum black, prepared as follows, was employed, namely, by precipitation from a boiling solution of platinum tetrachloride by neutralizing with sodium carbonate, and afterwards reducing with a boiling solution of sodium formate.

The resistance of a plate of plaster of Paris, 8 mm. in thickness and having 350 sq. cm. of surface, was found to be

$$R = 0.02 \text{ ohm}.$$

The maximum amount of work was obtained from this battery when the external resistance was nearly double the value of the internal resistance.

After much experiment it was found most convenient to work the battery with an electromotive force of about 0.73 volt, which allows a current of from 2.0 to 2.5 ampères to be taken out of an element with 700 sq cm. of active surface covered with 0.35 gramme of platinum foil and 1 gramme of platinum black. The temperature should be maintained constant at 40° C. by passing excess of air through the battery.

About one-half of the energy of combustion of the hydrogen gas is converted into electrical energy; this is, comparatively speaking, a high value.

Messrs. Mond and Langer, besides experimenting with oxygen and hydrogen, also tried air and a gas containing from 30 to 40 per cent of hydrogen—a gas, in fact, such as can be got by the action of steam, with or without air, on coal or coke.

As might be predicted, this battery after having been at work for some time begins to exhibit signs of polarization. In the opinion of Messrs. Mond and Langer, this phenomenon is caused by a charge in the concentration of the acid at the two electrodes, and may be remedied by interchanging the gases from time to time; this can be effected with the greatest ease since the materials to be interchanged are gaseous.

It is only fair to remark, in conclusion, that Messrs. C. R. A. Wright and C. Thomson have recently stated that the gas battery described by Messrs. Mond and Langer is practically identical in principle with one described by them in 1888 in a paper entitled "On the Development of Voltaic Electricity by Atmospheric Oxidation" (*vide Proceedings Royal Society*, Vol. XLIV., p. 182), and which was perhaps foreshadowed in a previous paper by them, entitled "Note on the Development of Voltaic Electricity by Atmospheric Oxidation" (*vide Proceedings Royal Society*, Vol. XLII., p. 212.)

* London *Electrical Review*.

CIRCULAR RAILWAY.—Albuquerque, New Mexico, is to have a circular electric railroad, which is to be built by Philadelphia parties.

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A WEEK OF CONVENTIONS.

This is indeed a week of conventions. The telephone people have just closed one of their most successful meetings at Detroit, Mich. The deliberations were timely and important, and all who attended were well repaid for their visit. The Edison Convention at Minneapolis, the Old Time Telegraphers' Convention, at Kansas City, Mo., and the State Electric Street Railway Convention, at Rochester, N. Y., are convening as we go to press. It is unfortunate that the same date for holding these conventions was selected by each of the three last named interests. It certainly looks as though a committee should be appointed by each of the associations whose duty it shall be to guard against a confliction of dates. A number of people in the electrical business would have been delighted to have attended at least two of the three conventions which occurred on the same day, but of course, such a thing was impossible. It is to be hoped that a remedy will be sought before another year passes by.

DUPLEX GAS ENGINES.

Mr. Elmer A. Sperry, the well-known electrician, of Chicago, contributes an article which appears in another column of this paper on duplex gas engines. Mr. Sperry states that the efficiency of the steam engine when taken as a measure of the recovery of power from the total power-equivalent of the heat employed, following the most improved methods, is only about ten per cent. when large units of power are considered. He adds, that to compare this performance with that of the gas engine, it is but fair that we take equal units in either case. In the comparison of the two motors as heat engines, size for size, the actual performance of the gas engine is over two hundred per cent. better than that of the steam engine, with a vast unexplored region beyond in the case of the gas engine, giving promise of great improvement and higher economy than the most excellent performance yet recorded.

The whole article gives very valuable statistics and information on this important subject which are worthy of perusal.

THE DISPLACEMENT OF STEAM BY ELECTRICITY.

In another column appears an article from the *American Machinist*, one of the most widely read mechanical papers in the country, on the subject of displacing steam by electricity. The article is worthy of consideration by the electrical fraternity, for the reason that it shows conclusively that those who have heretofore joined fortunes with the steam engine are now gradually preparing themselves to adopt electricity, if it proves the better medium of power. The article, of course, is written from the standpoint of a steam engine advocate, but between the lines can be discovered a slight feeling that electricity, sooner or later, will overshadow the engine of to-day.

ELECTRIC CAR INTERESTS CONSOLIDATE.

Advices reach us from Pittsburg, Pa., on the authority of Mr. George Westinghouse, that the long-talked-of combination of the Westinghouse Electric Company, of Pittsburg, and the Pullman Manufacturing Company, of Chicago, for the construction of outfits for electric street railways was arranged in Chicago September 12. The combined capital of the two companies will be $20,000,000. There will be no direct consolidation of plants at once, but each company will make contracts for the other and there will be an exchange of stock. Mr. Westinghouse also says he will at once begin the erection, near Pittsburg, of the largest electric plant in the world. His establishment now is running night and day.

THE EDISON ENGRAVINGS.

We take pleasure in placing before our patrons excellent pictures of Mr. Thomas A. Edison and his able assistants. It is, we believe, the first time that pictures of so elaborate a nature have ever appeared in a weekly publication. We congratulate all of these gentlemen. Their good looks is the very best recommendation they could have. Every man is an expert in his own particular line. We also congratulate Mr. Edison for gathering around him so many efficient and scholarly people. Of course, the number we present does not begin to represent all branches of Mr. Edison's business. They were all we could get hold of, however, and those who have been overlooked can rest assured they were not forgotten, and at some future time we expect to take them in hand.

Mr. Edison has come out in a new character. The process of accelerating the passage of drugs through the skin by electrical endosmosis has, for some time, been regularly practiced under medidal sanction. Edison had noticed that gouty concretions are often treated with the aid of lithium salts, taken internally, to facilitate the formation, dissolution, and excretion from the body of urate of lithium. The difficulty in this treatment has always been the uncertainty of the absorption of the salts into the system, and it occurred to Edison that more rapid success might be obtained by external application and the employment of electrical endosmose to carry the lithium into the tissues. For the purpose of testing this application he carried out a series of experiments last year, the results of which were placed before the International Medical Congress, recently held at Berlin. The subject experimented upon was seventy-three years of age, and had lived an active and healthy life until ten years previously, when he contracted the tendency to gouty concretions through sleeping in damp sheets. All the joints except the knees were very much enlarged, and the joints of the little finger were almost obliterated by concretion. The patient experienced freedom from pain, which had up to that time been intense, after the first day's treatment, and in fourteen days a reduction of nearly an inch and a quarter was affected in the circumference of one of the fingers, whose form was favorable to accurate measurement. The general condition of the patient was temporarily ameliorated, and the results of the experiment were in every way encouraging.

THE EDISON CONVENTION.

The annual Convention of the Association of the Edison Lighting Companies for the year 1890, will be held at the West Hotel, Minneapolis, Minn., commencing on Tuesday, September 16th. The managers of the principal stations of the country are expressing an unusual interest because the officials of the parent company are making preparations to attend, and the presence of Mr Edison, and Samuel Insull, second vice-president of the Edison General Electric Company, are assured.

The following are among the subjects which will be discussed at this session :—

Lightning Protection—Results of Experiments.
Insurance of Edison Central Stations.
A National Code of Insurance Rules.
Edison Patent Litigation.
Central Station Steam Piping.
Re-organization of Edison Interests.
Grounding the Neutral Wire in Three-Wire Systems.

The presence of Mr. Edison and his views upon the many points which will be brought up for discussion, will, of course, be of great value.

At the same time, the Minneapolis Industrial Exposition is in the height of its, activity, and its most attractive exhibit is the display shown by Mr. Edison at the Paris Exposition, and more recently at the Lenox Lyceum, New York City, consisting of a long line of inventions from the early electric "vote recorder" to the perfected Phonograph.

The Phonograph will be elaborately exhibited and some novel and beautiful lighting effects displayed, and it is safe to say that the Convention will be a most happy occurrence, all of which will be arranged by Mr. Hammer, as at the Paris Exposition.

BUZZING IN THE TELEPHONE.—The Central New York Telephone and Telegraph Company of this city has devised a plan by which the induction to its lines by the electric current on the wires of the Belt Line street railroad is in a measure overcome. When the electric cars were first operated and at times since patrons of the telephone company have complained of a buzzing sound in the instrument when the receiver was placed to the ear, making it difficult to understand the person at the other end of the line. Trouble was also occasioned in the exchange by the frequent falling of the annunciator when no one had sent in a call. Investigation by the company's electricians revealed the fact that the trouble was occasioned by the electric cars. The current from the underground wires of the railroad spread out and interfered with the return circuit of the telephone company. The difficulty can never be entirely obviated, but a plan has has been hit upon by which the service is greatly improved. A large copper wire has been run from the central office between the line wires on which the 'phones are connected, and thence into the ground, thus establishing a balance between the two currents.—Utica *Herald*.

ELECTRIC LIGHT WANTED IN THE BERMUDAS.—A writer states that there are no electric lights on the islands, but that the principal inhabitants "want them badly." He mentions a dozen persons who would go to a heavy expense in order to have the electric light.

NEWSPAPER ENTERPRISE.—The London *Times* spent over £6,000 in telegraphing day-by-day the news of the revolution in Buenos Ayres.

SPECIFICATIONS OF LETTERS PATENT.

The late Judge Grier of the United States Supreme Court says:

"There are few things more difficult, even for well-educated and practical lawyers, than to describe a new invention clearly and point out the principle which distinguishes the subject of it from all things known before. As inventors are rarely experts, either in philology or law, it has long been established as a rule that their writings are to be scanned with a good degree of charity.

"But it is easy to abuse this liberality to the purpose of fraud.

"The public has rights to be guarded also, and these exact that the patentee's specification shall set forth his invention so fully and definitely that it cannot be readily misunderstood." (French *vs.* Rogers, vol. i., Fisher's Patent Cases, p. 138.)

The importance of clearly and correctly describing the use and operation of the invention is well set forth in the opinion of a patent law judge many years ago:

"The intention of the inventor, so as to effect the object designed, is to govern the construction of the language he employs. Inventors are not always educated or scientific men. Some of the most useful inventions have sprung from an illiterate source. Genius is not always blessed with the power of language. Courts look to the manifest design, in order to remove any ambiguity arising from the terms employed. But this ambiguity must not be such as would perplex an ordinary mechanic in the art to which it applies." (Page *vs.* Ferry, vol. i., Fisher's Patent Cases, p. 298.)

But the comparatively recent words of Judge Miller, now of the Supreme Court of the United States, are like "apples of gold in pictures of silver" to the inventor; they shine out in the inventor's firmament like the bright moon and stars to the lonely people under the splendors of the brilliant arctic night; they contain the most important information and advice to inventors, in words which are, at once, glowing, concise, beautiful and forcible:

"The growth of the patent system in the last quarter of a century in this country has reached a stage in its progress where the variety and magnitude of the interests involved require accuracy, precision, and care in the preparation of all the papers on which the patent is found. It is no longer a scarcely recognized principle struggling for a foothold; but it is an organized system with well-settled rules, supporting itself at once by its utility and by the wealth which it creates and commands. The developed and improved condition of the patent law, and of the principles which govern the exclusive rights conferred by it, leave no excuse for ambiguous language or vague descriptions.

"The public should not be deprived of rights supposed to belong to it, without being clearly told what it is that limits these rights.

"The genius of the inventor, constantly making improvements in existing patents—a process which gives to the patent system its greatest value—should not be restrained, by vague and indefinite descriptions of claims in existing patents, from the salutary and necessary right of improving on that which has already been invented.

"It seems to us that nothing can be more just and fair, both to the patentee and the public, than that the former should understand and correctly describe just what he has invented, and for what he claims a patent." (Merrill *vs.* Yeomans, vol. xi., Patent Office *Gazette*, p. 970.)

And the late Judge Grier, after a wide experience in patent legislation, rings out these solemn words of warning:

"The courts always labor to protect a man when they clearly see that he has made a good invention but has got among a set of bungling fellows to draw his patent; and many a time we have had to stretch almost our consciences to help through a good invention against a bad description drawn by some blockhead.

"The difficulty has been that mechanics did not understand law, and lawyers did not understand mechanics."—*The Practical Mechanic.*

ELECTRICITY VERSUS STEAM.

THE AMERICAN MACHINIST HAS THIS TO SAY ON THE SUBJECT.

The fondest dream of the enthusiastic electricians of to-day seems to be the relegation of our present locomotive engines to the scrap heap, or to museums of antiquities, by means of the electric motor; and it is confidently claimed by some of them, at least, that the speed of trains will be greatly increased—120 miles per hour being mentioned as among the easy possibilities.

If a track could be provided perfectly level and straight, with rails absolutely smooth and unyielding, and if a train could be placed upon this track, all the moving parts of which should be perfectly balanced, and capable of moving without friction, and if, finally, the resistance of the air could be avoided, such a train could be run as fast as anyone dared to travel, and the power required to do it would be easily supplied and never lost. But such conditions are not practically obtainable, and every departure from them not only calls for increased power, but sets a limit for the attainable speed entirely independent of the question of power.

Some of these conditions can be much more closely approached than is the case in present practice, and will be, as soon as the need for doing so becomes the limiting element in the problem.

By the use of the electric motor, the reciprocating parts of the present locomotive can be avoided, and none but rotating parts employed; this will make practically perfect balancing possible, and, together with the fact that an electric motor for a given train and speed can be lighter than the present locomotive, would seem to give considerable advantage to electricity, while the difference in economy between the best locomotives and the best stationary engines of the compound condensing type gives a margin of about fifty per cent. for loss of energy by conversion in electricity, and back again into motive power.

Whenever it is shown that the loss by this conversion and re-conversion is less than fifty per cent. under ordinary every-day working conditions, the question of economy will be in a fair way of settlement, though there will still be the question of the comparative cost of repairs and interest on money invested in motive power machinery, and this is a point about which there is little absolute knowledge as yet.

But there is some doubt as to whether the system of having power installations along a line of intervals, generating electricity to be taken by the motors from a conductor placed along the track, would prove practically applicable to railroads. On a very busy and crowded section of a railroad it is doubtful if the numerous motors required could all depend upon a single source of power, the failure of which from any cause whatever would make them all helpless and cause a very effectual blockade—one which might require vigorous work with independent motors of some kind to clear up. The storage battery system would get over this difficulty, but in its present stage of development the question of economy and weight would again be brought in by it. If the problem of converting the heat energy of coal directly into electric energy is ever solved, then electric motors will probably be made which can generate their own electricity on the road, as locomotives now generate their own steam, but this direct development of electric energy without the intervention of steam power is a problem which may never be solved. And supposing a satisfactory motor to be developed, then, when much higher speeds are attempted than are attained now, other problems will present themselves probably little thought of now. Electricity may possibly come into use on railroads, but it is safe to say that the science of electricity is not yet sufficiently developed to enable anyone to foretell in what way it will supersede present arrangements, and it is well for those who attack the problem to remember the maxim, "Never despise your enemy;" for the locomotive is quite an efficient machine all things considered, and we are by no means sure that it has reached the limit of its development in regard to either speed or economy.

Those who imagine they have seen the last days of the locomotive, may have long to wait before the very serviceable machine now in use is driven from the track and relegated to the scrap heap by a successful rival.

DISGUISED AS LINEMEN.

THREE MEN STEAL WIRE OFF THE POLES.

One day three weeks ago three men, dressed like telegraph linemen, climbed the poles of the Hudson Electric Light Company on Railroad avenue, Jersey City, cut the wires and carried them off. A day or two later about a mile of wire on Central avenue was carried away in a similar manner. The Company was greatly inconvenienced by the cutting of the wires and the damage done exceeded $500.

The police were notified and detectives were put on the case. They located the stolen wire. It had been sold to a junkman for less than 50 although it was worth about $300.

From information received the detectives on Monday arrested Thomas Williams, a former employé of the company, on suspicion of being concerned in the stealing of the wire. Williams, it is said, has served time in New York for a similar offense. He is held for examination.

The wires were new and no electric current had passed through them.

Some curious coincidences between the names of inventors and mechanical appliances have given rise to absurd mistakes. It was commonly supposed years ago that the Brush machine was so called on account of some special kind of brushes, and that the Lever arc lamp derived its name from two peculiar levers in its mechanism. "The Ball dynamo has no spherical armature, as might be supposed. The Short electric railway system is not specially adapted for lines of limited length. Bright shackles are never polished, and the Siemens galvanometer has nothing to do with the mariner's compass with which beginners sometimes confound it. The Parsons engine is not a clerical device, and the Upward battery has nothing in common with Excelsior carbons. Such popular errors may be excused, however, when we find a recognized text-book explaining the Daniells cell as being so called because of its constancy!" In this country a large number of people have always thought that the Bell telephone was so called because of the bell which is attached to it, and so widespread was this belief that the Long Distance Telephone Company made it serve a commercial purpose by adopting the bell as the trade mark.

Of novel applications of electricity there is no end. Bakers are now using the electric motor as a bread mixer, and are thus enabled to do in four or five minutes an amount of work that would otherwise require hours of hand labor.

A writer in a medical paper says he has frequently obtained much relief from facial neuralgia by applying an incandescent light to the part effected. He suggests that the lamp could also be used in poulticing advantageously. It could be laid over a flaxseed or other form of poultice, and constant heat could be thus secured.

The River and Rail Electric Company of this city, a few days ago received an order for five cars, to be delivered in ninety days, at $[illegible],000 per car, C. O. D., without guarantee.

ELECTRIC LIGHTING FOR BEGINNERS.

BY THE EDITOR.

Part VII.—Compound Wound Dynamos.

137—What is a compound wound dynamo?

A compound wound dynamo is one in which the series and shunt methods of winding the field magnets, as described in Parts V. and VI., are combined. The accompanying illustration shows in a clear manner the two windings.

138—Are there two separately wound coils of wire on the field magnets of a compound wound machine?

Yes.

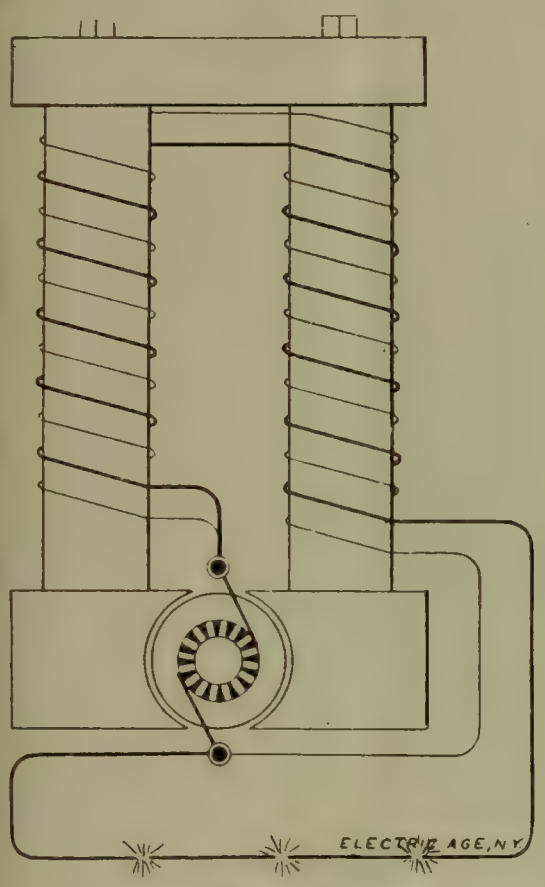
139—Are the two coils excited by the current generated in the armature?

Usually, yes.

140—Is there any other method than this of exciting the fields of compound wound machines?

Yes, by connecting one of the coils with an independent and outside source of electricity.

141—What may these outside sources of current be?



COMPOUND WOUND DYNAMO.

They may be another dynamo or a magneto generator—anything that generates a current of electricity.

142—Are compound wound dynamos always referred to by that name?

They are sometimes called self regulating machines.

143—Why are they called self-regulating?

Because they regulate their output of current automatically.

144—In a compound wound dynamo are the two coils of wire with which the field magnets are wound of the same size (diameter)?

No; one coil is of coarse wire and the other of fine wire (see illustration).

145—What part of the system includes the coil of coarse wire?

The main or external circuit—this is the one in which the lights are placed.

146—What is the fine wire coil?

It is the shunt circuit.

147—Which of two machines described in Parts V. and VI. is represented in the compound wound dynamo by the coarse wire?

The series dynamo.

148—And the fine wire winding represents the shunt machine?

Yes.

149—Are the wires of the two coils insulated from each other?

Yes; they are insulated from each other throughout their entire length.

150—Is there no electrical connection whatever between them?

Yes; at the brushes the ends of the two coils are connected electrically.

151—Does each coil excite the field magnets?

Yes.

152—To what extent does each of the two coils excite the field magnets?

In proportion to the electrical resistance in each of the circuits.

153—Do the two coils act together in the production of the magnetic field, or do they oppose each other?

They act together.

154—Are all compound wound dynamos of one class?

No; there are two general classes.

155—What is the object of each?

One class is designed to produce a constant potential, and the other a constant current.

156—In what respect do the dynamos of these two classes differ?

They differ in the winding of the field magnets.

157—In a machine designed to produce a constant potential how are the field magnets wound?

To produce a constant potential one of the two coils of the field magnets may be connected in series with the armature and the external circuit and the second coil excited from an external source of electricity; or, one coil may be connected in series with the armature and external circuits (as in the former case) and the second coil placed in a shunt. The latter combination is shown in the accompanying figure.

158—To produce a constant current how are the two coils of the field magnets combined?

To produce a constant current one of the field magnet coils may be placed in a shunt and the second coil may be excited by a current from an external source.

159—Is there any general rule for winding the coils of a compound machine?

No; no general rule can be given for the reason that machines have to be wound to suit the work they are designed to perform, in order to attain the best results.

160—What is the object to be attained in winding the coils?

The object is to so wind the coils that the right amount of current will flow through them to produce the required electro motive force.

161—In a machine of the class illustrated in this article, if the number of lights on the external circuit is increased what is the result?

Increasing the number of lights increases the resistance of the circuit, and increase of resistance diverts more of the current generated in the armature through the shunt coil. The increased current in the shunt causes an increase in the magnetism of the field magnets, and this in turn increases the current sufficiently to compensate the loss caused by the increased resistance in the external circuit.

162—If the number of lights on the external circuit is diminished what is the result?

A diminution in the number of lights reduces the resistance of the external circuit, and the decrease of resistance takes more of the current from the shunt, but by reducing the current in the shunt the magnetism and the current output is correspondingly reduced, thus the balance is maintained.

163—Then a compound wound dynamo delivers a given current under varying loads?

Yes; and for this reason such a machine is styled "self regulating."

164—Does variation in the speed of the armature affect the result?

Yes; speed is one of the factors in the determination of the elements of the machine.

(*To be continued.*)

RELIABLE SHIP COMPASSES.

The Secretary of the Navy recently advertised for proposals for the construction of ten Diehl-Gibson compensating binnacles for the compasses on board some of the new United States Naval ships. This binnacle is the invention of Lieut. S. W. B. Diehl, naval superintendent of compasses, and Ensign John Gibson, his principal assistant.

The object of a compensating binnacle is to counteract the magnetism of the ship so that the compass will be influenced by the magnetic influence of the earth alone. This is done by means of magnets differently arranged. In the Diehl-Gibson binnacle, the perpendicular magnetism of the ship is corrected by three magnets, composed of bundles of steel wires, each one of which is a separate magnet. These are placed on a brass plate below the compass so that they lie in the direction of the ship's magnetism, but with their magnetic poles opposite to those of the ship. This plate is so arranged that it can be raised or lowered by a rack and pinion, until the exact point is reached where the magnets neutralize the magnetism of the ship, and allow the compass always to point north, no matter how the ship points.

The horizontal error, which is comparatively little, is compensated by means of two large iron balls so adjusted on each side of the binnacle that their distance from the compass can be regulated by screws.

There is still another error, known as the "heeling error," which comes into play when the ship heels over from one side to the other in rough weather. This is compensated for by a perpindicular bar magnet, which is placed in a tube directly beneath the center of the compass, so that it can be raised or lowered to the right point to compensate the heeling error. With the adjustments all properly made, the compass in this binnacle would be as reliable as if it were mounted on shore, far away from any disturbing influences, unless the magnetism of the ship should suddenly change.

It is very seldom that such a thing as that happens, but there is one celebrated case on record, when a Coast Survey vessel off the Atlantic coast was struck by lightning one night, and one whole side of the vessel was converted into an immense and very powerful magnet by the electric charge it received.

It was only by skillful seamanship that the vessel was not wrecked.

ELECTRIC LIGHT AT THE VIENNA EXHIBITION.—The *Neue Freie Presse* gives the following particulars concerning Siemens and Halske's installation at the Vienna Agricultural Exhibition:—Sixteen Siemens and Halske dynamos are driven by 11 steam engines supplied with steam from six boilers. The machines supply 400 arc lights and 2,000 incandescents. The arc light machines work at 300 volts and can each supply 72 arcs of 2,000 normal candle-power, and taking 10 ampères. Altogether, these machines supply 400 arcs in the Rotunda and the Park. The incandescent lighting machines, five in number, can each feed 500 16 candle-power lamps at 110 volts. For the illumination of the fountains two separate dynamos are employed, supplying together 660 ampères at 80 volts. There are altogether 72 arc light circuits, six incandescent circuits, and two for the fountains. Their total length is about 60 kilometers, of which about 17 kilometers consist of lead-covered cables, placed underground. This installation is said to be the largest in existence in Austria. About 675 horse-power are converted into light. Up to the present the installation has been run without the slightest hitch of any kind.

As soon as the telephone between London and Paris is completed, arrangements will be made to extend the system to Brussels, Bordeaux and Marseilles.



SAM'L INSULL, SECOND VICE-PRESIDENT EDISON GENERAL ELECTRIC CO.



A. O. TATE, PRIVATE SECRETARY TO THOMAS A. EDISON, AND ELECTRICIAN, EDISON MFG. CO.



H. WARD LEONARD, GENERAL MANAGER LIGHT AND POWER DEPARTMENT.



FRANCIS R. UPTON, GENERAL MANAGER LAMP DEPARTMENT.



JAMES F. KELLY, MANAGER WIRE DEPARTMENT.



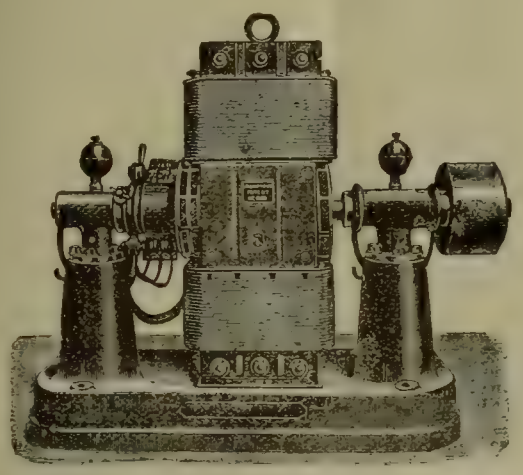
WILFRID H. FLEMING, MANAGER BUREAU OF ADVERTISING AND INFORMATION.



Thomas A. Edison.

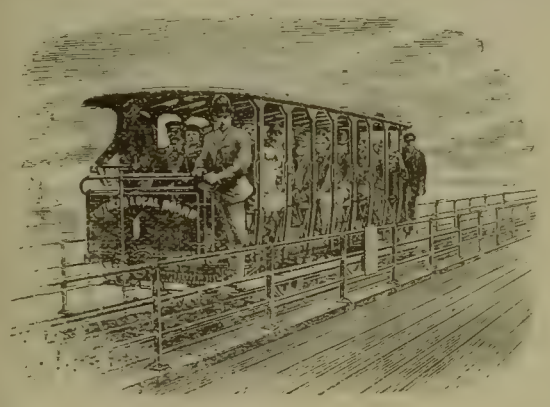
THE SOUTHEND ELECTRICAL TRAMWAY.*

The interesting features of this tramway are the dispatch with which the work was carried out, and the means by which this was accomplished, by using material from stock. The Southend Local Board, which is following the example of the enterprise of other watering places



CROMPTON DYNAMOS, 150 AMPERES, 200 VOLTS.

in spending money on local improvements, recently replaced the long wooden pier by an iron structure. To keep things up to date, it was decided to furnish the new pier with an electrical tramway. The contract was secured by Messrs. Crompton & Co. Three-quarters of a mile of track was laid, the car built and fitted ; a horizontal compound engine by Davey Paxman,



with a boiler of locomotive type, was provided, and the connecting cables were laid so smartly that the tramway was at work in six weeks. The dynamo is of the Crompton standard type, and is compound-wound for 150 ampères at 200 volts. The conductor on the pier is of the ordinary 1-in. by .134-in. copper strip, which is used for street mains ; and the supports, insulators, and straining gear have been taken from



stock, and are identical with those used in 30 miles of streets in Kensington, Belgravia, and Notting Hill. The insulators are placed at intervals of 15 yards, and straining gear with volute springs are placed at every 85 yards. The track is of 3 ft. 6 in. gauge, the rails being Vignolle's type. The conductor is laid about 12 in. from one of the rails, and 1 in. below the level of the rail tops. The rails are used for the return. The motor is a stock pattern ; it is speeded down by simple spur gearing as 3 to 1. At both ends of the car are handles for starting and reversing, with an ordinary brake. While 20 miles an hour can be attained, the car runs generally at 12 to 14 miles an hour, the trip being made in three or four minutes, instead of 15 minutes with horse cars. The current is collected by rubbing contacts designed by Mr. Chamen. Dr. Hopkinson, as consulting engineer to the Local Board, expressed great satisfaction with the work, which is much appreciated by the residents. The power required for propelling the car is considerably below that which was expected ; and Messrs. Crompton & Co. hope to make measurements of the tractive force.

*London *Electrician*.

ELECTRIC LIGHT IN TEXTILE FACTORIES.

In a communication to *L'Electricien* the distribution of electric lights in textile factories is considered.

The lighting for textile industries is here considered, says the article, first, because there exists none other which has need of so powerful lights and secondly, because it has been thoroughly studied in all its details, and in consequence the type of factories is nearly the same in all countries, all of which may. therefore, be compared among themselves. The rooms are large and they contain a certain number of similar machines. The walls and ceilings are assumed to be white. For spinning, the minimum number of lamps should be one 12-ampere arc for 180 to 200 square metres (say 230 square yards, or 15 yards × 15). The maximum for a 9 or 10 ampere arc should be 80 to 100 square metres (say 110 square yards. or 10½ × 10½ yards. These areas are for high rooms and for spinning unbleached or clear colored yarn. For weaving the minimum is a 12-ampere arc for 120 square metres (133 square yards, or 11½ yards square). For white unbleached or clear colors, a good light is given with a 10-ampere arc over an area of 75 to 80 square metres (93 square yards, say 9½ yards square). But for black, and especially for dark colors, which must be distinguished thread by thread, some workers are not satisfied unless 10-ampere arcs are placed 7 metres (23 feet) from each other, that is 49 square metres (59 square yards) for each lamp. In general it is not advantageous to employ lamps of less than 8 or 9 amperes ; 10 amperes gives a good light for industrial use. When the rooms are small, or the lighting is not evenly divided, 6 amperes may be used. For blacks and dark colors twice the amount of light must in general be used as for white or light goods, and even then the eye will be fatigued. In weaving light goods by glow lamps, a 10-candle and even an 8-candle lamp may be used for lighting two looms for unbleached stuff, and on the other hand, for colors, two 16-candle lamps to a loom ; or, if it is rather long, two 20-candle lamps are needed. That is exceptional, but it may be said that in most cases one 16-candle lamp will suffice for two looms. For arc lighting it is not a question of the number of looms, but the area which has to be lighted ; it is, in fact, a general illumination. The room must be lighted and all that is in it, without troubling about any particular machine or part on which the worker is occupied. Arc lamps obviously cannot well be employed in small rooms. For outside work, in courtyards and the railway-goods yards, an excellent effect is produced by lamps of 15 amperes, placed at 12 metres (40 feet) high, or, in case of need, lamps of 12 amperes at 10 metres (33 feet) high ; but it is not advisable to use less than this. These figures have been arrived at by practical experience in Belgium and Germany, and it is because they have been departed from in lighting the streets of Paris that the illumination there tires the eyes without making things properly visible. There is an unnecessary number of lamps placed too low, and of too feeble an intensity ; moreover, this arrangement is more expensive.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
35 COMMERCIAL BUILDING,
CHICAGO, Sept. 13, 1890.

Among the special devices placed upon the market by the Central Electric Company which have met with considerable favor is their new Spark Arrester. This device, as well as preventing sparks from falling from arc lamps, also prevents insects from getting into the globes. A large stock of the new Stoddard Porcelain Cut-outs has also just been received by this firm. Another device they are doing much business with is the Perry Wire Peeler, an instrument admirably adapted to the use especially of bell-hangers and incandescent wiring men.

While no special importance has been given by the Exposition Association to electrical exhibits, there are two or three besides the lighting stations which are themselves the most interesting feature of the exposition. Two No. 32 Edison shunt wound machines, of 1,250 light capacity each, are run from a 200 h. p. McIntosh and Seymour compound engine. The belts are furnished by Chas. A. Schieren and Co. and the Page Belting Company respectively, and show well the advantages of link belting for electric lighting purposes.

The new catalogue issued by the Electric Merchandise Company, of 11 Adams street, has been received. Whether the color chosen for the cover of this catalogue is intended to insinuate that they are going to paint things red in the railway line or not, the contents indicate that they are fully abreast of the times in all kinds of station, line and car equipment material. Although but a few months since this company was organized its management is in the hands of old railroad supply men, and much business has been done already. Mr. W. R. Mason is manager of the company.

The Pumpelly Storage Battery has found a new use this week in the decorating of floats for display parades. On August 30th the Pumpelly Company received a request from Mr. Edward G. Pratt, manager of the Capital City Gas Light Company of Des Moines, Iowa, for storage cells sufficient to illuminate five floats, and on September 1st 150 charged cells were shipped from the factory at Plymouth, Indiana. The cells were placed thirty upon each float, and traversed the streets in the procession three consecutive nights upon the charge given them at the factory. These cells are the latest improved make of the Pumpelly Company and are packed with loose cellulose fibre which prevents all slopping or splashing of the acid. Mr. Harry Osborne, of the Pumpelly Company, was in charge of these batteries at Des Moines.

INTER-STATE EXPOSITION.—Notwithstanding the reports that Chicago's Exposition had opened its doors for the last time a year ago, the old familiar building is daily and nightly filled with people. September 3rd the Inter-State Industrial Exposition opened for its usual forty days' run, with an attendance of 9,000 people. The building is more brilliantly lighted than ever—2,000 incandescent and 200 arc lights being employed. Above the entrance outside the building are the words, "Inter-State Industrial Exposition." in large letters formed of incandescent lights, 315 lamps being employed. Opposite the entrance, in the centre of the building. the first thing seen is the great fountain, the basin filled with water flowers, among which are incandescent lamps, other lamps appearing in the midst of the spray. Above the fountain is a great circle of festoons of red, white and blue incandescent lamps which radiate from a centre over the centre of the fountain, 600 lamps being used. Around the fountain are a number of arc lights provided with various hued globes, the effect of all of which is very pretty.

The Great Western Elect ic Supply Company has a very attractive exhibit showing some of their handsome incandescent g obes and shades of cut, ground and colored glass. The feature of their exhibit is three elk heads forming a large chandelier, under the centre of which is a very large incandescent globe, and from the tips of the antlers are clusters of incandescent lamps.

The arc lighting station of the Sun Electric Company using Sperry apparatus is adjoining six 30 light dynamos arc run, four from a 150 h. p. compound Ideal engine and two from a 60 h. p. Ideal engine. The Edison switch-board stands on the boundary line between the two exhibits, and above it on one side appears the word "*Edison*" and on the other "*Sperry.*" Not far from these is the exhibit of the Duplex Rotary Engine Company, where a 15 h. p. duplex rotary engine running 1,000 revolutions is driving a 7-light Excelsior dynamo. Another smaller engine is also running. Messrs. Meyer, Kiehl and Grant are the inventors of this engine, which is a new one on the market, and is claimed to be especially well adapted for driving dynamos.

The electric light is being turned to very artistic use by a prominent wall-paper manufacturer. The dark, clear cut shadows caused by the play of the electric light among the foliage of trees have often been remarked, and the gentleman in question has been for some time making, by means of photography, a series of records of these beautiful effects, which he intends to use in connection with his business. The collection is a valuable one, and some of the designs which have already been made from it are of exceptional merit.

An interesting transmission of power by electricity has been carried out near Domene, in France, where power equal to 200 horse-power is transmitted to a paper mill at a distance of 3¼ miles from the waterfall utilized. An interesting feature of this installation is that for two months, in the heart of winter, the generating works are entirely cut off by the snow from the paper mill where the power is utilized, but, nevertheless, the work goes on smoothly and steadily, connection with the inhabitants of the valley being maintained by telephone.

An expert report has been made on the lighting of the London, England, theatres by electricity, which goes to show that temporary electric lighting on a small scale can be produced there more cheaply by batteries than gas engines and dynamos. The great saving effected by electric lighting in the absence of dirt and tarnishing of decorations is also called attention to, as well as the advantage of coolness and reduced fire risk, and these constitute a source of economy which it is estimated will enable the cost of the plant for a theatre to be paid for in a few years.

Electric Mining Plant.—Operations are successful at the Ogden Iron Mines, about 3½ miles from this place, for the purpose of testing Edison's newly invented process for concentrating, separating and reducing ore peculiarly susceptible to the retention of magnetism. An extensive plant for this purpose was erected at Allentown, Penn., two years ago, but the ore found was not sufficient for a paying business and the machinery is now being torn down and will be shipped to New Jersey. Work at the Ogden mine has been abandoned for some time, but it is thought that with the improved machinery of the Edison patent, an industry of much value will be developed. A newly discovered magnetic vein in the mine is said to extend at least two miles in length. The Edison concern has purchased the property and extensive works have been erected. The main structure is nearly 250 feet long, and has many side wings. The plant will crush and reduce 1,000 tons of ore each day, rejecting the stony refuse and rendering a magnetic product of 65 per cent. pure. Operations on a large scale will be begun in a very short time.

ELECTRICAL PATENTS ISSUED SEPT. 2d, 1890.

435,421. Battery compound. Ernest M. G. Hewett, Newton, Mass., assignor, by direct and mesne assignments, to the Safety Electric Light Company, of Maine. Filed June 29, 1889. Renewed Feb. 3, 1890.

435,424. Electric Switch. Charles W. Huntington, Baltimore, Md, Filed Jan. 24, 1890.

435,438. Telephony. Thomas D. Lockwood, Melrose, Mass. Filed Feb. 15, 1890.

435,440. Automatic Electric Annunciator. John W. Luthe and Alfred E. Jeavous, Cleveland, O.; said Jeavous assignor of one-half to said Luthe. Filed Jan. 23, 1890.

435,447. Electric Conductor for Street Railways. Luther M. Perkins, St. Louis, Mo. Filed Oct. 17, 1889.

435,486. Conduit for Electric Railways. William R. Elliott, Kansas City, Mo. Filed Jan. 18, 1890.

435,487. Electric Conduit. William R. Elliott, Kansas City, Mo. Filed Mar. 20, 1890.

435,490. Automatic Electric Switch. Theodore M. Foote, Boston, Mass. Filed April 25, 1888. Renewed July 23, 1890.

435,502. Trolley for Hoisting Apparatus. Richard Lavery, Boston, Mass. Filed Jan. 3, 1890.

435,503. Commutator. Charles A. Lieb, New York, N. Y. Filed Apr. 30, 1890.

435,504. Commutator and process of making the same. Charles A. Lieb, New York, N. Y. Filed May 6, 1890.

435,505. Suspender or Support for Overhead Wires. Charles A. Lieb, New York, N. Y. Filed June 13, 1890.

435,516. Electric Signaling Apparatus for Preventing Collisions Between Railway Trains. Theodor Perls, Wurzburg, Germany, assignor of one-half to Martin Perls, London, England. Filed Jan. 31, 1890. Patented in France, Belgium, Germany, and in Austria-Hungary.

435,525. Regulator for Dynamo-Electric Machines. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Apr. 28, 1885.

435,526. Regulator for Dynamo-Electric Machines. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Mar. 8, 1886.

435,527. Regulator for Dynamo-Electric Machines. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Nov. 19, 1887.

435,536. Electric Conduit. Herbert N. Curtis, New York, N. Y. Filed Mar. 31, 1890.

435,545. Automatic Regulation of Electric Circuits. George B. Prescott, Jr., Newark, N. J., assignor to the Accumulator Company, of New Jersey. Filed Apr. 29, 1890.

435,550. Electrical Measuring Instrument. George W. Walker, New York, N. Y., assignor to the Walker Electric Company, same place. Filed May 15, 1890.

435,558. Railway Signal. William F. Z. Desant, New York, N. Y., assignor to the Desant Electric Company, Columbus, O. Filed Oct. 31, 1889.

435,578. Switch for Incandescent Lamp Sockets. Waldo C. Bryant, Bridgeport, Conn. Filed July 14, 1890.

435,582. Workman's Time Recorder. Frederick L. Fuller, Norwich, Conn. Filed Jan. 30, 1888.

435,629. Apparatus for Covering Electric Wires. Alfred G. Holcombe, Long Island City, assignor of one-half to Charles L. Browne, New York, N. Y. Filed Mar. 17, 1890.

435,639. Electric Motor. Harry H. Blades, Detroit, Mich., assignor to the Detroit Motor Company, same place. Filed Sept. 25, 1888.

435,640. Means for Supporting Storage Batteries on Railway Cars. Harry H. Blades, Detroit, Mich. Filed Jan. 10, 1890.

435,641. Electric Railway Car. Harry H. Blades, Detroit, Mich. Filed Jan. 10, 1890.

435,642. Electric Railway Car. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed Mar. 26, 1890.

435,643. Method of Electric Welding. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed June 12, 1890.

435,644. Method of Electric Welding. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed June 14, 1890.

435,660. Manufacture of Filaments for Incandescent Lamps. Vincent M. Hobby, New York, N. Y. Filed Oct. 26, 1889.

435,662. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company, of Connecticut. Original application Filed Feb. 23, 1887. Divided and this application filed Oct. 18, 1889.

435,668. Electric Cigar Lighter. John Roberts, Pittsburg, Pa., assignor of two-thirds to Homer H. Redpath and Irvin Redpath, same place. Filed Feb. 3, 1890.

435,679. Method of and Apparatus for Producing Musical Sounds by Electricity. George Breed, U. S. Navy. Filed Jan. 31, 1890.

435,687. Means for Charging and Using Secondary Batteries. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Sept. 3, 1881. Patented in England and in France.

435,688. Process of and Apparatus for Generating Electricity. Thomas A. Edison, Menlo Park, N. J. Filed Sept. 19, 1883.

435,689. Telegraphy. Thomas A. Edison, Menlo Park, N. J. Filed Feb. 19, 1886.

435,690. Method of Making Armatures for Dynamo-Electric Machines. Thomas A. Edison, Llewellyn Park, N. J. Filed Sept. 15, 1888.

435,695. Electric Current Indicator. Albert B. Herrick, New York, N. Y., assignor to The Bergmann & Company, same place. Filed Mar. 13, 1890.

435,700. Device for Controlling the Current of Electric Generators. Harry W. Leonard, Chicago, Ill, Filed Mar. 13, 1889.

435,744. Electric Motor. Henry Groswith, Philadelphia, Pa., assignor, by direct and mesne assignments, of three-fourths to Charles W. Kennedy, same place. Filed Jan. 7, 1890.

435,851. Telegraphy. Alexander Muirhead, London, England. Filed Mar. 6, 1888.

435,870. Suspending Device for Overhead Electric Conductors Elihu Thomson, Lynn, Mass. Filed June 20, 1890.

435,872. Pole for Electric Wires, etc. Edmund Verstraete, St. Louis, Mo., assignor of one-half to Peter M. Kling and George J. Kobusch, same place. Filed Dec. 27, 1889.

435,879. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. Filed May 20, 1890.

435,893. Electrical Signaling Apparatus. Adin A. Hatch, Kansas City, Mo., assignor to Benjamin F. Jones, Edward L. Martin, and Alfred W. Jones, all of same place. Filed Nov. 20, 1889.

435,894. Electrical Signaling Apparatus. Adin A. Hatch, Kansas City, Mo., assignor to Benjamin F. Jones, Edward L. Murtin, and Alfred W. Jones, all of same place. Filed Jan. 6, 1890.

435,896. Electrical Indicator. John W. Howell, Newark, N. J., assignor to the Edison Lamp Company, Harrison, N. J. Filed Mar. 30, 1889.

435,897. Electrical Controlling and Operating Apparatus. Edward H. Johnson, New York, N. Y., assignor to the Interior Conduit and Insulation Company, same place. Filed Oct. 19, 1887.

435,898. Electric Controlling and Operating Device Edward H. Johnson, New York, N. Y., assignor to the Interior Conduit and Insulation Company, same place. Filed Oct. 19, 1887.

ELECTRICAL ENDOSMOSE AND GOUTY CONCRETION.

At a recent meeting in Berlin of the International Medical Congress, a communication from Mr. Thomas A. Edison on the title subject was read.

Having ascertained that gouty concretions are in many cases medically treated with the aid of lithium salts taken internally, says Mr. Edison, with the object of causing urate of lithium to be formed, dissolved, and excreted from the body; and being also informed that the difficulty met with in the treatment was in ensuring that the salts so administered should be absorbed into the system, it occurred to me that perhaps more rapid success might be obtained if the application were made externally, employing the well-known principle of electrical endosmose to carry the lithium into the tissues. This method of operation appeared to offer considerable hope of success, because the lithium would be brought directly into the neighborhood of the concretions and would thus be more likely to act promptly and effectively.

Electrical endosmose, as the name implies, is that property of an electrical current passing through a porous diaphragm between two solutions, in virtue of which one solution is mechanically transferred across the barrier. The current seems, in fact, to accelerate the diffusion which always takes place between solutions separated by a porous diaphragm, and at the same time acts in one direction, the solution being carried from the positive to the negative pole, from the anode to the cathode. A full description of the phenomenon is given in Wiedemann's "Die Lehre von der Elektricität."

To test the possibility of causing lithium salts to pass in this way through an animal membrane, I made the following experiment:—

A glass funnel of 7.5 centimetres diameter at aperture was closed by a piece of sheep bladder 0.012 cm. thick, thus providing a porous diaphragm of 44 sq. cm. area. This funnel was inverted and filled with slightly acidulated water, and a platinum wire passing down the tube formed the negative electrode. The whole was then immersed about 1 cm, below the surface of a 2½ per cent. solution of LiO_2 contained in an evaporating dish above the bottom of which it was supported about 1.25 cm. Immediately after immersion, a second platinum wire forming the positive electrode was dipped in the dish, and a current of 150 milli-amperes sustained steadily through the apparatus for 75 minutes. The funnel was then removed and emptied. Its contents were mixed with a solution of $NapO_3$, and the mixture evaporated to dryness The residue was then treated with water to dissolve the sodium salt and then left for 12 hours. The final precipitate was found to contain 0.5 gramme of $LiPO_3$.

The experiment was then repeated under precisely similar conditions except that no current was passed through the apparatus and diffusion only could be active in transferring the salt. The analysis in this case showed that 0.3 gramme of lithium phosphate was present, from which it was presumed that in the previous instance the current had increased the diffusion transfer to the extent of 67 per cent.

Finding the experiment succeed with a membrane, I next tried whether a healthy man, after being subjected to such a course of treatment as a patient suffering from concretions might be expected to undergo, would not give indications of the absorption of lithium in his excretions. In October, 1889, J. D., an active healthy laborer, aged 20, and of 140 lbs. weight, was operated upon in my laboratory. He sat in a chair and kept his hands immersed to the wrists in glass jars, one containing a solution of 2 per cent. lithium chloride with a platinum electrode, and the other containing a solution of common salt with the negative electrode. The current passed through him was 4 milliamperes, which was as much as he could conveniently stand. This treatment was continued for about two hours daily during one week, the total time of application amounting to 11 hours. His urine was collected during that week, and tests were then applied to it. Using a particular spectroscope and method, it was found that a solution containing $\frac{1}{40000}$th part by weight of LiCl in water was just detectable by a faint red band in the spectrum. No such band could under these circumstances be discerned from the urine itself, but a condensation of all the week's urine reduced to the form of chloride gave a distinct band An evaporation of $\frac{2}{3}$ths of the total quantity of this liquid yielded on analysis 0.22 gramme of lithium chloride, and it was therefore presumed that the whole amount of salt excreted was 0.55 gramme, corresponding to 0.09 gramme of metallic lithium, or equivalent to the removal of 2.43 grammes of uric acid.

I next tried the application of the method to a patient suffering from an acute and typical form of the malady, in December, 1889. This person volunteered to try the effect of the method. He was 73 years of age, and had lived an active healthy life until ten years previously, at which time, according to his own statement, he contracted the disease through sleeping in damp sheets. Concretions commencing continued to increase slowly until they assumed large proportions. All the joints, except the knees, were much enlarged by atheromatous concretions. A certain degree of venous congestion was visible in his face, and incessant pain had supervened in various parts of the body during the last few months, apparently from the pressure of the calculi upon the nerves. The joints of the fingers were almost obliterated by concretion.

The girth of the little finger of the left hand was by careful measurement, 8.6 cms., that of the corresponding finger on the right hand even greater. There was great weakness and difficulty in walking, but the mind was clear and intelligence unimpaired.

Treatment was commenced in the manner above described. The current generated from my laboratory 120 volt dynamo, passed through about 5,000 ohms resistance, and entered a jar containing an aqueous solution of lithium chloride, density 1.08, in which the patient immersed his left hand up to the wrist. His right hand was similarly immersed in a solution of common salt. The current, after passing through his body, left the latter jar by a negative electrode. It was found that he could stand 20 milliampéres without inconvenience, and this strength of current was steadily applied for six days during four hours daily. At the end of that time the girth of the left hand little finger was distinctly reduced to 8.2 cms.; the patient also experienced freedom from pain after the first day's treatment. He continued the treatment for two days more during the week following, and then the journey to and from the laboratory exhausted his strength. The finger girth, after 14 days from the date of commencing treatment, was 8.0 cms., a total reduction of 0.6 cm. This was estimated to represent a reduction of 3 ccm. of concretion on this particular finger, whose form facilitated accurate measurement. His general condition, beyond the weakness resulting from unaccustomed journeying, was temporarily ameliorated.

From these experiments, I think it fair to conclude that satisfactory use can be made of the principle of electrical endosmose in such cases.

It should be mentioned that lithia was first tried in the bath solution, and given up on account of its caustic effects. Even an aqueous solution of 1 per cent. of lithia was found to blister the hands after some continued immersion. It would, therefore, have been necessary to employ a very weak solution, had its use been retained, with a corresponding lengthened course of treatment, but time did not allow of. The chloride was used in the expectation that it would be decomposed within the cuticle during the act of endosmose by electrolytic action, or that, failing this, it would enter into a direct combination with the uric acid.

THE LIVERPOOL ELECTRIC RAILWAY.

In a few months there will be opened in Liverpool the overhead railway worked by electricity, says the London *Electrical Review*, which will occupy the proud position of being the first of its kind attempted in England. Last year a few Liverpool merchants met together to discuss the advisability of erecting a railway which would meet the wants of a rapidly growing traffic. As a result, it was decided to commence the erection of an overhead railway worked entirely by electricity. It was not until the close of the year, however, that operations were fairly commenced. Now the work is being pushed on with great rapidity, and many of the girders are fixed in their places.

The railway, when completed, will consist of a wrought iron viaduct about six-and-a-half miles in length. Columns, composed of two channels and rivetted plates, support the superstructure. Stations are to be placed every half mile, at the points where the population lies thickly, from thence any place on the line will be reached in a few minutes. It is the intention of the company to charge very low fares so that the line may become popular; seeing that it will traverse a working district, this is perhaps necessary, for the revenue will probably be obtained from the lower class fares. The structure will certainly be the finest of its kind, and, as a viaduct, is the longest in the world.

The exact system of electrical propulsion is not yet defined, but there is sufficient guarantee as to the soundness of the technical work when it is mentioned that Sir Douglas Fox and Mr. J. H. Greathead are the engineers.

The Generation of Electricity by the Tide.—A French engineer, M. Decœur says the London *Electrician*, proposes to supply electric power to Paris by utilizing the flow of the ebb and flood on the coast. For this purpose he intends to construct, near Havre, two large basins joined to each other, into one of which the sea at flood-tide flows over a dam, while during the ebb it flows out of the other into the sea again. At the inlet and outlet M. Decœur proposes to erect a number of powerful turbines for transmitting the energy of the water. The mechanical enegy thus produced M. Decœur estimates with a tide of 18ft., which is the average at Havre, at six horse-power per hectare of basin area. He intends parting off by means of a dam 16½ miles long an area of 7,000 hectares between Havre and Tancarville from the sea and the Seine respectively, and thus creating 42,000 horse power, which power he transforms into electrical energy and transmitts to Paris. M. Decœur's scheme is looked upon with favor, and although the estimated net profit of 8,500,000 fr. is too high, the *Morning Post* says that there are indications that it will ultimately be carried out. In his Presidential address to Section A at the British Association Meeting of 1881, Sir William Thomson pointed out the impracticability of such schemes; and on the subject of building dams said, "if so much cou'd be done, it would in many cases take only a little more to keep the water out altogether, and make fertile land of the whole basin."

Any one who passes by the great Edison Laboratory at Orange, N. J., by night, is apt to find the lights burning, no matter what the hour. Edison is an indefatigable worker, and he pays little heed to the passage of time when occupied with a new experiment or some fresh investigation.

Water Power.—The Johnstown, N. Y., Electric Light and Power Company possess an excellent water power for the operation of their dynamos. The water used has a head of 75 feet.

Electric Railway at Prague.—The Town Council has granted a concession for an electric railway from the Belvedere to the Baumgarten.

ELECTRICAL NOMENCLATURE.

In regard to the proposition made at the meeting of the Institute of Electrical Engineers, in this city, last June, to connect the names of Franklin and Henry with some electrical units, Mr. J. A. Fleming, in a communication to the London *Electrician*, says :

I venture to think that this proposal deserves attention. The British Association Committee on Electrical Standards committed itself last year to the adoption of the term *quadrant* as a name for a practical unit of self-induction, and in face of the fact that private enterprise had already coined and set in circulation the name "secohm" for that of a practical unit of the same nature. Both these terms involve a departure from the principle first suggested by Mr. Latimer Clark and Sir Charles Bright, in 1861, and adopted by the British Association Committee in 1862, of forming the names of practical units out of the surnames of distinguished investigators.

Objection has been taken to the term "quadrant" in that it conveys the notion of *a length*, and that it is not desirable that the name of a unit should convey the idea of its dimensions on a particular system of measurement, which now is but to-morrow may be replaced by some other mode. I will not discuss the *pros* and *cons* of this point, but limit myself to the suggestion that the practical unit of self induction in the system of measurement which employs the ampère, volt, and ohm, etc., as units, should be called a *hen*. Henry first actually observed the effect and invented the term "self-induction," and used it in a memoir published in the *American Journal of Science*, in July 1832 ; whilst the account of Faraday's investigations on the extra current was not published until December, 1834. Henry has, therefore, every claim to be considered as the discoverer of the fact and the inventor of the name ; and in employing this short monosyllable for the name of that practical unit, we shall do justice to his work, and bestow upon the unit a name which carries no suggestion of dimensions, and which is susceptible of being used in such compounds as *microhen* and *millihen*, convenient for subdivisions of the unit. There is nothing to prevent any one from speaking of true *hens*, or legal *hens*, or British Association *hens* if it is required to be very precise. Instruments for the measurement of self-induction would be appropriately called *henmeters*, and the act of measurement, *henometry*. There is more difficulty in recognizing the mode in which to embalm the name of Franklin ; but I desire to point out that, if a place should be found for him in our Pantheon of units, there is yet another, namely Gilbert, who deserves not to be forgotten. With diffidence I offer some suggestions on a magnetic nomenclature which will give opportunity to use them both. We want two practical units : one of magnetic induction, and the other of magneto-motive force (M.M.F.).

It may be questioned whether our time honored phrase, "number of lines of magnetic force" (or of induction) is entirely satisfactory from a practical point of view. The machinery of tubes of induction, surface integrals, etc., is admirable for its purpose, but it is much more suited to the class-room than the workshop.

It is also equally open to question whether the conceptions of magnetic force and magnetic induction derived from ideal visits to imaginary and exquisitely narrow crevasses in magnetized iron, the explorer being furnished with tiny imaginary "free poles" for experimental purposes, are of a nature best suited to assist actual magnetic engineers. Let us suppose all this for the moment set on one side, and, adopting ideas well expounded by Mr. Bosanquet in the *Phil. Mag.*, for 1883, Vol. XV., p. 205, consider only magnetic induction as something produced in the iron by magneto motive force, just as current is produced in a circuit by electro-motive force. Magneto-motive force is produced in a magnetic circuit by linking it with current-turns. Let us dismiss the term "magnetic resistance," objected to by some on the grounds that "resistance" involves ideas of dissipation of energy, and speak of the *magnetic pliability* of a magnetic circuit to indicate its capability of experiencing magnetic induction under impressed magneto-motive force.

Then, further, let it be granted that the total magnetic induction in a magnetic circuit is measured in *gilbs*, and that the gilb is the unit of magnetic induction, one gilb being equal to a hundred million C.-G.-S. units of induction, and being defined by the condition that a uniform rate of change of induction in a magnetic circuit of one gilb per second produces an electro-motive force of one volt in an electric circuit linked with it. Let magneto motive force or difference of magnetic potential along a magnetic circuit be measured in *franks* and let one frank be defined by the condition that a uniform slope of magnetic potential along a magnetic circuit of one frank per centimetre of length produces magnetic induction of one gilb per centimetre of cross-section in that circuit, when that circuit consists of material of unit pliability (permeability).

What is now called "the induction" (B) will be called "density of or intensity of induction," and be expressed by gilbs per square centimetre.

The magneto-motive force will be expressed in franks or microfranks, instead of $\frac{4\pi}{10}$ times the ampere-turns (one microfrank = 80 ampere-turns) ; and the general relation between the magnetic quantities will be that the density of the magnetic induction in a closed magnetic circuit uniformly acted upon by M.M.F. is proportional to the magneto-motive force per unit of length, and to the magnetic pliability of the material of that circuit.

Magnetic pliability is a constant quantity (taken as unity in measurement) for all non-magnetic circuits ; but in ferro-magnetic circuits it is a function of the induction or of the magneto-motive force. Tables can be made out from the observations on permeability at various inductions, giving the pliability of different kinds of iron for magneto-motive forces of different magnitudes applied in particular ways.

Suppose, for example, that a ring is wrapped over with insulated wire, and that there are 100 turns of wire on it, and that a current of 8 amperes is sent through it ; there are 800 ampere-turns, or 10 microfranks of magneto-motive force impressed on that closed magnetic circuit uniformly. Let the length of that annular solenoid be 100 centimetres. The slope M.M.F. is $\frac{1}{10}$ microfrank per centimetre. Hence, if the ring is of wood or brass, for which magnetic pliability is unity, we have that the density of induction in the circuit is $\frac{1}{10}$ of a microgilb per square centimetre of cross section. If the ring is of soft iron, proper tables would tell us that the magnetic pliability of soft iron under an impressed magneto-motive force of $\frac{1}{10}$th microfrank per linear centimetre is 1,200 units, and hence that for such iron ring the density of induction is 120 microgilbs per square centimetre (12,000 C.-G.-S.).

If the iron ring has a cross-section of two square centimetres, and is wrapped over also with 10 turns of secondary wire, and the primary current is completely reversed in $\frac{1}{100}$th of a second, the rate of change of total induction through this secondary would be approximately 480,000 microgilbs per second, and create in the secondary a mean electromotive force of nearly half a volt during the time the uniform rate of change of induction was proceeding.

These rough suggestions will perhaps show that from a practical point of view calculations for dynamo and transformer work might be simplified by the use of such units. The employment of a properly simplified nomenclature for the magnetic units will be a gain, and some such modifications as I have attempted to suggest are wanted for workshop use. One cannot readily teach workmen to handle formulæ bespattered with 4π and 10^8, μ and B ; but the conception of ampere turns (80 of which constitute a unit) wrapped around an iron magnetic circuit, whether dynamo magnet or transformer core, acting to produce a certain density of something called induction (measured in gilbs), more or less according to the magnetic pliability of the material, grafts on to existing experience with electric currents, electric pressure, and electric resistance, and only wants a proper set of units and names to make it adapted for every day use.

Train Lighting in Australia.—The Railway Commissioners of Sydney have recently made a very successful experiment in connection with the lighting of railway cars with electricity. The system now introduced is exceedingly simple. Two accumulators, each containing 14 Crompton cells, and weighing about half a ton, are placed under the carriage, and at convenient distances between the bougies. These are charged from the dynamos at Redfern required for the electric lighting of the station, and they are calculated to feed the 16 candle power Thomson-Houston lamps for about 14 hours. The *Sydney Mail* says that it was decided to use the Crompton cells, because they take up much less space than any other, are of less weight, are more perfectly insulated, and are more easily recharged. The system is completely under control, and the power of the lights can be regulated at will ; and, what is of importance, the cost, it is estimated, will not exceed that of gas. The Commissioners first of all intend to apply the change to the sleeping cars attached to the express, and then probably one of the suburban trains will be lighted throughout by electricity. In the summer time the change will be appreciated, for the heat of the cars at night will be materially lessened.

We have received a descriptive circular, catalogue and price-list, of the Weston Standard Portable direct reading voltmeters, ammeters, milli-voltmeters and mil-ammeters for direct current circuits, made by the Weston Electrical Instrument Co., Newark, N. J. This valuable little book gives considerable information regard these important instruments. They are direct reading ; all scale readings given at zero ; the instruments are remarkably "dead beat ;" there is no "magnetic lag ;" the temperature correction is negligible ; the instruments can be kept in circuit any length of time as the heating effect, it is said, except in the higher ranges is so small as to be unappreciable. In the voltmeters provided with a calibrating coil changes in scale value resulting from extensive injury are easily checked. The respective parts of the instruments are made to gauge, and are therefore interchangeable. Copies of the catalogue can be procured upon application.

Monopoly of Gutta Percha.—The President of Liberia has issued a proclamation, securing to the Liberian Concession Company (providing they comply with certain conditions previously agreed upon) the sole right of exporting all caoutchouc or rubber or gutta-percha gathered or collected within the Republic ; and also announces that the violation of their said right by any individual shall be deemed a misdemeanor punishable by a fine.

Bimetallic Conductors.—The Administration of Posts and Telegraphs, France, is about to make a trial with the Durand system of bimettallic telegraph and telephone wires, composed of red copper with steel cores.

Prosperity in theirs.—The business of the Fort Wayne Electric Light Company has increased to such proportions that it has been rendered necessary to enlarge their factories in order to keep up with their orders.

Electric Lighting at Berlin.—The electric light is to be adopted at all the railway stations in Berlin and its suburbs.

CORPORATE ORGANIZATION.*

BY E. J. HALL, JR.

Corporations have been called "artificial persons," owing their existence to the creative power of the State, and designed by process of law with more or less skill to approximate natural persons in their powers and duties.

When the legislative powers are exercised wisely and skillfully and those artificial persons have been properly constructed, they take their place in society as most useful members, serving the needs of the public in many ways with far greater efficiency and reliability than any natural persons possibly could; for while it may be true that corporations have no souls, it is equally true that they are not subject to paralysis or indigestion.

On the other hand, their design being subject to the fancy of legislative bodies, these artificial persons are sometimes over developed in some directions and lacking in others—the builder who follows the legal specifications often finding that parts essential to some material function are wholly omitted while others are so dwarfed or magnified as to be out of proportion to the symmetry of the intended design.

In the early days of these, now members of society, the natural persons then composing it had a feeling of, perhaps, not unnatural alarm that if these artificial persons became too big or too numerous they might be troublesome neighbors. What, for instance, if the power which gave them legs and arms should take a notion to add cloven feet, horns and a tail?

This has from time to time occasioned the introduction of various restrictions into the specifications, some of them doubtless wise, others unquestionably unwise; but with a realization of the fact that society had not lost, and could not lose, the power to protect itself, has come to a better understanding of the benefits, to be derived from properly constructed corporations and a disposition to formulate the specifications so that their construction shall be encouraged and their capacity for work utilized to the fullest extent by society.

The tone of the press during the recent labor troubles on the New York Central Railroad reflects a marked change in public sentiment from that existing even a few years ago, and, to some extent, this change is due to a better understanding on the part of corporation managers of the obligations which rest on them to so organize their forces that the public shall be efficiently served, stockholders receive proper returns and last but by no means least, that employés shall be justly compensated and fairly treated.

To organize and conduct a corporation so as to fully meet all these obligations is no easy task. In my own work I have been greatly helped by making diagrams of any proposed arrangement of forces, for the purpose of studying from that the exact relations which would exist between various departments and employés if the plan were carried into effect.

Almost invariably the study of a diagram brings out unexpected defects of arrangement or suggests changes which would improve the efficiency of the force. President Sargent has asked me to explain this diagram system, and I am glad to comply with his request, because I believe there is for us no more vital problem than the best method of constructing the "artificial persons" who are furnishing the public with its telephone service but for whose actions we are all largely responsible.

I do not see why we should not go at this just as we would at the construction of any picee of mechanism. Surely it is more complicated and more delicate than any of our electrical apparatus, and, at the same time, its motions are attended with such consequences that we cannot afford to make any mistake.

When we undertake to prepare plans and specifications for the construction of an "artificial person" to conduct the business of a telephone exchange we must look, first, to the statutes of the State, in which we will find the legal specifications. From them are prepared the charter, articles of incorporation, which, in a general way, define the nature of the proposed corporation and the position which it desires to occupy in relation to the State, while the by-laws, which are to some extent controlled by statute, provide, generally, for the relations of the corporation with its stockholders.

By the articles of incorporation and the by-laws provision is made for the control of the corporation by trustees or directors elected by the stockholders, and by certain officers, usually a president, secretary and treasurer, elected either by the stockholders or by the directors. These officers are common to all corporations, and are charged with certain duties by the State and by the by-laws.

It would be interesting to go more fully into the relations thus established between the new corporation, the State which gives it being and the stockholders who risk their fortunes on its success. We will not, however, stop to do so now, because we are considering to-day only the executive forces, the *physical structure* of our "artificial persons." The functions of the officers named will be considered only as they relate to the performance of the work for which the forces are to be organized.

The unit of work, that is, the amount which can be performed by one person, is very small, so we must subdivide until each part of our work receives its proper share of attention; but, as all of the parts are inter-related, it is evident that there must be somewhere a single central authority, for the division means chaos. From this central authority there must be a direct line of communication to every department and every employé; no matter how many departments or employés there may be, this line must be kept in good working order, free at all times from breaks and crosses.

To carry our simile of the artificial person a little further: When in a natural person the stomach wires the brain for supplies, the feet must receive orders to move toward them, first one, then the other; they cannot be left to argue between themselves as to which shall move first; then the hands must do their work and, at the right moment, the mouth must be ready to do its part, and so each member performs its office as the orders are sent over the connecting lines, and reports from each keep the brain constantly advised of the manner in which its instructions are being carried out.

To construct a diagram of these lines of communication will help us to see how best to arrange the various parts of our artificial person to secure as exact results.

For convenience we will call this main line "Line of Authority," and extend it unbroken from the management to each employé. Other lines there may be and must be to unite all the parts of our mechanism into a complete working body, but they must never be mistaken for or tangled with the line of authority or confusion will follow.

On the diagram which I have made, we can trace (pointing to diagram) now the line of authority originating with the stockholders, extending to the Board of Directors, then to the President, then to the General Manager, and dividing at that point, branches extend to each department chief and through him to his subordinate officers, superintendents, managers, foreman and so on until it reaches the last messenger boy.

The general office is particularly the department of the general manager. Its work consists, *first*, in receiving and recording the orders of the president and directors and transmitting them to the proper persons for execution. With the orders must go to the funds and materials for carrying them into effect and the details of the methods to be followed. *Second*—To the general office must come back the reports and results of all work, which must be recorded and transmitted in proper shape to the directors. *Third*—Through the general office all arrangements must be made for *transfers* from one department to another.

The General Manager acts as the connecting link between the authority which shapes the plans and controls the policy of the company, and forces which carry those plans into effect. He should be identified as closely as possible with both, and this is often accomplished by making him a member of the Board of Directors, thus enabling him to fully understand the nature of the results to be accomplished, while, at the same time, his close relations with the working forces enable him to keep the Directors fully informed as to the conditions of the company's plant and forces, their possibilities and needs for accomplishment of any desired result.

The General Manager, as the diagram shows, has no authority over the Secretary, Treasurer, Auditor, or any employé on the President's line, but such relations as are necessary must be established by order of the Directors or the President, unless, as is often the case, the General Manager is also Vice-President, in which case his relations are established by the *latter position.*

This distinction is important, and it applies equally in the case of all relations between officers and employees of different grades when one person fills two offices not on the same "line of authority."

The General Manager should be responsible for the appointment of all employés on his staff or below it, but it does not by any means follow that he should in person select all individuals for appointment; on the contrary, holding a veto power over all, he should select none but his personal assistants, and the heads of the departments, for the same reason which makes it necessary for him to control all appointments makes it necessary that, following the line of authority, and, conversely, of responsibility, each other officer should, so far as possible, hire and discharge all for whose efficiency he is immediately responsible.

Just here I want to point out the error which all of us who have charge of a number of men are apt to fall into: That is, of doing too much detail work, too much *work* I was about to say, but it is the quality not the quantity generally at fault. It is often so much easier to do personally than it is to touch others, that we fall often insensibly into the error of doing routine work which others can do as well or better; and, having filled our day with arduous labor, go home at night tired but satisfied that the day has been well spent, when, as a matter of fact, we have perhaps lost sight of our duty to keep track of and direct the work of others, and have performed the work of a junior clerk, while the interests committed to our charge have suffered in all directions from neglect.

The functions of the Construction and Operating Departments, with their various sub-divisions, are so well understood by all that it is unnecessary to go into details, and we will follow quickly along the line of authority through the office of the General Superintendent to the linemen on one side, and on the other to the operator and messengers.

Now, to pass on one point of the diagram to another, we must follow back and around on the established lines. There must be no cross lines of authority established, or immediately there is a division of responsibility. This does not mean that there are to be no direct relations between officers and departments, except over the route of lines of authority. On the contrary, as I have already said, there must be almost innumerable "lines of relation." These lines may be established in two ways. First, by order of some common superior authority, and, second, by an understanding between the employés concerned.

For instance, by order of the President, the Treasurer might be authorized to use office

*Paper read at the twelfth meeting of the National Telephone Association at Detroit, Sept. 9, 1890.

managers to collect certain accounts or pay certain bills. The Treasurer would then have a line of direct relation established with each office manager, but the authority would originate with the President, and his order would pass through the hands of the General Manager, General Superintendent and Superintendent of Exchanges, to the office managers. Authority given to the Treasurer to employ the managers would always be given with the tacit or expressed understanding that the regular duties of the employé called on should not be interfered with, and that the employé's first duty was in every case to his immediate superior.

As an instance of the second sort, it might be arranged between the Construction Department and the Equipment Department that one would do certain things in connection with the other's work ; for example, that the Equipment Department, would hang a cable which the Construction Department was responsible for hanging. The test of this transaction would come in case of failure to carry out this understanding. Would it be any excuse for the Superintendent of Construction to say that the Superintendent of Equipment had promised to hang the cable, and had failed to do it? Clearly not. The diagram shows how such an arrangement could have been made by authority. He took the chances of an arrangement under which he had no control over the other party, and he accepted all the responsibility.

In a bad organization this constant shifting of responsibility is always found, and the blame should be with the organizers rather than with the employees, who are probably doing the best they can with the faulty system.

Another fault always found in a bad organization is a defective method of giving orders. Sometimes an organization that otherwise would be good is demoralized in its work by a careless habit of giving vague verbal orders, a practice sure to result in confusion.

Whenever practicable, orders should be given in writing ; they should be brief and clear, and whatever is to be left to the discretion of a person carrying out an order should, if possible, be so stated. Advice and suggestions may be verbal, and often are better so. When an order is accompanied by advice or suggestions as to methods, care should be taken to so separate the order and the suggestions that there may be no misunderstanding.

When verbal orders of any importance are received by any employé he should take the earliest opportunity to reduce them to writing and send an acknowledgment of them, explaining his understanding of their nature, to the officer from whom they were received.

The chart which I have made shows substantially the general organization of a large company, but one which operates a comparatively small territory. Of course a chart prepared for one telephone company or exchange would not be suitable for all others, or perhaps, for any other ; but there are certain functions which are common to all and modifications can easily be made to fit all conditions.

The key note of all successful organizations is sounded in the Bible words : "No man can serve two masters." In the abstract we doubtless all agree with this, but in practice we often make discord instead of harmony among the delicate strings which bind our forces together. It is easy to say that we all arrange our forces so that no man shall serve two masters, but it is far from easy to do it. Especially is it difficult in a small company where the number of men must neccessarily be limited, but where the manifold duties of the service must still all be performed. Even in the larger organizations it is far easier to cross and tangle the lines than it is to keep them straight. The diagram system will aid the manager of a small company to arrange his men to advantage, while to the manager of a large company it will act like the "deadly parallel column" in the newspaper, pointing out all inconsistencies between theory and practice.

Our work of organization and administration is, under the most favorable conditions, perplexing and difficult. Lines must be built, offices equipped, apparatus designed and constructed, records kept, rights of way obtained, reports made, supplies purchased and taken care of, problems legal, financial, scientific and practical solved, and withal we must reckon with human nature in all its varied forms. Each unit of the vast aggregation must be placed where it wi l be most beneficial to the whole and yet each be so dealt with that personal pride and self interest shall be considered, faithful service and capacity duly rewarded, the ignorant educated, the idle punished, the vicious and incapable eliminated, and over all strict discipline, tempered with sympathy and kindness, maintained. Only a thorough organization, wisely administered, can accomplish all this. Without organization the ablest will fail and with it the best will often fall far short of their ideal.

When we have constructed our "artificial person" from drawings which clearly show the location and relations of all the parts and from specifications which define in exact language the function of each, it may still lack much of the perfection of the natural person, but I am sure it will do its work with far more efficiency and vastly less disturbance than if it be simply an aggregation of unrelated parts tangled together by the old-fashioned "rule of thumb" method.

TELEPHONE CONVENTION NOTES.

The National Conduit Mfg. Co. had on exhibition some samples of their new style of Telephone Conduits.

The Ansonia Brass & Copper Company, was represented by Mr. Gilbert M. Smith, the Western Manager of that concern.

The Washburn and Moen Manufacturing Company, of Worcester, Mass., distributed neat little pamphlets giving considerable electrical information of value.

The Long Distance Telephone Company had two sets of their telephone apparatus on exhibition. One was of the upright pattern and the other of the table style.

Mr. James F. Kelly represented the wire department of the Edison General Electric Co. and also the Edison-Lalande battery of which three cells, one each of the 15,50 and 150 ampere-hour types, were on exhibition.

J. H. Bunnell & Co. of 76 Cortland street, were represented by Mr. J. J. Ghegan, who exhibited a score or more of cells of the celebrated Burnley dry battery which we described and illustrated in our last issue. An electo-medical instrument was also shown. This instrument is handsomely and compactly gotten up, the whole apparatus, including one cell of the Burnley dry battery, being on one base. Another valuable use to which the cell can be put was shown by the lighting of a four candle power incandescent lamp with four cells of battery. The light emitted was remarkably brilliant and lasting. There are now 10,000 cells of the Burnley dry battery in use for telephone work alone.

The Norwich Insulated Wire Company had an extensive exhibition of samples of their spiral wound paper insulated cables in various stages of manufacture. Mr. L. D. Beck, the President of the company and Mr. Jean A. Wetmore were present and explained the details of construction of the company's goods. The insulating material used is somewhat unique in that it is of paper of a special make the manufacture of which is protected by patents. The paper is wound around the conductors in several layers in cross directions, and then thorougly dried by heat. A lead sheathing is then drawn on the outside. In this process the paper insulation is subjected to very great pressure which has the effect of making a very compact and dense fibrous mass, which forms a very excellent insulation. One piece of electric light cable was shown the conductor of which was subjected to a presure of over 9,000 volts without any effect whatever on the insulation. There are now 30 miles of this cable in use in the New York subways, and it is extensively used in the telephone service in Brooklyn, also in Chicago and other cities.

DETROIT LETTER

Detroit, Mich., Sept. 11, 1890.

The Detroit authorities are very partial to the mast system of electric lighting, and there are many of these masts scattered throughout the city. The effect of the elevated lights is very attractive when viewed from the river at night.

The Steamer Frank E. Kirby plying between Detroit and Sandusky, is one of the few lake boats containing an electric light installation. This steamer is lighted throughout by electricity, having 204 lamps in all. The system used is that of the Fisher Electrical Company, and the distribution of the incandescent lamps throughout the cabins is both artistic and beautiful.

It is said that the placing of a duty of 35 per cent. upon mica, as proposed by the United States Senate the other day, will affect the State of Michigan more than any other. The main reason for this is the fact that a great deal of that mineral is used here for use in stoves which are manufactured here in great quantities. Electrical interests will of course be affected somewhat by the duty, and the imposition of the tax is regarded with great disfavor in the electrical trade.

The following is a list of those at the convention :

New York—Jeam A. Wetmore, C. O. Baker, Jr., Henry D. Stanley, Wm. A. Hovey, A. G. Fuller, Frank W. Price, Gen. C. H. Barney, F. A. Magee, J. P. McQuaide, E. J. Hall, Jr., Geo. T. Manson, C. W. Price. E. I. Carson, Geo. A. Hamilton, Thomas R. Taltavall, H. B. Thayer, J. J. Carty, A. S. Hibbard, T. A. Picknell, L. D. Beck. James F. Kelly, J. J. Ghegan, C. E. Stump.

Chicago—C. E. Morley, C. H. Wilson, C. D. Crandall, E. M. Barton, F. G. Beach, Fred. DeLand, Dr. Gilbert, M. Smith, W. Forman Collins, F. E. Degenhardt, A. C. Durborow, Jr., J. W. Dickerson.

Boston—Thos. B. Lockwood, Charles B. Doolittle, J. H. Farnham, J. N. Keller, Francis J. Hovey, H. V. Hayes, A. O. Morgan, Col. D. B. Parker.

Philadelphia—H. S. Hindekeeper, E. A. Westbrook.

Cincinnati—E. V. Cherry, G. G. Hall.

Kansas City—J. O. Stockwell, Chas. W. McDaniels, Paul W. Bossart.

New Orleans—A. W. Crandell.

Albany—A. B. Uline.

Elmira, N. Y.—W. N. Esterbrook.

Louisville Ky.—Capt. H. N. Gifford.

Austin, Texas—Frank B. Knight.

Auburn, N. Y.—H. L. Storke.

Nashville, Tenn.—O. F. Noel.

Salt Lake City, Utah—D. S. Murray, Geo. Y, Wallace.

Cleveland, Ohio—James P. McKinstry.

Milwaukee, Wis.—John B. McLeod.

Buffalo—H. C. Palmer, E. J. Hall, Sr.

Atlanta, Ga.—W. J. C. Cole.

Brooklyn, N. Y.—W. D. Sargent.

Columbus, Ohio—J. E. Zeublin.

Williamsport, Pa.—R. Bailey.

Omaha—C. E. Yost.

Detroit—W. A. Jackson, F. A. Forbes, Frank B. Rae, R. B. Watson, Louis A. Palmer, J. F. Land.

A pocket telephone has been introduced in Berlin. The idea upon which its use is based is that electric bells are found everywhere, and the pocket telephone is to be connected to the bell wires of hotels and hospitals as well as private houses.

TWELFTH MEETING OF THE NATIONAL TELEPHONE EXCHANGE ASSOCIATION.

RUSSELL HOUSE, DETROIT, MICHIGAN, SEPTEMBER 9, 10 AND 11, 1890.

FIRST DAY'S PROCEEDINGS.—MORNING SESSION.

The Association was called to order at 11:30 a. m, the President, William D. Sargent, of Brooklyn, N. Y., in the chair, and C. H. Barney, of New York, Secretary.

President Sargent announced that owing to the absence from the city of the mayor on important business, that official was not present to welcome the Association, as was proposed.

Secretary Barney then called the roll, after which he read his report as follows :

SECRETARY'S REPORT.

NEW YORK CITY, Sept. 2d, 1890.

To the National Telephone Exchange Association:

GENTLEMEN:—I have the honor to respectfully submit my report of this Association for the year ending August 31st, 1890.

At the beginning of the Association year, the roll contained the names of 34 active, 6 associate, and 27 honorary members. The changes during the year have been as follows :

At the Minneapolis meeting the resignation of the Sunset Telephone Telegraph Company, of San Francisco, as an active member, and of Clark B. Hotchkiss as an associate member, were both accepted, and the Callender Insulating and Water-proofing Company was dropped from the roll of honorary members, it having gone out of business.

Mr. A. G. Day, an honorary member, has died during the year.

These changes leave us with a membership at the close of the Association year, as follows : Active, 34; associate, 6; honorary, 25.

There is now in my hands, to be presented to the Association, the resignation of the City and Suburban Telegraph Association, of Cincinnati, as an active member, and of J. A. Roebling's Sons' Co., of New York City, as an associate member.

The office of the secretary has remained at 510 West 23d street, New York City, during the entire year. The usual number of inquiries for information have been received and replied to, and the NEWS LETTER has been regularly issued, semi-monthly, until January 1st, 1890, and monthly since that date. The Treasurer's report will show that the income of the Association has during the past year, considerably exceeded its expenses, by reason of a deduction in the latter. There is now in the treasury a balance of $320.99 as against $66.41 at the beginning of the year. All accounts due the Association have been collected, and all debts of the Association have been paid to the end of the fiscal year.

Total income for the year, $2,009.15
Total expenses " 1,754.57

The report was accepted and ordered filed.

Treasurer H. L. Starke reported an improvement in the Association's finances of about 500 percent. over last year's report, the balance on hand being $320.99.

Mr. Jackson extended an invitation to all in attendance at the convention to participate in a carriage drive on Wednesday, around the city and to Island Park, with a lunch to be served at the Casino. The invitation was accepted with thanks by the meeting.

The next business was the nomination and election of officers. Before proceeding to this duty, President Sargent asked the indulgence of the Association to listen to a few remarks that appeared to him to be pertinent to the occasion of the Tenth Anniversary of the Association. On the 7th of September, just ten years ago, the first convention of telephone men assembled at Niagara Falls. The meeting was the result of a circular sent out some time beforehand, signed by representatives of the leading telephone companies in the United States The object of the convention, as stated in the circular, was, "the formation of a general telephone association to consider the various questions affecting the telephone business and its development." This meeting was organized by the election of George F. Durant as chairman, and E. J. Hall, Jr., as secretary. The roll of representatives showed 86 individuals, representing various companies, 6 representatives of the American Bell Telephone Company, and 21 representatives of manufacturing interests; making a total of 113 individuals. A constitution and by-laws were offered, and various reports and papers were listened to and discussed, after which the convention, on the morning of September 9th, adjourned sine die. Immediately following this adjournment, and on the same day of which this is the anniversary, the first meeting of the National Telephone Exchange Association of the United States assembled. The present constitution and by-laws were adopted, and the following officers elected: President, Geo. L, Phillips; Vice-President, H. H. Eldred; Secretary, M. F. Tyler; Treasurer, D. I. Carson. The Association then adjourned to meet in Chicago on the first Tuesday in April. The subsequent meetings in Saratoga, Boston, Cincinnati, Philadelphia, and so forth, are a part of the history of our business.

Of the original members many have left the business, and a few—but all too many—have been taken away by death, notably our universally esteemed first president, George L. Phillips, and others less dear, and of whom the Association has expressed its appreciation in just and loving tributes to their merits.

Ten years ago, how crude the business was. The multiple switch-board was a mere idea. Tables were only hinted at. The use of iron and steel wires was almost universal. Insulation was considered of little account by many, and some declared insulators superfluous (laughter), the value of the service was underrated by the public, and our standards were far below those of to-day. The highest efficiency and reliability is what the public demand of us, and business and prosperity will follow us just as fast as we are able to meet that demand. The standard of to-day requires the use of copper for conductors, overhead as well as underground, and the substitution of metallic circuits for single grounded wires. The underground wires and cables of five years ago do not answer the requirements of to-day, and the same may be said of central office and subscribers' equipments. With improved service comes increased use by the public and the ability and energies of the best minds in the business may well be taxed to the utmost to keep up with the demand.

This association has in the past been active in the development and extension of new ideas and improved methods, and it is therefore with regret that I call your attention to the lack of interest and the falling off in membership during the past three or four years. The City and Suburban Telephone and Telegraph Company of Cincinnati have resigned, and the active membership is now only 33. The Secretary's request for papers to be read at this meeting met with no response. The papers which we have were procured by personal solicitation on the part of the officers. It may be said, indeed, that outside of the Secretary's statistical report the furnishing of papers to serve as topics for discussion during the last few years has been done by a very few individuals. If the association is to be of service in the future its members generally must take a more active part in the preparation of the papers and reports which form the basis for our discussions.

In conclusion, I desire to thank the association for the kindly manner in which they have treated an inexperienced presiding officer (applause).

The nomination and election of officers was then proceeded with, with the following result :

Officers elected for the ensuing year : President W. D. Sargent, of Brooklyn ; Vice-President Frank G. Beach, of Chicago ; Treasurer H. L. Starke, of New York ; Mr. W. A. Jackson, of Detroit, was elected member of the Advisory Committee for three years, and Mr. E. B. Crandell was elected to fill the unexpired time of Capt. Stone, resigned.

Messrs. E. J. Hall, Sr., of Buffalo, Chas. F. Cutler, of New York, Chas. H. Wilson, of Chicago and H. N. Gifford of Louisville were elected members of the Executive Committee, the latter three being re-elections.

The routine business having been disposed of the reading of papers was taken up.

Mr. J. J. Carty, of New York, in the absence of Mr. Davison, read the latter gentleman's paper. The thanks of the association were voted to Mr. Davison for his paper, after which a discussion took place, which was participated in by Messrs. Lockwood, Wilson, Carty, Gifford, and others.

Mr. Lockwood, during his remarks, said in referring to the telephone exchange switch-board :

It requires the most constant supervision of any electrical instrument that I know of, for many reasons. Each line has to pass through a great number of contacts, and necessarily so. The instruments for receiving calls have to deal with currents which are not strong, and sometimes which have to pass over unavoidably leaky lines which cannot at all times be kept in the highest order of repair. The instruments through which the talking is performed, namely, the transmitting and receiving telephones, do not generate a strong current at the very best, and frequently it is a very weak one—the weakest, as we are in the habit of hearing, known, which is capable of accomplishing any useful result—and therefore I say that the troubles which appear are not altogether, either in number or in variety, greater than might have been expected if we stopped to consider what the current was that we were dealing with, and of the very uncertain nature of all machinery, especially when it is worked to such a large extent as is a central office switch-board.

In answer to a question Mr. Wilson of Chicago explained the use of a single cord board in operation in the Chicago main office. It filled all the requirements for metallic circuits but was not considered so good as the double cord board on account of mechanical details.

Referring to spring-jack troubles Mr. Wilson said :

We found in Chicago, where we have long underground circuits, that the introduction of a small amount of resistance in the circuit makes a very great difference in the talk, and it is particularly apparent from our office why the incoming trunk line business from the branch offices don't pass through the spring jack — through the spring board. The trunk line ends in cords and plugs. The outcoming trunk lines necessarily duplicate through the switch boards, passing through nineteen sections of the switch board and twenty spring jack contacts. If the contacts in the switch board become dirty—not necessarily open, to interrupt the circuit entirely—we notice a difference between the incoming and the outcoming talk, and we have found that a resistance of 200 or 300 ohms in a contact makes a very appreciable difference in the conversation. Some six months ago we organized a labor force to work every night on our switch board, and the series of contacts through the switch board have been measured with a galvanometer, and if a resistance exceeds 150 ohms — that included the drop which is 100 to 130 ohms—the spring jacks are all cleaned. In that way we keep our service reasonably uniform.

Mr. Hibbard—I wish to mention it as a matter of observation in exchanges pretty much all over the country that the dirty jack trouble is moer noticed in places West where they do not burn hard coal and where the whole atmosphere is permeated with dirt and dust ; also, in places where an exchange is located near a railroad yard, where smoke and soot from the engines float in through the windows. I think it may be possible that that is the reason why we do not have so much trouble with dirty jacks in Brooklyn as they have out in

Chicago and Louisville. Why, in the Chicago office, if you enter it you are at once impressed with the fact that it is a dirty office (laughter). In Brooklyn, if a trouble occurred, I should say it was pretty likely to be an open because there is not enough dirt floating in. The Buffalo exchange has l noleum on the floor, and when they want to clean it they simply wipe it off. I think that is a feature that we should all pay attention to, that is, having clean fl ors.

Mr. Barton made some general remarks on single and double cords and switch boards, and in conclusion said: In answer to the question of a gentleman here awhile ago as to whether there are any single boards in use in the United States, I would say that there are a considerable number of such boards, among others, the principal exchanges in Cleveland, one in Cincinnati, one in Providence, one in Columbus, one in Portland, Oregon, one in St. Joseph, Mo., one in Topeka, one in Los Angeles, and perhaps others which don't occur to me at this moment. Those boards are tolerably well liked, I think, by those who have them. There is, so far as I know, however, with the exception of the one which has been mentioned as in use, in a certain sense, experimentally in Chicago—that is, for the purpose of trying it—there is no switch board on the single cord system, and with the best equipment for metallic circuits.

After a humorous reference by Mr. Gifford of the recent arrival of a "beautiful young Wilson" at the house of Mr. Wilson, of Chicago, the convention adjourned until 2 P. M.

AFTERNOON SESSION.

The business of the afternoon was the reading of a paper by Mr. E. J. Hall, Jr, on the subject of "Corporate Organization." To illustrate the subject two large diagrams were displayed, showing in a very clear manner the division of responsibility from the stockholders down to the humblest employé. Mr. Hall explained the points of his paper by frequent reference to one of the diagrams, and Mr. Carty used the other to illustrate the practical operation of his department, which particularly concerned the maintenance of the plant.

Several questions were asked by various members, and answered, after which the meeting adjourned until Wednesday, A. M.

WEDNESDAY'S SESSION.

The convention was called to order shortly after 10 A. M., by President Sargent.

The first business of the meeting was the selection of a place for the holding of the next annual meeting.

New Orleans was selected as the place, and the time is to be left with the Executive Committee for determination.

Mr. W. R. Patterson then read a paper on "The Housing and Care of Central Office Apparatus."

At the conclusion of the reading of Mr. Patterson's paper, Mr. F. A. Pickernell read a paper on a similar subject, both of which papers were jointly discussed.

Mr. Wilson made some remarks concerning the proper location of operating rooms, and was followed by Mr. Hibbard, who thought that the advantages of locating the operating room on the top floor of the building were very great. The operators being on the top floor were out of the way, which was an important point to consider. They would not then be liable to interference.

Mr. Pickernell thought the noise from the street a strong reason against placing operating rooms on the second floor.

Mr. Gifford described the Louisville Exchange, which is located on the second floor.

In referring to the disposition of lightning arresters and testing apparatus, Mr. Hibbard advocated placing them in places which would be accessible at all times. He also made the statement that a perfectly reliable lightning arrester was something yet unproduced.

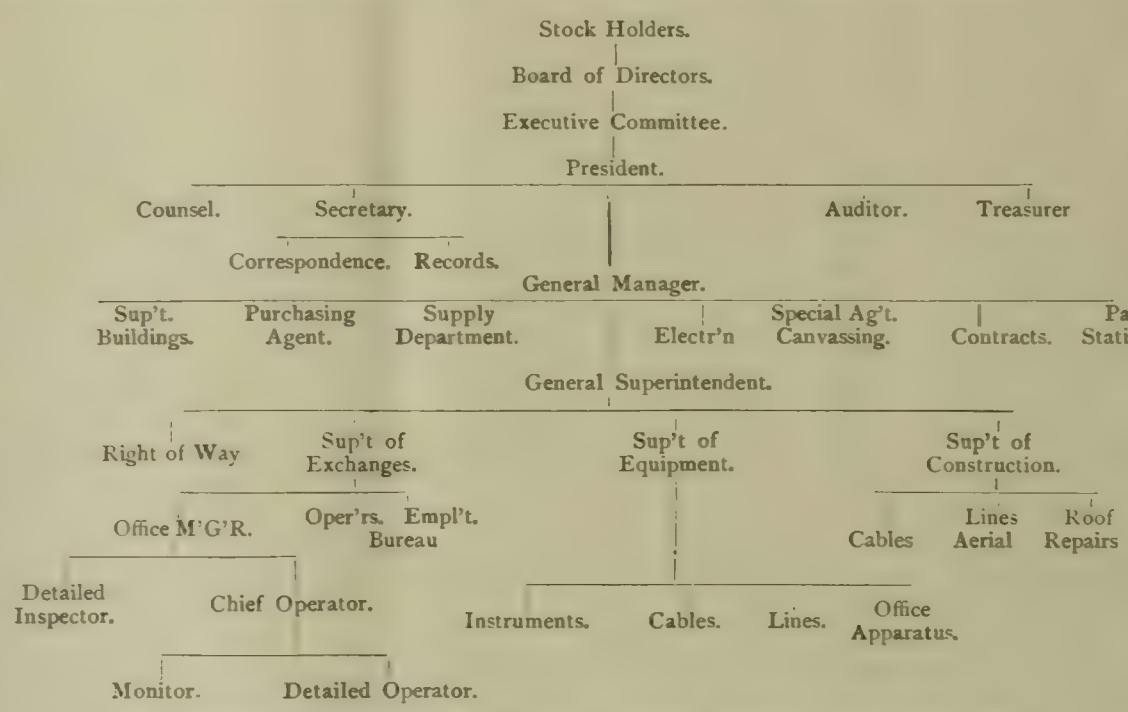


DIAGRAM ILLUSTRATING MR. HALL'S PAPER ON CORPORATE ORGANIZATION.

After the close of the discussion of the papers of Messrs. Patterson and Pickernell, Mr. J. J. Carty explained the operation of the "Bridging Bells" used in the New York Exchanges, which greatly increases the working margin of telephone circuits.

An interesting discussion followed this paper, after which Mr. Wilson described the use of storage batteries in connection with the operation of transmitters in the Chicago Exchange. This system has given very satisfactory results, and its extension on a much larger scale is contemplated.

The Secretary announced the completion of his statistical report, and it was received and ordered filed.

After passing a vote of thanks to the Telephone and Telegraph Construction Company and the Michigan Bell Telephone Company, for courtesies, the meeting adjourned *sine die.*

On Wednesday evening the Telephone and Telegraph Construction Company of Detroit entertained the members of the association at an elaborate banquet at the Russell House. At 8:30 o'clock the entire party, about 100 in number, marched into the spacious dining hall of the hotel and took their seats. It was well nigh midnight before coffee and cigars were passed around. It had been agreed that no toasts would be offered, and that no one would be called upon to speak, but some way or another the agreement was broken, President Sargent himself being the first one to be caught in the trap. Being called on he briefly responded in a few well chosen remarks, and in turn called upon Mr. Tyler from Connecticut.

Mr. Tyler kept the company hilarious with his references to the experiences of the first Telephone Convention, and compared that meeting with the one just held.

President Sargent then invited Mr. T. D. Lockwood to speak on any subject of his own selection. This, ordinarily, is an extremely difficult task to perform but Mr. Lockwood did remarkably well and kept up the fun at white heat.

Secretary Barney next made a few remarks, and was followed by Mr. H. L. Storke, the Treasurer, who evoked a great laugh when he related how during the afternoon drive, Mr. Tyler had been expelled from the park by a policeman because he had his kodak with him.

A few remarks were made by Mr. E. J. Hall, jr. then Mr. A. S. Hibbard, with his neck festooned with a collar of smilax, arose and delivered himself of "Why am I so happy," in words suited to the occasion, the crowd at his end of the table joining in the chorus. Messrs. Zeublin, Gifford, Forbes, Vice-President Beach and Jos. E. Lockwood followed with remarks in the order named, and the festivities were brought to a close by singing "Good Night, Ladies," and "Auld Lang Syne."

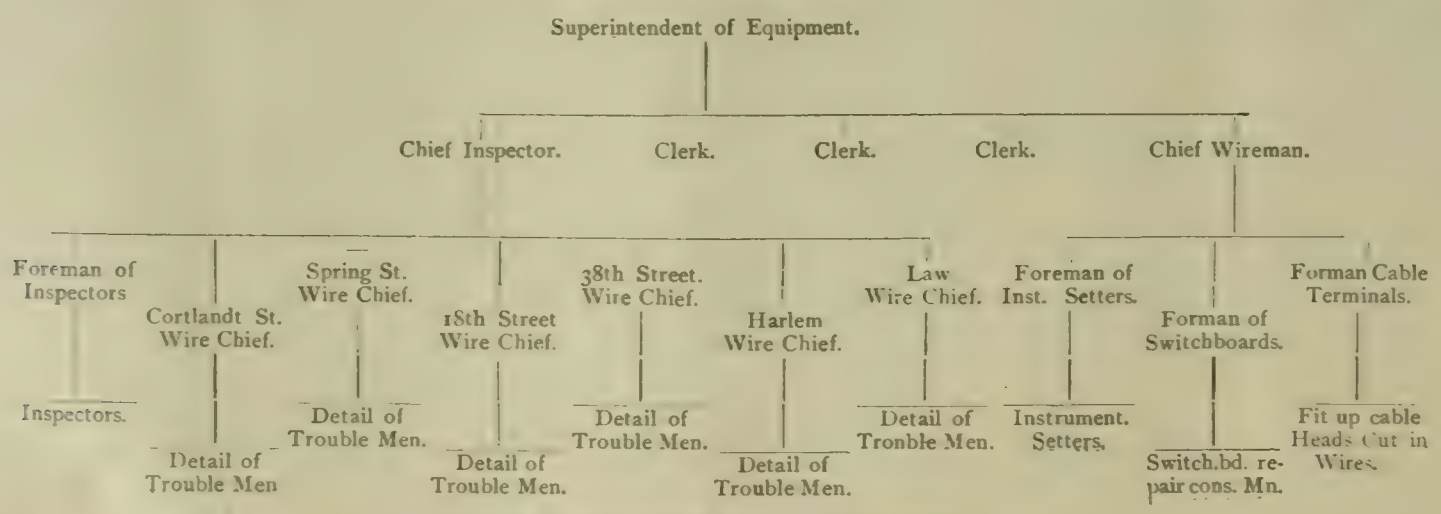


DIAGRAM ILLUSTRATING MR. CARTY'S PAPER.

THE OPERATION OF THE DOUBLE CORD KEY-BOARD AT BROOKLYN, N. Y.

BY GEORGE J. DAVISON.

A year ago, I addressed a somewhat extended report regarding the workings of the new multiple switch at Brooklyn, as then operated with the single cord key board. On account of the troubles therein shown, and because it was essential that we should be able to operate mixed circuits in the multiple board, it was decided to change the key-board from the single cord, grounded system to the double cord metallic. This change was completed early in March, 1890, and the new key-board has, therefore, now been in use for about six months.

The equipment is full metallic, with tubular clearing out drops, retardation coils, condensers, split telephones, etc., etc.

The change required the connection of answering spring jacks which were placed horizontally in the lower part of the switch, necessitating the moving upward of all the spring jacks originally connected. This movement disarranged the switch cable wiring to some extent, and increased the liability to troubles in that particular, but very little has developed.

The wiring of the line drops had to be entirely renewed, they having been wired originally for grounded circuits only.

The number of troubles as shown by the table herewith is very low, and those occurring were almost entirely of a trivial nature, readily located, and easily removed.

In the parts of the apparatus not referred to in the tabulated form, there has been scarcely any trouble. After the change of key boards hadbeen completed, new transmitter cords were put in, none of which have failed; triple receiver cords were necessarily substituted for the double cords, only one of these having failed.

One of the condensers became short circuited, the result of which was to cause all grounded circuit lines to test "busy" whether in use or not.

The split telephones have been very satisfactory, no trouble whatever having been experienced in their use.

Spring Jacks:—We have added 1720 spring jacks to the 15,660 in use last year, making 17,380 now in use. For the first thirteen month's use there were ten cases of dirty contact; for the past six months there have been twenty two cases of this trouble. I think this increased percentage of trouble is due to a considerable extent to the disturbance of the switch cables at the time of changing the system, which set free whatever slight accumulations of dust there was in the cables, no small portion of which found lodgement in and about the spring jacks. None of the springs jacks have platinum contacts, the use of which would, I think, lessen this difficulty.

Drops:—1,770 in use, an increase of 110 over last year's report.

The trouble with these have been much fewer than was previously shown, comparing as follows.

	13 months, 1889.	6 months 1890.
Catch,	26	3
Shutter,	36	8
Armature Trunn'n,	203	None.
Crossed with Core,	6	1
Open in Coil,	2	1
Burned out,	1	5
Broken Wires,	20	8
Total,	294	26

None of these troubles require any special comment, the cause and remedy of each being apparent.

Ringing Keys:—The ringing keys are of the pattern known as long distance metallic, and there are 273 pairs, or 546 individual keys in use. Only five cases of trouble have developed, four of these being a failure to ring, caused by the generator springs not being properly adjusted, being so far away that the depression of the button did not close the contact between the line and generator springs. The remedy was easy and is obvious.

The other case of trouble was where the button, being depressed, would not return to its normal position. This was due to a slight roughening of the sides of the wedge-shaped rubber plunger where the springs rest against it. A little oil applied at the point of trouble was all that was necessary.

Listening Keys:—There are 273 listening keys in use with which there have been forty-one cases of trouble, no one of which, however, was in the main line circuit, or interfered with the subscribers after the correction had been made.

These forty-one troubles may be divided into four classes, as follows:

Failing to cut in operator,	9
Failing to cut out operator,	1
Rubber Plunger sticking,	27
Rubber Pin broken,	4
Total,	41

Failing to cut in operator:—The nine cases of this trouble occurred in the first two months and on account of the springs not having been properly adjusted when they were connected. The springs rested against the rubber plunger and did not close the contacts on the operator's circuit. No recurrence of the trouble after properly adjusting the springs by bending them.

Failing to Cut out Operator:—Only one case of this caused by the rubber pin of the plunger being so short that the "throw" was not great enough to break the contacts.

Rubber Plunger Sticking:—This trouble occurred twenty-seven times, and, as in the case of the ringing key, was where the plunger remained down when cam was thrown forward. It was due to some extent, to a lack of proper smoothness of finish on the wedge-shape sides.

The plunger is pressed upon by two springs on one side and one on the other, the unequal strain having a slight tendency to make it bind. The difficulty was readily overcome by rubbing a little oil on the sides of the "wedge."

Broken Rubber Pin:—Four of the little rubber pins which are acted upon directly by the cam became broken from some unknown cause.

The cams of the listening key make considerable noise when they are thrown forward, and I do not know how this can be avoided.

Tubular Clearing-Out Drops:—Two hundred and seventy-three in use, which have required attention twenty-three times. All of the troubles, except two, were with the catch. The drops are located directly in the rear of and on a level with the cores, the plugs of which, in being returned to their normal position, occasionally strike against and bend to some extent the rather slender catch of the drops, which in consequence fails to release the shutter. The remedy for these troubles after their occurrence, is obvious. To guard against them, the drops should be located elsewhere, which, however, is not practicable in this switch.

The "adjustments" referred to were where the armatures were too loose, requiring the changing of the position of the trunnion binding screws.

Cords:—It appears from the record that only about thirty-five per cent. of the cords in use had failed during the six months. As a matter of fact, a percentage of failures of the cords *actually used* is much greater. Each of the subscriber operators has eighteen pairs of cords available, but habitually used a much smaller number. A half dozen or so pairs of cords being used for the greater portion of the connections, the other pairs in a lesser and lesser degree according to the volume of business.

There were a few failures of the cords at the point of soldering into the shoe, inside of the plug, but the percentage of troubles from this cause is very low.

Almost all of the failures are just at the base of the plug, due to the strain upon the cord in withdrawing the plugs from the spring jacks. The breaking of the tinsels is increased considerably by the perspiration from the operator's hands penetrating the covering of the cords. It is the rule that operators shall withdraw the plugs by taking hold of the same, and not by the cord, but it is almost impossible to enforce the rule on long reaches.

The percentage of cord troubles in the double metallic is very much greater than in the single cord, grounded system. In the thirteen months' use of 1,200 single cords there were only eight failures as against 209 failures in six months out of 576 in use in the double metallic. There are two prominent reasons for this increased percentage; first, because as there are two conductors in the metallic circuit cords the liability to trouble is doubled in the same number of cords, and second, because in the double cord system the use of the cords is so much greater. In the single cord system a cord is not used except to complete the connections for which the subscriber, of whose line it forms a part, may call, which in the double cord system a pair of cords may be used any number of times, in fact, may be used almost continually.

The one case of trouble, "conductors crossed in cord," was caused by abrasion of the insulating material. The effect of such a crossing of the line or test is, that any grounded circuit subscriber's line tested with that pair of plugs would show "busy" whether in use or not.

Plugs:—The troubles with the plugs have not been many, amounting to thirteen in all out of 576 in use.

Four tips of plugs were broken off in the spring jacks due, however, more to accident and a lack of care than to faulty construction of the plugs.

The removal of one of these tips from a spring jack is a somewhat difficult matter when it happens to be broken off when the plug is wholly within the jack, and the tip held fast by the line spring. It is then necessary to relieve the tension of the spring by partially or wholly withdrawing the screw, holding it in place and pushing the tip forward until it is within the sleeve of the "test." From this point I find the most convenient plan of removal to be the use of a short piece of flexible rubber tubing, placing one end of the tubing firmly over the opening of the spring; a quick inhalation of breath rarely fails to bring it out.

Tips unscrewed:—The little rivet used to prevent such troubles has come out of nine plug tips, rendering it unsafe to use the plug until repaired.

Referring to last year's report, it will be seen that in the thirteen months' record, there were 459 cases of trouble with the combination key and 76 with the grounding jacks, a total of 535 in the single cord key board, or an average of a little over 41 per month. The report herewith for six months shows troubles in the double cord key board as follows: Ringing buttons, 5; listening keys, 41; clearing out drops, 23; a total of 69, or an average of 11½ per month. When it is further considered that about forty per cent. of the troubles in the single cord key-board interfered with the subscriber's conversation, after the connection had been made, and that not one of the double cord troubles interfered in this way at all, the contrast is very great

Add to this, too, the great difference in the ease with which repairs may be made to the double cord system, and that the making of such repairs need not interfere with the operator's efficiency nor with any subscriber's line, it seems to me that there can be but one conclusion arrived at.

*Read at the twelfth meeting of the National Telephone Association, Detroit, Sept. 9th, 1890.

Over 40,000 passengers, at penny and two-penny fares, have been carried in the electric launches at the Edinburgh Exhibition.

DUPLEX GAS ENGINES.

BY ELMER A. STERRY.

It was Prof. Fleming Jenkin who first gave to the world the mathematical demonstration of the increased economy attending triple and quadruple expansion in the steam engine. Prof. Thurston, in this country, in his recent paper on steam engines for electric lighting, has pointed out the extremely high theoretical attainment of the latest forms. He says that in fact these have now arrived "to so perfect a condition that the range for further improvement is probably very narrow, and the gain still to be made must come slowly and painfully." The first named eminent authority has further made the statement that "the actual achievement of the steam engine has nearly reached the limit of the possible."

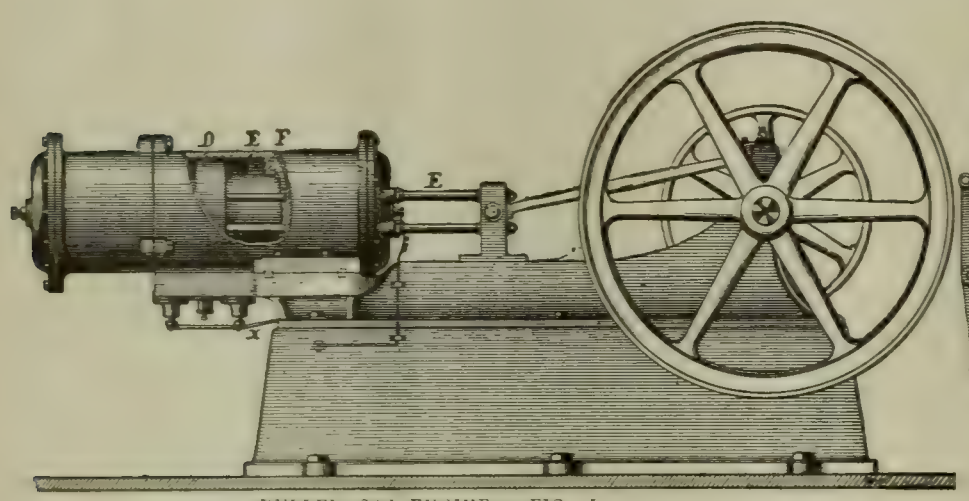
The efficiency of the steam engine when taken as a measure of the recovery of power from the total power-equivalent of the heat employed, following the most improved methods, is only about ten per cent when large units of power are considered. To compare this performance with that of the gas engine it is but fair that we take equal units in either case. In the comparison of the two motors as heat engines, size for size, the actual performance of the gas engine is over two hundred per cent. better than that of the steam engine, with a vast unexplored region beyond in the case of the gas engine, giving promise of great improvement and higher economy than the most excellent perfomance yet recorded.

have its furnace in its cylinder, thereby eliminating the gigantic waste attending latent heat which is encountered in the case of steam. The high performance of 1.4 pounds of coal per horse power per hour in a ten horse power engine compares favorably with from 7 to 12 in the steam plant of equal size.

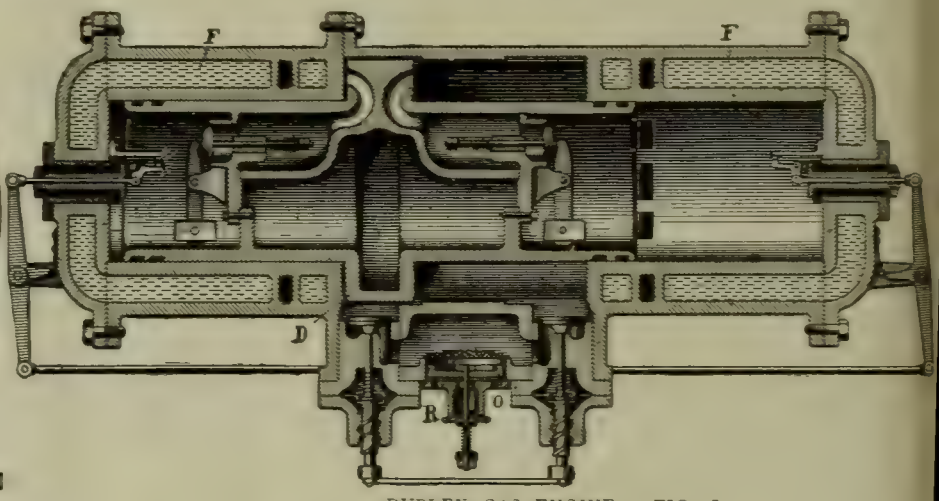
This being true, the question is asked, "Why are not gas engines more sought and employed for ordinary power purposes?" The answer to this question can only be found by a study of the porformance of the present gas engine, noticing the difficulties encountered and the limited application to the more exacting power consumers, and the devices resorted to in the attempt to overcome some of these difficulties. The greatest evil of the present method and cycle of operation in the gas engine, is the want of uniformity of speed in the power developed. This is owing to the fact that usually but one out of four, frequently one out of eight, of the strokes or units of power is available for producing effective results. The others are not only non-productive, but actually consume the energy developed in the one. It is true that engines have been produced that give every other stroke an effective stroke; but this system at best produces irregularity that renders it indifferent for driving more delicate machinery, especially electrical generators for lighting purposes. It is true that dynamos may be driven by existing engines to supply storage batteries with some degree of success. But where direct illumination is required the noticeable irregularity and throbbing prohibits general adoption.

ders, is also a single mechanical element, the two ends being of similar size, forming plunger pistons operating in the combustion cylinders, in the middle of which is an annular enlargement, D, which fits the larger bore of the pump cylinder. The differential area so produced between the combustion piston and the pump cylinder is the area which is available for transferring the gases, and forms the piston area of the pump cylinder. It is to this element, namely, the annular shaped pump piston, that the main piston rods, E, two upon each side, are attached as may be seen in Fig. 1, thereby eliminating the necessity of packing against the high temperatures; the only packing required in the piston rods is against the low pressures of the cold mixture within the pump. It will be seen by Fig. 2 that the two combustion cylinders, A A, are at opposite ends of the compound cylinder. The water jackets are shown at F. Along parallel to the front cylinder are the cored passages, G, in which the two piston rods, E, connecting with the cross head, reciprocate (see Fig. 1). The packing glands, I, are required to pack only against the small pressures of the gases in the pump cylinder. This pressure is so slight as to be wholly disregarded.

The law of operation or cycle of the engine is as follows: The pump is double acting and is provided at either end with an induction valve, below which is a screw, by turning which the seating of the induction valve may be varied. This varies the pressure within the pump, and therefore the amount of mixture transferred into



DUPLEX GAS ENGINE.—FIG. 1.



DUPLEX GAS ENGINE.—FIG. 2

In considering the great problem of transforming heat energy into mechanical and electrical energy it may be well to investigate the laws of operation and working of a system that has already realized so much in the direct line of transformation of heat into mechanical motion.

The gas engine is a hot air engine in which the air as it is drawn into the cylinders is charged with a substance which may at the proper moment yield the heat required to increase its bulk, the confining of which develops the pressures utilized in moving the piston. This increase of bulk on ignition, and the corresponding pressure of the air is from four to five times. Thus if the air or mixture in the cylinder at the time of ignition is 40 pounds, the pressure resulting from ignition is about 200 pounds. The ignition does not cause an explosion, as is usually supposed, but on the contrary the inflammation goes forward until a certain pressure and temperature is reached, and at this point is arrested, and further inflammation is developed as the piston goes forward, and the pressure thereby tends to decrease. The writer has seen cards from gas engines in which constant pressure was developed throughout nearly the entire stroke. This is especially the case with lean mixtures, or below 11½ to 1 of ordinary illuminating coal gas.

This system of transferring the furnace, wherein the energy is primarily developed, into the cylinder of the engine itself and there utilizing directly the benefits of combustion, is undoubtedly the greatest step in advance of the present half century in the direction of high economy and efficiency. There is no doubt but that the engine of the future is to

The gas engine of to-day undoubtedly stands in the same position as the steam engine in 1860 when Charles T. Porter first proposed to develop double or triple the power from the same weight of material from the same weight of engine by increasing the number of its power producing elements per minute from 50 strokes, as was the practice, to 250. Or to follow history in steam engineering still further back in the days of Newcomb and Crawley, when all cylinders were single acting and a multiplication of cylinders were required to increase the number of power strokes.

The commercial gas engine of to-day has a single acting cylinder. The difficulties of packing against the high temperature has been found, and probably will remain insurmountable. French engineers have sought in vain, through long continued and expensive experiments, to find methods of packing a piston rod against the high temperature of the cylinder, and thus to produce a double acting engine. The American engineers have heretofore tried, but thus far have failed, to produce a double acting gas engine.

The most successful practice in gas engines has been followed in producing the engine illustrated herewith, that is, single acting combustion cylinders are used, which are placed opposite to each other, and form a single mechanical element. Midway between them is a cylinder of larger bore, performing the office of a pump for transferring the mixtures to their proper destination before combustion. The compound piston, which reciprocates in these three cylin-

the combustion cylinder previous to ignition. The ignition is performed by the electric spark, the two igniters being coupled in multiple arc. The mixing device is peculiar, extremely simple, and consists of a valve, O, covering both gas and air passages in a perforated plate. This valve is so large as to nearly fill the circular space in which it is contained, leaving only a very narrow circular slot at its periphery. The gas and air as they are drawn through this narrow slot are given a very high velocity by the suction of the pump at either end. A wire gauze diaphragm, R, stands immediately in front of this passage and completely breaks up the rushing gases as they emerge from the slot. These, as they reunite form a most intimate and complete mixture. Experiment has shown that this mixture attains almost theoretical perfection, aiding materially in the perfection of combustion and economy attending the operation of the engine. The compression of the engine is from 35 to 45 pounds before ignition when the engine is working near its capacity, and from this figure down to atmospheric compression when working less than its rated capacity. A governor on the axle is connected by rod, X, to the two screws beneath the induction valves, and thereby automatic regulation is obtained, which is found in practice to hold the engine within three per cent. from full load to zero.

The actual performance of the engine is very high, being from 19 to 21 cubic feet per horse power. The perfect uniformity of speed is owing to the fact that every stroke is effective, and a

comparatively small weight of engine is required to the horse power. Chief among its merits is its low cost of manufacture.

A 13 horse power engine of this make weighs only about 1,900 pounds and requires but a small fly wheel, and for purposes of driving dynamos the fly wheel may be used for band wheel, about the same practice being followed as in steam engineering in determining the weight of these elements.

The engineering department of the Patent Office looked upon this invention with unusual interest, owing to the fact of its being the first system of construction which rendered the double acting gas engine feasible, and a patent containing some sixty-five claims was granted upon same.

The ELECTRIC AGE went to press two or three days earlier this week than usual. This was for the purpose of supplying copies of the paper to the Telephone Convention delegates who have just returned home, and for the purpose of supplying the delegates assembled at the Edison Convention at Minneapolis, The Telegraphers' Convention at Kansas City, and the State Street Railway Association, at Rochester, New York, all of which assemble Tuesday, the 16th instant. That our advertisers are pleased with this arrangement goes without saying, all of whom will be glad to know what an enterprising Electrical Journal can do, while the subscribers, and those who are not subscribers, but who receive copies free by reason of a general circulation at the conventions now being held, will be doubly satisfied. We have never before published a line of a self-laudatory nature ; we prefer to let our actions and achievements do the talking. It will please our friends, however, in all sections of the country, to note that this paper is more sought after than ever before, and its business is doubling every month. One satisfaction we have is the fact that we never make a friend except to hold him at all times, while perhaps the strongest point in our favor is the fact that we have never yet made an enemy.

CENSUS BULLETINS.—A bulletin has just been issued showing the statistics of quicksilver at the eleventh census. The bulletin also shows the value of the quicksilver, the wages and other expenses, and the capital required for this product. This statement is only a brief summary of the more important facts which will be published in the complete report. No similar statement concerning quicksilver was published at the tenth census ; therefore comparisons cannot be made. A table is given, however, showing the total product of quicksilver of the world, and also the product of the United States in each year since the industry was first established.

THE BERMUDAS-HALIFAX CABLE.—Messrs. Henley's telegraph cable ship, *Westmeath*, lately engaged in the laying of the Bermuda-Halifax section, returned to the Thames on the 19th inst., having successfully completed the laying of the cable from Halifax, Nova Scotia, to the Bermudas. The expedition left the Thames on the 23d May last, so that the whole work has been accomplished (including the guarantee period of 30 days) within three months.

Many of the occupations which had formerly to be suspended when the shades of night fell can now be carried on effectually by the use of the electric light. Not long ago a large horse sale was conducted at night by the electric light at one of the horse markets of New York. The points of the animals were seen as distinctly as in the day time, and the purchasers appreciated the cool evening breezes which blew through the building.

A TELEPHONE EXPERIMENT.—The experiment of transmitting opera music from the Opera House to the Urania Theatre in Berlin by telephone was made Sept. 3, and proved a complete success.

BRONZE FOR ELECTRICAL USES.

In Europe bronze has very largely superseded iron and copper in electrical appliances destined to the practical uses of electricity. It is the metal of the nineteenth century. Bronze has been ordered used for telephone purposes between London and Paris, similar to that so successfully used between Paris and Marseilles. The sudden turn of electricians to this metal, leads us to inquire for the reason therefore. A visit to the Henry Bonnard Bronze Company's works in this city, the leading one in the United States, furnished all the proof that was desired. We were informed by Mr. E. L. Aucaijne, the Superintendent, that the artistic and technical ability of manufacturers especially engaged in bronze work, have succeeded in rendering that metal, the *ces perennis* of the Roman poet, as malleable, ductile, and light as iron and copper castings can be. Mr. Edison and all other inventors have long since recognized the superiority of bronze over all other metals as a conductor for electric currents. The rudely shaped and inartistic candelabras, lamps, and other electrical appliances now manufactured, do not render justice to the electric light of to-day. The bride is divinely handsome, but the garments do not fit her properly.

A quick and very creditable piece of work was done by an electrical firm in Berlin at the advent of the Buffalo Bill Wild West Company in that city. As the German authorities do not permit of the use of high-tension alternating currents for public shows, the Wild West Company were obliged to leave their own removable lighting plant at Paris, and subsequently invited tenders for the electric lighting of their show (about 60,000 square yards area), in conformity with the very severe rules of the German authorities. The firm which bid for the work undertook to do it in eight days, and successfully finished in seven days eight and a half hours. It consisted of 150 arc lamps, with reflectors, of 1,500 candle power each, suspended from high posts ; 50 glow lamps of 25 candle power each, and a search light projector of 45 amperes, together with 20,500 yards of wire and cables, and 1,500 insulators, a special machine house having to be erected for four boilers of 25 horse power each, and four 200-volt dynamos.

A very novel telephonic phenomenon was observed the other day. Two electricians were conversing over one of the Long Distance Telephone Company's lines, when, in order to shut out some conversation, one of the speakers placed the receiver with the diaphragm end over the mouthpiece of the long-distance transmitter. The receivers at both ends immediately gave out a continuous musical sound. The effect was due to an action almost analogous to that brought into play in the buzzer, or vibrating bell ; this is neither more nor less than a sort of battledoor and shuttlecock action between receiver and transmitter, and its continuation, which is dependent on the time the receiver is held against the transmitter, gives a musical note of high pitch and uniformity. The effect is an interesting one, and the discovery of this peculiar illustration of it will lead to further experiments and possibly valuable results.

TRAIN LIGHTING IN RUSSIA. — The Russian Government, anxious to see the wholesale introduction of electric lighting for trains, has decided that all the carriages of the State railways are to be lit by electric light after this month.

The Commercial Cable Company has declared a quarterly dividend of 1½ per cent., payable Oct. 1, to stockholders of record Sept. 20. The transfer books close Sept. 20 and re-open Oct. 2.

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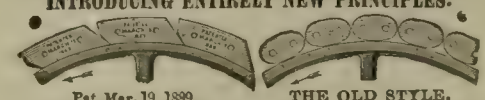
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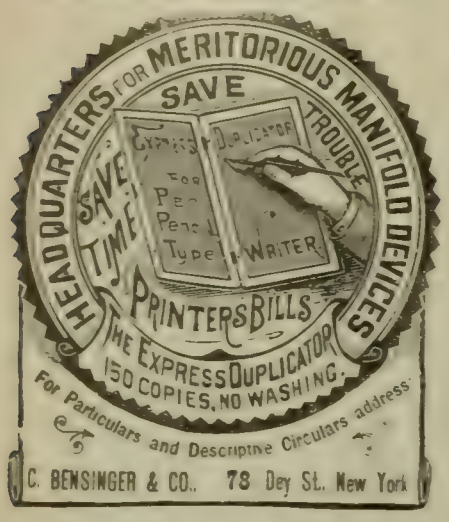
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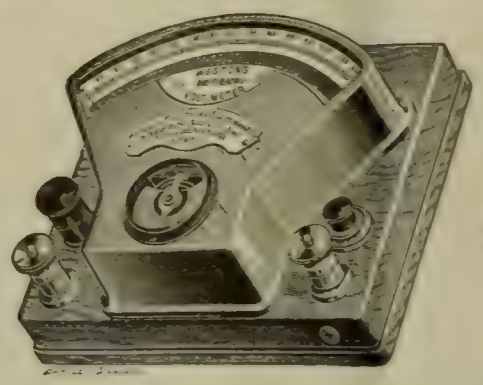
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Improved Typewriter Carbon Paper.

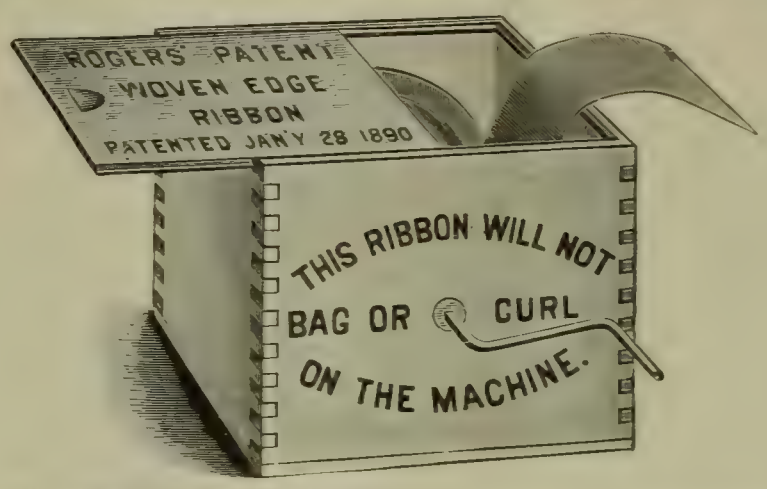
They manufacture a superior Typewriting Carbon Paper, and have contracted to supply the P. O Department at Washington, and they with many others who use it claim it "A No. 1," as it gives a clean copy, does not fade, lasts a long time, and is jet Black. Other colors are made such as Blue, Purple, Green, etc. The "full" is used for manifold tissue paper, when 10 to 40 copies are desired, and for extra thin paper when 5 to 8 copies are desired. "Semi" is used on linen or superfine papers, when making 2 to 6 copies, according to the weight of paper used. It is put up in packages of one dozen, price, 40 cents, and in fancy boxes containing 100 sheets, price, $2,75. If ordered by mail the postage is 3 cents by the dozen, and 25 cents by the hundred.

The company are also manufacturers for the trade, typewriter, manifold and tissue paper books which are unsurpassed as many as forty copies can be made on this paper with a typewriter or styluses by using their improved typerwriter carbon paper.

The company also manufacture "semi" or one side carbon paper, and "full" or both sides, on them a thick paper for all purposes, in sheets or rolls, of a superior quality, unexcelled by any other make.

All of the carbon papers are in large demand, as they invariably give the fullest satisfaction to all who use them. Of course this is saying a great deal, but it is true and can be substantiated by the many testimonials in their possession. A trial of them is desired, and price list will be furnished on application.

The rank occupied by this house as manufacturers of carbon paper, manifold books and styluses is surely a prominent one, and parties interested in typewriters supplies will find it to their advantage to write to the headquarters, which, we repeat, are at 75 Maiden Lane, New York. (*Geyer's Stationer*, Aug. 7th, 1890.)



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The trade always welcome a meritorious article and the makers of it sooner or later reap their due measure of credit and profit from its sale. In typewriter ribbons, for example, the Rogers Manifold and Carbon Paper Company, 75 Maiden Lane, has placed on the market a valuable invention, which is designed to supersede anything of its kind heretofore made. It is well known that the old style of ribbon is made by cutting from a sheet of cloth and has its cut edges treated with glue or cement. Other ribbons have not a straight edge, the strips when unwound ofttimes presenting a zigzag appearance, while the glue or cement at times spreads over too much surface and diminishes by so much the available area of the ribbon. In order to obviate such difficulties, the Rogers Manifold and Carbon Paper Company now makes a patent ribbon which is woven of the exact width required, and being manufactured on improved machinery will not bag or curl in the centre by use on the machine. The woven web holds the cross threads in position and with such a tension that, as stated, the ribbon will not curl, no device being rendered necessary to keep it quite straight. Clean, clear impressions are guaranteed. The ribbon is put up flat or in tinfoil, and, better still, in the company's new patent reel box, which enables the operator to take from and put on the machine the ribbon without soiling her or his hands. The company will be glad to send price list and sample on application. *American Stationer*, Aug. 21, 1890.

A Popular Firms Speciality.

(*From Geyer's Stationer, July* 21, 1889.)

Rogers Manifold & Carbon Paper Co., 75 Maiden Lane, N. Y, are busy filling orders for their manifold letter books and duplicating order books. The facilities of the firm for turning out these goods are of the best, and yet they are constantly pushed to keep up with the demand. Most all of the carbon papers now so extensively used are made by Rogers Manifold & Carbon Paper Co. on their own perfected machinery, and the result is said to be a product much superior to the hand made carbon papers. In fact the superiority of the goods is already recognized, and increased orders from users speak highly for its quality.

In stylus there are 21 different grades offered by the firm, in bone, porcelain, steel and agate, ranging from the cheapest to the most expensive with pearl handles in fancy cases, suitable for gifts. Catalogues and price-lists will be sent upon application.

A specialty that deserves detaile dmention is the *Rogers Manifold Letter Writer*. It is said to be known the world over, and the directions for use are printed in each book in 8 different languages. Although handsomely bound in colored covers and presenting a very attractive appearance, the manifold letter writer for duplicate writing without the use of a pen or letter press, is sold at a very low price, and contains in addition to other attractive and novel features, viz, *Rogers' Lightning Word Finder, and Handy Rules for Letter Writers*. This is a collection of 47,000 words in general use, comprising synonyms and words of similar pronunciation besides Latin and French phrases in every-day use, making a complete book of reference, and obviates any recourse to a dictionary to settle any doubtful point. The indexing of the words in the word finder is a marvel in labor saving devices, and any word can be found in two glances. Type-Writers will find this a handy book, and will appreciate it when examined, for the convenience it affords when wanting to find the spelling of a word in a hurry. Price, Letter Writer with the Handy Rules, Word finder, etc., $2.00. Price of the Handy Rules, Word finder, etc., cloth, 50 cents. Paper, 25 cents, sent by mail on receipt of the price.

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NEW YORK, SEPTEMBER 27, 1890.

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THE EDISON CONVENTION.

The convention of the association of Edison Illuminating Companies held at Minneapolis last week will go on record as one of the most successful ever held. We are enabled, by the courtesy of Secretary Jenks, to present to our readers a synopsis of the proceedings of the convention. The papers read were of general interest, but some were withheld from publicity, being in the nature of confidential communications. That these were of especial interest and value to those directly concerned is evident from the reference to them in our report.

The meetings were held with closed doors and were for this reason more in the nature of a family gathering.

There exists among the members of the Edison Association much difference of opinion as to the wisdom of giving to the electrical press any information whatever of the proceedings of these meetings. Certainly matters of a confidential and private character should properly be withheld from public knowledge, but it would indeed have been unfortunate had extreme conservative ideas prevailed and the facts we have been enabled to provide for our readers should have been withheld too.

The Edison light is too great to be hid under a bushel.

ELECTRICAL CENSUS.—The bill pending in Congress providing for the census enumeration of electrical industries is acknowledged to be a meritorious one. It is generally recognized as a matter of the utmost importance, and we hope that the official endorsement of the bill by the Edison Convention, last week, will have the effect of accelerating its passage without any further delay.

INSURING ELECTRIC LIGHT STATIONS.—One of the most important acts performed by the Edison Convention in Minneapolis was the endorsement of the Electrical Mutual Insurance Company. This company owes its existence to the refusal of the regular companies to accept risks on electric light stations, and its success has been deservedly great. It is based on common-sense ideas of electricity, but the refusal of the underwriters to insure electric light property was due more to ignorance of electrical matters and prejudice. Now, however, the old companies are beginning to realize that electricity is not such dangerous stuff after all, and they are accepting such risks without question. It must be very encouraging to the officers and promoters of the Mutual Company to receive the hearty support and encouragement which has been accorded the company in many directions, and the last endorsement will, no doubt, aid very materially in giving the company the status its promoters have long been faithfully and earnestly working to attain.

DISAPPOINTMENT.—Many people in Minneapolis were disappointed over the absence of Mr. Edison from the convention held in that city last week. He would have been a drawing card, had he been present, and Minneapolis would have received an impetus to her boom. The industrial exposition would also have received a boom if the managers of that fine show could have engineered things so that Mr. Edison would have made a visit. Thousands of people would have been glad to visit the exposition with the hope and expectation of getting a glimpse of the great inventor.

On September 19th, representatives of all the electric light companies, appeared before Mayor Grant in this city, to restrain the Board of Electrical Control in its endeavors to fix the rental of subways. Every company in the city had the most prominent legal adviser who could be procured. It is quite possible that a great legal battle will be fought over this question, for the companies state that it is a matter of life and death to them. The figures imposed upon the companies for occupying the ducts are far beyond what they can get in the shape of revenue from those using the wires. The argument has been laid over for one week. In the meantime, Mayor Grant will consult the corporation counsel. Mayor Grant stated that while he was making a thorough investigation of the subject, the companies should pay at least, half of the rent claimed to be due up to date.

The first complete electric street railway built on the Westinghouse system has just been put in operation at Lansing, Mich. It is said to be a success. Each car is equipped with two motors of 15-horse power each. A maximum speed of 20 miles an hour can be made on a level, and while going at full speed it is claimed the car can be stopped within half its length. The motors are encased in iron, the frame being suspended from the axle at one end and resting on compression springs at the other, the springs preventing any concussions from a sudden start, which is one of the advantages claimed by the system. The gears are of five-inch face cut steel and the mechanism is only comprised of five parts, solidly encased in oil-tight castings which are partially filled with oil, giving perfect lubrication to the gearing and preventing all noise.

JERSEY CITY'S TELEPHONE EXCHANGE FIRED BY LIGHTNING.—On September 17th, lightning set fire to the New York and New Jersey Telephone Company's Exchange in Jersey City, N. J. The lightning followed the wires and set fire to the tower on the roof of the building. The force made its escape without harm. It required considerable work on the part of the firemen to get the fire under control. Two thousand wires run into the tower from New York and neighboring cities The wires are all burned out, but the switchboards are not damaged. All connection is cut off from New York and all cities by telephone. Superintendent McCully and Manager Thompson called twenty-five linemen and set them at work at once repairing the damages, which are estimated at $25,000 to the company and $200 to the building. It will require at least four days to get everything in smooth running order.

MINNEAPOLIS NOTES.

Mr. Samuel Insull, Second Vice-President of the Edison General Electric Company expresses the opinion that there will, before very long, be an entire revolution in the present methods of electric street railway operations. He thinks that the present styles of motors will undergo great changes, and that the coming practice will be to use only one motor per car.

A reporter for a Minneapolis afternoon paper was made the victim of a rich joke on Tuesday. Dressed in his best clothes the youthful reporter made his appearance at the hotel where the Edison convention was being held, in quest of news for his journal. His great thirst for electrical news and his intense desire to scoop his contemporaries were the cause of his downfall. Perceiving his eagerness he was "sized up" at a glance by a certain delegate. The young man was anxious to secure an interview with Mr. Edison, so the aforesaid delegate, seeing an opportunity for some fun, introduced him to another prominent but whiskerless delegate as Mr. Edison. The lucky young man with visions of a grand scoop in his mind, made the best of his opportunity, and plied Mr. "Edison," with all sorts of questions. He started out by asking the alleged Mr. Edison to explain Ohms' law in popular language and after several other similar questions, he finally got down to the important feature of the interview. He was anxious to know what great invention Mr. Edison proposed to give to to the world next. Mr. "Edison" informed the young man that he was at work on his greatest effort, and that it was nothing more nor less than an invention to prolong human life by electricity. With this startlingly important information the hero of journalism rushed to his office and wrote up a very lengthy article, which he imagined was the first public announcement of Edison's greatest of inventions. But his glory was ignominiously shattered by the receipt by the Editor of the paper of a note from the originator of the joke, requesting him not to publish the interview as it was a joke and stating that Mr. Edison was not within 1,500 miles of Minneapolis, explaining that Mr. Edison had been personated by another, whose only resemblance to the great inventor was the fact that he had no hair on his face.

Mr. M. E. Baird, of the Eddy Electric Motor Company, was present during the Edison Convention. He reports a great demand for Eddy Motors. The company has just put in an installation of 11 motors in the Toronto *Globe* office. The motors range from 2 to 15 horse power. There are many other Eddy motors in practical use in Toronto, all of which are giving the best of satisfaction.

The handsome 12 story building of the Guaranty Loan Company, in Minneapolis, is lighted throughout by electricity on the Edison system. There are 1,600 incandescent lamps throughout the building.

CONSOLIDATION OF PHONOGRAPH COMPANIES.—A certificate of the consolidation of the Metropolitan Phonograph Company and the New York Phonograph Company under the name of the New York Phonograph Company, was filed September 12th, in the office of the Secretary of State. The capital of the new company, which equals the aggregate amount of the two companies, is $2,500,000. The trustees of the consolidated company are John P. Haines of Tom's River, N. J., and John D. Cheever, R. T. Haines Noah Davis. William Fahnestock. W. Seward Webb, and John L. Martin of New York city.

The operations of the corporation will be carried on in the village of Tarrytown, town of Greenburgh, Westchester county. The assets of each company will be inventoried, and all the property of the two companies of whatever nature will become the property of the new corporation, which paid a State tax of $3,125 for the privilege of organization.

A NEW MAGNETO WATCHMAN'S TIME DETECTOR.

There has been a marked advance in the demand for a good reliable Watchman's Time Detector, and this demand has been met by The Holtzer-Cabot Electric Company, of Boston, who have brought out the Magneto Watchman's Register, which we illustrate. Their well-known Time Detector which is worked by battery has



MAGNETO GENERATOR.

been on the market for so many years, and so many are in use that commendatory remarks are needless here. Suffice to say this new departure is an improvement and an addition to their Watchman's Time Detector systems. The same mechanism is used in this clock as in the battery clocks, making it possible to work the



NEW REGULATOR TIME PIECE.

same clock by either the magneto or battery. The Magneto Generator we show, is made especially for the work, and delivers a battery current. The cut shows their new Regulator Time Piece combined with the Watchman's Register, and is thoroughly reliable, accurate, and elegantly made up. The Register is made without a time piece when so desired.

The Brush Electric Company of Cleveland has begun proceedings in the United States Circuit Court against the Sprague Electric Railway and Motor Company of New York. Plaintiffs charged defendants with infringing on a patent in dynamo machines invented by Charles F. Brush, and ask for an injunction and accounting.

STORAGE BATTERIES AND THEIR USEFULNESS.

J. K. PUMPELLY.

Our first paper gave a rough synopsis of the nature of the storage battery and some of the different makes now on the market. In order to give in this article some directions how to select batteries, when desiring to purchase, it will be well to look into the process by which batteries are made. Lead is invariably the metal used at this date, because lead is a conductor of electricity and is also only slightly corroded by the action of the sulphuric acid in which it rests, perhaps for years. As a general thing, metals that are good conductors of electricity are strongly acted upon by the acid, such as copper, iron and zinc. Hence, lead is the only metal of low price which can be used. Silver and platina, which are not acted upon by the electrolitic acid, would be far better but more expensive. What is called the active material, composed generally of the red lead of commerce, and litharge another form of lead used in making paint, are pasted on or forced into the holes of the metal lead plates, after it has been mixed into a sticky paste, which hardens in a few hours. Sometimes the dry powder of red lead is forced into the holes and held there by the use of fibrous material, which will remain in the acid without disintegrating, and thus become formed into a firm paste by the action of the current passing through the electrolite or acidulated water. This method seems to put the active material into the best condition for the storage of electricity; it also allows the film to become the support of the citinic material, thus lessening the weight of the lead conductors. It is known that Brush experimented in this way some years ago, but not using or finding a porous material which could remain long in the electrolite without disintegrating he gave it up. Such a material is now imported which is not only porous but a support to the active material. This material is now in use and will be spoken of later on. One can easily see that a material, once a powder and then made into a paste, at one time semi-soft and at another time quite hard during the action of the electric current, both in charging and discharging, must be very unequal in its tenacity as to being held in the holes of the lead plate, and as these plates in most batteries stand perpendicular in the liquid, the plates forming the negative pole face to face with the plates forming the positive pole, and less than one-fourth of an inch apart, there is great likelihood of this paste, when soft, falling or washing out from the holes and getting packed in between the plates of the opposite poles. When this happens, what is called a short circuit is formed, and the efficiency of the battery is, for the time, destroyed. Batteries thus made, it can be seen, are often out of order, and to those who are not supposed to understand their nature a constant source of trouble in the mind of the purchaser. There is one kind of battery made by the Pumpelly Storage Battery Co. of Chicago which avoids this trouble, and the reason why this is accomplished can be seen by any purchaser by merely seeing how the batteries are made. The very porous but compact fibre just referred to, is used, which is actually pure cellulose; it is a non-conductor of electricity, not disintegrated or acted upon by the acid, and hence, unchangeable. Still it is tenacious enough in its texture to prevent any particles from penetrating it. This fibre is placed between each plate of the battery, preventing always, and automatically, any contact between them, and also allowing the plates to be horizontally placed in the surrounding case or cell, which permits of their safe transportation when fully charged. Their use to drive the phonograph motor is, for this reason, extended all over the United States, they being shipped from the factory in water-tight boxes to any distance, charged and ready for work on their arrival. Some sent by this company, as far even as Australia, did good work on arrival. Storage batteries are now in general use for lighting private houses and flats where the incandescent light is furnished by a dynamo until 10:30, during which time a small part of the current passes into the battery and is stored there to be used for lighting the house during the night, the dynamo and engine being shut down during this time. This proves economical, as the consumption of coal ceases as does also the extra wages of the night engineer, besides doing away with the noise and smoke.

It is well known now that street cars are being driven by storage batteries placed under the seats, doing away with the overhead wires and its dangers, avoiding the trouble of grounds, by which the telephone service are so much inconvenienced through induction. The pleasures of boat riding, by means of the still running motor, driven by storage batteries can be easily imagined. No noise, no smoke, no smell of heated oil and no valuable room taken by machinery, the batteries being covered and used for seats and the motor being under the stern-seat. Every day finds the storage battery more perfect and useful. It is actually the only source of power, light and motion at one and the same time. In closing, the writer may well refer again to the matter of running boats by means of batteries. The secretaries of battery companies are deluged with letters asking about this matter. For the satisfaction of those wishing to try the plan, which is by no means an experiment, we can advise as follows: Select a boat in which the width of beam is not much over one-tenth of length. If a 20-ft. boat, purchase a ½ horse-power motor of any good manufacturer or their agent, wound for 25 volts; purchase 12 storage batteries and have a good machinist arrange gearing of the new raw hide pattern as it runs without noise. Place the batteries in the boat where they are most convenient—under the cross seats or through the centre, using them as seats—and make the trial trip, if it needs be, a long one. Large cells must be used, if a short one smaller ones. A 300 ampere cell would run such a boat at from six to eight miles an hour for ten hours, probably longer. These cells would weigh about forty pounds apiece. One weighing but 25 lbs. each would run a trip of six hours. If the speed is not over five miles an hour the battery would run once again as long. The packing of fibre in the Pumpelly battery referred to above is well adapted for this use since it does not slop or spill out with handling.

ELECTRICITY ON ELEVATED ROADS.—The managers of the elevated roads have by no means abandoned the plan of propelling the trains by electricity. About ten years ago Messrs. Sage, Field and Gallow were induced by Mr. Daft to take an interest in an electric motor which was being experimented with on a temporary circular tailway at Greenville, N. J. An agreement was made by which the more desirable peculiarities of the invention could be incorporated in an ideal motor. This machine was constructed and trial trips were made with it on the Second avenue line. More are about to be made. Russell Sage says the day is not far distant when electricity will supersede steam on the elevated roads.

Alfred G. Hathaway, of Cleveland, Ohio, is the sole manufacturer for the Charles Hathaway patent transfer tables and turn tables, and expects to have one of his transfer tables at the coming convention of the National Street Car Association.

The *Street Railway Gazette* for September, has just made its appearance. It has been delayed a few days for the purpose of crowding into its columns the deliberations of the various conventions that have lately been held. It is the best issue of that paper ever placed before the public and at the same time, it is the largest. The enterprising manager, Mr. Cavill, is to be congratulated upon his great success.

ASSOCIATION MEETING OF THE EDISON ILLUMINATING COMPANIES, AT MINNEAPOLIS, MINN.

The session was opened by President John I. Beggs, at 11:30, Tuesday, September 16th, who explained that session had been postponed by action of the Executive Committee suspending the clause of the by-laws providing for the holding of the annual meeting on the second Tuesday of August, on account of the holding of the Exposition during the present month.

The members present at the opening session were as follows :

EDISON GENERAL ELECTRIC COMPANY.

Samuel Insull, second vice-president; H. Ward Leonard, light and power department; John Muir, railway department; Francis R. Upton, F. E. Jackson, Wilson S. Howell, lamp manufacturing department; W. J. Jenks, legal department; M. J. Sullivan, official stenographer; L. Stieringer.

ILLUMINATING COMPANIES

John I. Beggs, Harrisburg, Pa. ; Geo. H. Finn, St. Paul, Minn. ; C. H. Maxcy, Minneapolis, Minn. ; Oscar Ericsson, Sioux Falls, S. D. ; Edwin R. Weeks, Kansas City, Mo. ; Frederic Nicholl, Toronto, Canada ; F. G. Kurz, Appleton, Wis. ; B. L. Smith, Laramie, Wyoming ; Wm. D. Kurz, La Crosse, Wis. ; Wm. L. Church, Chicago, Ill. ; John R. Markle, Grand Rapids, Mich. ; M. A. Beal and W. H. Van Sickel, Sault Ste. Marie ; W. F. Wollin, York, Pa. ; Leigh Carroll, Birmingham, Ala. ; C. L. Edgar, Boston, Mass. ; J. A. Colby, Des Moines, Ia. ; W. S. Barstow, Brooklyn, N. Y. ; H. J. Smith, New York ; Chr. Wuestenfeld, Elgin, Ill. ; A. L. Smith, Appleton, Wis. ; C. P. Gilbert, Detroit, Mich. ; Hoyt Post, Detroit, Mich.

Choice of officers for the ensuing year resulted as follows : President, John I. Beggs ; Vice-President, C. L. Edgar ; Secretary, W. J Jenks ; Treasurer, Wilson S. Howell ; Executive Committee : John I. Beggs, *ex officio ;* A. L. Smith, Appleton, Wis. ; Thos. P. Merritt, Reading, Pa. ; E. R. Weeks, Kansas City, Mo. ; C. P. Gilbert, Detroit, Mich. ; Leigh Carroll, Birmingham, Ala.

An interesting discussion arose upon the results of the burning of arc lamps on Edison circuits, during which it appeared that the trial of this method during the past few months has resulted very satisfactorily to the companies whose experience was quoted.

At the afternoon session Mr. Samuel Insull, Second Vice-President, made interesting and important explanations of the status of the patent suits now being pressed by the parent organization, and the recent consolidation of all the licensed manufactories with the General Company. By this statement it appears that the effort will be to furnish electric light and power apparatus of any variety of the most approved character and at low prices in competition with any other of like excellence on the market. It is also the purpose of the company to furnish an Edison motor, and thus by the keeping of a stock of armatures and other supplies at each of the district centres, render it more easy for the companies to secure promptly anything of this kind than heretofore ; also that Mr. Edison, who was unavoidably detained at the laboratory, is, and will in the future be actively engaged in perfecting the present and developing new apparatus in the field of electric light and power.

A discussion of the effects of crosses from high pressure circuits with Edison three-wire conductors developed a great interest, and a report from Wilson S. Howell, who has for some months been gathering statistics showed that in no case thus far noted, has a cross with a high pressure direct or alternating circuit proved damaging to the Edison wires or apparatus. A committee was appointed to further investigate this subject with a special reference to the possible future interference of electric power systems, such as railways. The committee was appointed by the president as follows :

C. P. Gilbert, Detroit ; Wilson S. Howell, New Brunswick, N. J. ; C. L. Edgar, Boston ; H. Ward Leonard, and J. H. Vail, New York.

The recent improvements in the Edison electric meter and the development of a new mechanical (registering) meter formed the subject of two papers from A. E. Kennelly, of the Edison Laboratory and R. S. White, of Brooklyn, N. Y. In these it appears that the perfected Edison chemical meter has been shown by a year's experience cheapened and rendered about three times as accurate as formerly by the improvements noted at the meeting a year ago, and that Mr. Edison has constructed a meter in accordance with some of his earliest ideas on this subject, which is expected to prove cheap and reliable for small currents, probably up to 20 or 25 lamps.

A report by the secretary on the "Grounding of the Neutral Wire in three wire Systems" was read and assigned for discussion.

Special assignment of the questions of central station insurance and the proposed National Code of Insurance Rules for Electric Light and Power Work was also made to Wednesday at 10 A. M.

A paper on "Comparative Statistics on Electric Lighting in the United States" was read by F. R. Upton of the lamp department of the Edison General Electric Company, and excited an interesting discussion.

Adjourned until Wednesday morning.

SESSION OF WEDNESDAY.

The convention was called to order by President Beggs, at 10:30 A. M. Delegates not noted in the list of the opening day handed their credentials to the secretary : H. G. Balkan, Brockton, Mass. ; E. A. Hammer, New York.

The special committee on insurance of central stations, consisting of Messrs. C. L. Edgar, Thomas P. Merritt, W. J. Jenks and John I. Beggs (*ex-officio*) reported substantially as follows :

This committee which was appointed a year previous to investigate the feasibility of some plan of mutual central station insurance, made a somewhat careful report at the Niagara Falls meeting last year, and subsequently in the minutes of that meeting made an additional report from material gathered after the meeting, by which it appeared that the published proceedings of the Niagara Falls convention had stimulated, at least in one direction, healthful action upon the subject of this mutual insurance of central stations. In one of the appendices to the report there was printed in full a prospectus of the Electric Mutual Insurance Co , of which Mr. S. E. Barton is the President. That brought the matter up to so late a date and outlined so clearly to the committee the probability of a fruition in the direction of their work without any further effort on their part, that the committee have not considered it necessary to render this morning any formal report, but merely to call attention to the fact that this prospectus of the Electric Mutual Insurance Co. was followed up by the projectors of that enterprise in the development of an organization and the beginning of business, with which facts most of you gentlemen, are more or less familiar, and the committee desire, in view of the mutually useful and profitable results which appear to be coming forward, in the interests of the central stations. to report at this meeting that their work has practically been accomplished. The committee also decided that, as Mr. Barton was in this vicinity, they would secure from him a statement somewhat in a historical way, and somewhat in explanation of the business methods of the Insurance Company in which we are all interested or likely to become interested, so that we might receive in a more intelligent way than could be otherwise devised by the committee.

The President then introduced Mr. S. E. Barton who said :

I am indeed grateful for the privilege extended to me of meeting you all here in this session. I do not feel that I have come as a stranger, nor brought to you any scheme that any one is particularly interested in. I feel, and I want you to feel, that in this system of insurance all of you who may become insurers will become owners, as it were, and I, occupying simply the position of being the head of the company, your servant.

By this system of insurance there is no profit. There is nothing to be gained by any person, with the exception, of course, of those engaged in its business management who may receive a salary. The system is to deal directly with the insured—with the owners of the property themselves—and not by a system such as is carried on by the stock insurance plan.

We have in four months secured and put upon the books of the Electric Mutual Company nearly $2,000,000 worth of insurance. About $300,000 of that has been upon first-class manufacturing property ; $1,700,000 has been written on electric stations.

As soon as we started with the company several of the manufacturers' Mutuals of New England who had up to that time written very sparingly upon electric stations, having insured perhaps fifteen or twenty, and met with but a single loss (Fall River) came to me and desired to co-operate with us.

They had particularly expressed themselves as being willing to undertake the insuring of central stations, particularly those operating the Edison system, if the Edison parent company would undertake the electrical supervision of those risks. That was of course something that no parent electrical company would want to do ; but the question was entirely settled by the formation of the Electric Mutual. Then they announced that they would be entirely satisfied with our selection and supervision and were very willing to write policies on any station partly insured in the Electric Mutual, and I am very hapy to say that to-day all of those companies are co-operating with us.

Permit me in a few words to explain the system of insurance which we have adopted, and the basis upon which we have made our calculations. It is not an untried field with us by any means. Nine-tenths of one per cent. is our minimum rate. Our rates have averaged a little over one per cent. up to the present time. Of course this rate of nine-tenths applies to a station of the best construction, built of brick or stone, not over two stories high, having the electrical apparatus arranged in strict accordance with the requirement, and all necessary fire appliances. This building must be free from any wooden construction inside, such as sheathing or anything of that sort. It need not, however, be necessarily a fire proof station. It shall not have any exposures, but if there are any, the same must be cut off by fire shutters on all openings. The station shall have what we term a "standard or fire protection," with pumps, and hose attached. The hose shall be small or large, according to the size of the station, but preferably small, the idea being that any part of the station can be reached instantly with a small stream.

Mr. Smith—Do you make any reduction for water power.

Mr. Barton—We find no particular difference for the reason that generally speaking water power stations are farther removed from the fire department than the steam power, in which case matters are neutralized.

Mr. Balkan, of Brockton, Mass., submitted the following resolutions :

Resolved, That the association of Edison Illuminating Companies in convention assembled, hereby tender a hearty vote of thanks to Mr. S. E. Barton, for his able exposition of the mutual insurance question, and the aim and objects of this company ; and the association recognizing the many advantages of such a system of insur-

ance hereby gives its unqualified support to the Electric Mutual Insurance Company ; and

Resolved, That the report of the special committee comprising the informal statement of the secretary, and the supplementary statement of the results of their work as detailed by Mr. Barton, be received and spread upon the minutes of the association, and that the committee be discharged with the cordial thanks of the association for their conscientious work during the two years of their successful service.

Mr. F. E. Jackson then read his paper on miniature incandescent lamps in decorative work.

Mr. Carroll of Birmingham, Ala., then offered the following, which was unanimously adopted :

Resolved, That the association recognizing the great importance of securing uniformity in the insurance rules by which installations of electric light and power throughout the United States are inspected, express their interest in the work of the National Electric Insurance Bureau as reported by our secretary, and bespeak for the codifying committee of the Bureau the cordial co operation of all electric illuminating companies, which may be able to contribute to the result which the committee has in view.

The Executive Committee presented the following resolution, which was unanimously adopted :

Resolved, That the president and secretary of this association be requested to express to the committee on the census of the United States Senate, the hearty approval and support of the association of Edison Illuminating Companies, of the Senate bill entitled "A bill to amend an act entitled, an act to provide for the taking of the eleventh and subsequent Census," approved March 1st, 1889 ; and further, that the members of this association be requested to urge upon their respective representatives in Congress, the necessity for the passage of said bill.

Mr. Van Sickel, of Saulte Ste. Marie, inquired as to the proper construction of sub marine cables for electric light and power works, and remarks were made by Messrs. Stieringer, Edgar, Beggs, Nichols, and the secretary was instructed to request Mr. Kennelly of the Edison Laboratory to prepare a paper on the subject to be incorporated in the minutes of this meeting.

On motion of Mr. Edgar, the association adjourned to meet on the Atlantic sea-board, 12 months hence, the exact date and place to be designated by the Executive Committee.

In addition to the delegates to the Edison Convention the following named persons were in attendance :

Wm. Hubbard, Elgin Telephone Co., Elgin, Ill.; Foree Bain, Chicago; Robert Coleman, Indurated Fibre Co., New York ; Fred. W. Cushing, Central Electric Co., Chicago ; B. L. Ames, of Ames, Wright & Co., St. Paul, Western Electric Company's agents ; John Roberts, *Street Railway Gazette*, Chicago ; M. E. Baird, Eddy Electric Motor Co., New York ; Senator Washburn, of Minnesota ; H. T. Greenfield, Electrician Interior Conduit and Insulation Company, New York ; D. B. Dean, Fred. De Land, A. C. Durburow, jr., J. B. O'Hara, E. L. Powers, W. Forman Collins, of Chicago ; Thomas R. Taltavall, of the ELECTRIC AGE, New York.

E. A. Hammer, of New York, and A. Theo. E. Wangeman, of the Edison Phonograph Company, represent the Edison interests at the Exposition.

AT THE MINNEAPOLIS EXPOSITION.

The "Tower of Glory," at the Minneapolis Industrial Exposition is the crowning feature of the great show, and it excites great wonder and enthusiasm among the thousands of people who visit the exhibition day and night. The tower itself is seventy feet high, the top of which is formed in representation of the Egyptian lotus. The shaft is octagonal in shape, the outside surface being studded with thousands of tiny Edison incandescent lamps with globes of various colors. On the tower and the festoons there are no less than 7,500 lamps, and the lighting of these in sections and entire gives a very beautiful effect. Mr. Louis Steiringer, who has charge of this feature of the exhibition has received and deserves hearty congratulations on the successful issue of his labors. The work entailed in planning and wiring the tower was something enormous and would have overwhelmed most men, but the result of Mr. Steiringer's labors is evidence that he is an artist in this peculiar line.

The miniature electric railway running around the base of the tower attracts a great deal of attention, especially at this time, as Minneapolis and St. Paul are deeply interested in electric railways. The equipment of the little road at the Exposition is that used at the Lenox Lyceum exhibition in New York last Spring ; there is a much greater length of track, however, and the road runs over bridges, trestles, etc.

The electrical lighting exhibits at the exposition are very interesting. The Westinghouse Company shows a standard automatic engine and a junior automatic, both in operation. They have no electrical apparatus on exhibition on account of the interference of the strike at Pittsburgh with the original plans. The exhibit is in charge of Mr. W. O. Everett, who represents the Chicago office of Westinghouse, Church, Kerr & Co.

The North-Western Thomson-Houston Company have a very complete exhibit of their apparatus in full operation. The plant consists of four Thomson-Houston arc light machines, two alternators for incandescent lighting, and one 250 volt direct current generator for motor work. This plant supplies the light for almost the entire building and the power is supplied by a 300 horse-power Milwaukee Corliss engine, of which Messrs. Cooley and Vater, of Minneapolis, are the agents. The size of the cylinder is 20 x 42 inches ; revolutions per minute 86, and steam pressure 100 pounds. The engine is said to be perfect in its operation under all conconditions.

The Edison General Electric Company's exhibit comprises one 80 ampere generator, used for the small electric railway and a few lights inside the tower, and two 440 ampere generators which supply the current for the 7,500 lights on the tower. It takes a current of 720 amperes to feed the tower lights. The power is supplied by an Atlas Engine, of which Cooley and Vater are the Minneapolis representatives. The engine is of 200 horse-power, with 165 revolutions per minute. The Edison exhibit is in charge of Mr. E. W. Hammer.

The Interior Conduit and Insulation Company makes a very fine and artistic display of their well-known interior and underground tubing system. The method of laying these conduits underground is well shown, and the fact is noted that over 150 miles of underground tubing is being laid in Minneapolis and St. Paul for the electric railways between the two cities.

The various types of the Edison-Lalande battery are shown among the Edison experimental instruments which are located on the second gallery of the building. What is said to be the largest leather belt in the world is to be seen at the exposition. It is 73 inches in width and was made by the W. S. Mott Company, of Minneapolis, for the Minneapolis Street Railroad Company.

BOSTON'S NEW POSTAL TELEGRAPH OFFICE.

The Postal Telegraph-Cable Company's central office was removed Sunday from 177 Devonshire street to more commodious and elegant quarters at 234 Devonshire street opposite Winthrop square.

Manager E. B. Pillsbury, who exhibited the attractions of the new establishment to the AGE correspondent yesterday, claims to have now the best arranged and equipped telegraph station in the world.

The principal improvements consist of increased accommodations whereby the force of operators can be enlarged from 40 to 90, an increase in the number of switchboards and loops whereby the rapid transaction of business is greatly facilitated, and the substitution of dynamos for batteries in the generation of the electric current.

Under the old system of batteries the establishment used 4,000 cells, but now by using dynámos the same result is gained by means of coils of resistance, which regulate the current for wires of whatever length.

In the basement are two 10 h. p. motors, each run on alternate days by power from the Edison station. These motors furnish power to drive a line of shafting to which are belted the eight small dynamos which furnish the current. Both motors and dynamos are made by the Westinghouse Company especially for the Postal Telegraph Company. Dynamos are of different potential varying from 20 to 300 volts. There are three switch boards with 36 main circuits, and innumerable lesser circuits and loops were made by J. H. Bunnell & Co., of New York, especially for this office.

A large, neat black walnut case, the doors of which are set with brass wire screening instead of glass (for ventilation), contains the 500 resistance coils which regulate the circuit from the dynamos.

Eight miles of Kerite wire are used in the office on switch boards and operating tables.

Forty day operators, about one third of whom are ladies, eight night men working in three shifts. There are sittings for ninety operators.

Basement, dynamo room, boilers for heating, delivery room, wardrobe and dressing room for messengers, two supply rooms for storing sent messages and copies of those received, capable of holding eight months' business ; separate entrance for messengers. The office is on street floor ; windows are very large and of plate glass, giving splendid light and on which the seal of the company is laid in silver. Signs (of which Manager Pillsbury feels justly proud) extend the whole circular front of the building and up and down each side of the door and are composed of white letters edged with gold and are in relief on a handsome dark blue background. These signs are the prettiest feature of the square on which the office fronts.

The roof structure is 23 ft. high, 24 ft. square, and has eight 20 pin arms—two on each side. The tower in which the lines center is ten feet high and seven feet square, the roof pitching all four ways. Around the inside of the tower house is a lightning arrester from which radiate the sixteen cables which pass from the house over a specially designed frame, and down the walls of the building to which they are firmly cleated, and into the switchboard. The neatest and most comprehensive piece of outside construction in or about Boston. Francis W. Jones, the assistant general manager and electrician of the company, has had the entire work done under his supervision, and it is done thoroughly and well. The plans for the office—dynamo room—switchboard, etc., are all his. The outside construction was designed and executed under the supervision of John Morrell, the superintendent of construction for the company, and it is a commendable fact that after everything was ready, it took only twenty minutes to make the change from one office to the other, and there was not a mistake or a hitch in the whole proceeding. The company use the Jones system of quadruplexing, and value it highly.

Mr. Morrell has risen from a lineman to the position of superintendent, and is deservedly proud of his excellent work in connection with the fitting up of the office.

Reports come from every direction, of great activity in the electrical trade. Business houses report a lively demand for electrical goods.

ANNUAL MEETING OF THE NEW YORK STREET RAILWAY ASSOCIATION.

HELD AT ROCHESTER, N. Y., SEPTEMBER 16.

SUBJECT OF ELECTRICITY FULLY DISCUSSED.

Members of the Street Railway Association of New York State met at the Powers Hotel this morning, the occasion being their eighth annual convention. Inasmuch as the change from horse power to electricity, as the motor, is occupying public attention in many parts of the State, the association decided to make its session open to representatives of the press, although this is contrary to the usual custom, according to which these meetings in previous years have been of a private character.

The session was called to order shortly after ten o'clock by the president, John N. Partridge, president of the Brooklyn City and Newtown Railroad Company. William J. Richardson, secretary of the Atlantic Avenue Railroad Company of Brooklyn, performed his duties as secretary of the association. T. E. Crossman is the clerk and stenographer of the association.

In opening the session President Partridge delivered an address as follows :

GENTLEMEN OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK : We are assembled here to-day from all parts of this State for the interchange of thoughts and ideas gathered from our daily experiences as street railroad men, and to consider new theories and inventions applicable to our business. Let us take hold of the work before us so energetically and pursue it so faithfully that we may return to our homes at the close of our session, enlightened, refreshed and better fitted for our work.

So far as I can learn, the companies here represented have had a successful business year and are to be congratulated upon it. Certainly, many of the conditions which bring prosperity have prevailed. Prices for provender and supplies have been low; we have been comparatively free from labor strikes and agitation, and our employés, in the main, have been contented; our last winter was mild and brought us but little snow and ice, and business generally throughout the State has been prosperous.

The Legislature, at its last session, treated us kindly. A disposition to deal fairly with all measures affecting street railroads was manifested both in the Senate and Assembly.

Marked progress has been made since our last meeting in the substitution of mechanical and electrical devices for the propulsion of street cars in the place of horses. In New York city the Third avenue company is about to extend its cable system down town, through the busiest thoroughfares to the City Hall, this extension having been made possible by a recent decision of the Court of Appeals.

In many of our cities and towns where the electric car was unknown a year ago it is to-day a familiar sight. Its coming has been opposed by a few alarmists, who predicted that it would bring with it death and destruction. Similar predictions were made of the locomotive and even of horse cars in their early days. But public convenience was served by both, and their use has been marvelously extended. Wherever the electric car has been introduced it seems to have met with general favor.

Its noiselessness, its cleanliness, and its capacity for attaining a high speed, whenever a high speed is safe, commend it to the riding public as a welcome substitute for the horse car, with the clatter of the hoofs and the slow jog of the horses and their offensive droppings.

Some of the brightest minds in this and other countries are actively working to develop improvements in the various systems known as the "conduit," the "storage battery" and the "overhead wire." Who will dare to say what they will accomplish, in view of the great progress made during the last decade in the telephone and in electric lighting.

What we, as street railroad men want, is a system which is simple and economical in its construction, in its adaptation to our existing equipment, and in its operation.

The introduction of the electric car, with its greater weight, creates a demand for a heavier rail and a more substantially constructed road. Inventors are looking after our needs in this direction and new patterns of rails and new methods of laying them are constantly brought to our notice.

These and kindred subjects will be more fully and ably treated in the reports of special committees and in the discussions which will follow. To these, and to the regular business of the convention, I now ask your attention.

Secretary Richardson read the report of the Executive Committee. It showed that there are now twenty-three members in the association, and during the year the Fifth Ward Railroad Company, of Syracuse had withdrawn. The formation of mutual aid associations, among employés of the Third avenue railroad, of New York, and the Atlantic avenue road, of Brooklyn, was favorably commented on as an indication of improvement in the relations between street railroad companies and their employés. The report was signed by the committee, including the president, secretary, and Messrs. D. F. Lewis, Troy ; D. D. Wyman and George Green, New York.

Under the head of legislation the committee reported : "We desire, however, to take this opportunity to congratulate the State and especially the city of New York, upon the action of the wise Governor of this great State in vetoing the iniquitous cable bill. This hydra-headed monster, which like the ghost of Banquo would not 'down' at the bidding of either press or public, but annually stalked forth to affright the community, has, we trust, been given its quietus." In closing, the committee spoke feelingly of the death, during the year, of Herman B. Wilson, of New York, one of the oldest men in the street railway business.

The report of Secretary and Treasurer Richardson was read and showed the finances of the association to be all right.

John W. McNamara, president of the Albany street railway, read the paper of the day on "An Electric Street Railway Motor." The paper is as follows :

Soon after the road-bed of the Albany railway was completed and during the summer of 1864, when the directors and projectors of that road often saw four horses vainly endeavoring to draw the passengers contained in a twelve-foot car up a grade of eight per cent on State street their attention was very naturally turned to the solution of the problem of transmitting the power of steam to the car.

Device after device was tried, but all proved failures, but still the directors never lost hope that at some time the problem would be solved. The successful use of the cable in San Francisco stimulated the stockholders to an effort to secure capital enough to construct a cable road ; but the large amount of capital necessary to lay a cable road, and the want of faith in its working in this climate during the winter months, proved formidable obstacles.

More than twenty years had passed since the road was opened, and horses were still being used to draw the cars, when the attention of the managers of the road was called to certain experiments made by Mr. Leo Daft, who had for many years been a resident of two adjacent counties. Those of the managers who saw what the Daft electric motor did, felt that the day of emancipation for the State street car horses was rapidly drawing nigh. The experimental roads which are familiar to us all were earnestly examined, and the time when the obstacles to smooth operation would be overcome hopefully expected.

The time came much sooner than the most sanguine of us dreamed of ; Baltimore, Scranton, Meriden, Richmond, Hartford and Boston followed in rapid succession, Scranton and Meriden demonstrating that it was possible to operate electric motors in winter. Our sister city, Troy, joined the electric band, and our sister company, the Watervliet Turnpike and Railroad Company, also contracted for electric equipment, before the Albany company could determine which of five systems was the best and make a contract. It was finally made with the Thomson-Houston Electric Company, on the 3d day of November, 1889, and cars began running on the State street line, April 28, 1890, and on May 1st, all the horses on that line were withdrawn.

None of our drivers had had any training until the evening of April 27, 1890, yet we were able to begin running schedule trips with three cars the next day. Over four months' experience has taught us that the electric motor is efficient and reliable. We have yet to learn, by experience, that it will ascend State street an eight per cent. grade, at the rate of five miles per hour in winter, as it has during the summer. We have also to learn, by experience, for it seems to be impossible to learn it in any other way, whether operating cars by electricity is more economical than by horses.

At the time of the introduction of the electric motor, the ordinary street car drawn by horses was the most convenient vehicle in public use. It was easy to enter one and easy to alight from one. The various makers have vied with each other, until one was able to step as easily from the street into a car, as he could ascend two steps of his own stairs. The early builders of electric cars endeavored to retain this feature of the street car, and placed the motor proper *on* the car, communicating motion to the axles by means of sprocket chains and wheels ; but the mechanical difficulties, and the noise made by the chains and wheels led to their abandonment, and the motor or motors were then placed on the axles and *under* the car, where we find them to-day.

At first the easy-of-access feature was retained, but as the necessity for larger motors and more room for them became apparent, the car body was gradually raised until it is too high for childern and elderly people to enter readily, and a great deal of time is consequently used in receiving and discharging passengers.

The car body has been raised at the expense of comfort without, it seems to me, improving the condition of the motor. It is still under the car near mud, dust, snow and slush, and is as difficult to get at as it ever was.

With these exceptions the electric motor of to-day is well nigh perfect, but these exceptions, as time goes on, will become more serious. When the novelty of being regularly and rapidly carried to their homes and places of business ceases, then the passengers will call attention to the difficulty of entering and leaving cars.

The size of the motor, especially for use on grades, should not exceed the standard—sixteen feet for box cars and about twenty-five feet for open cars. On level and suburban roads, where the headway is not less than twenty minutes, larger cars with eight wheels might probably be economically used ; but for populous cities where headway is less than five minutes, the old standard car body is, in my opinion, the best.

How the motor is to be arranged with reference to the car body so as to admit of easy access to it for examination and repair may, or rather must be left to mechanical and electrical engineers. That we will continue to drag them in the dust and mud very long I cannot believe.

I think the opinion of all who are unprejudiced is, that the overhead single trolley under contact systems are the most reliable and efficient. With good overhead construction the loss of power in transmission is but slight, and the conductors are always where they can be seen and kept in place.

The ideal motor is one which is independent of every other motor or other engine, and con-

tains everything necessary to make it go. This motor exists and seems to work fairly well on grades of not more than five per cent. ; but that it is capable of doing the work now being done by motors of overhead systems is still problematical. However, as we have already witnessed such wonders in propelling cars by electricity, may we not hope for a storage battery electric car which shall be equal to any now in use?

We are justified, I think, in recommending to all who think of changing from horse to electric motors, or to all who think of building new roads, the overhead single trolley system. All the manufacturers of motors and generators have their systems in use in cities which can be readily visited, and the merits of all can be compared.

The question as to whether the electric motor is as economical as the horse car cannot yet be answered and need not be answered. Just as certainly as the horse car supplanted the omnibus, the electric motor will supplant the horse car. The horse car, however economical must go, and the electric motor, no matter how expensive, must come.

Frank J. Rogers explained the Short electric system, which he represents. This is the system being introduced in Rochester. A number of questions were asked by the members and answered by Mr. Rogers.

Edward E. Higgins representing the Edison General Electric Company, explained that company's system, and also answered all questions asked. Mr. Higgins made many friends for his system.

Norman McCarthy spoke on the merits of the Thomson-Houston system.

A general discussion of street railroad and electric questions followed.

The secretary then read the following letter, dated New York:

J. B. TALTAVALL, ESQ.,
Business Manager ELECTRIC AGE.

Dear Sir.—The enclosed pamphlets will explain themselves. I understand that it is your intention to attend the convention of street railroad companies, to be held in Rochester on the 16th. If you see no objection to do so, I will thank you to call the attention of the convention to the subject of this pamphlet and see if they will kindly take favorable action endorsing the bill printed in the pamphlet. Your co-operation in this matter and the action of the convention will be highly appreciated by

THE NATIONAL ELECTRIC LIGHT ASSN.
ALLEN R. FOOTE, Secretary.

Mr. Wm. Richardson, of Brooklyn, N. Y., moved that Mr. Foote's suggestion be adopted and he further moved that it be the sense of the association that Congress pass the bill, and that the secretary of the association be instructed to write each senator and member of Congress, urging favorable action thereon. The bill reads as follows:

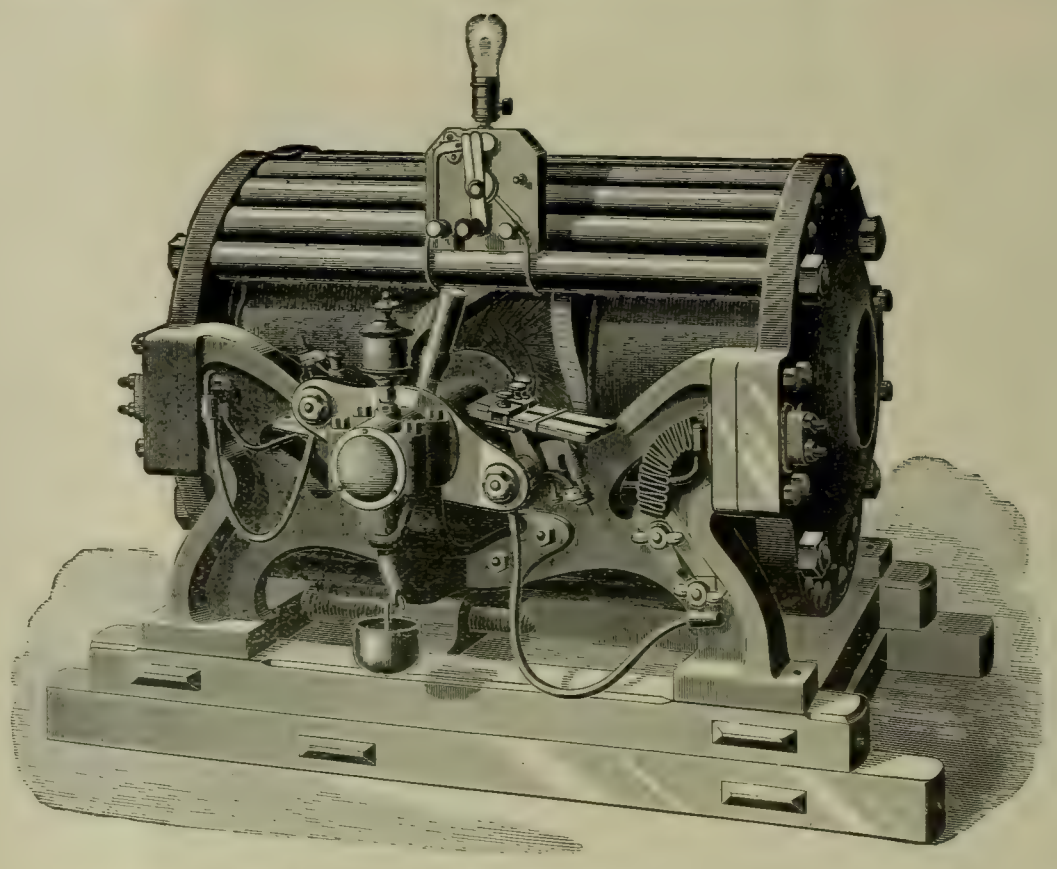
Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the purpose of rendering the investigation of the electrical industries by the eleventh census thorough and complete in every detail, the Superintendent of Census, under the direction of the Secretary of the Interior, is hereby authorized and directed to make such sub-divisions of the subject as may seem to him advisible, and to associate with the special agent now commissioned to investigate the manufacture of electrical apparatus and supplies and their uses, as special expert, the ablest person whose services can be secured to write the statement for each sub-division so made, subject to the supervision of said special agent; and the sum of fifty thousand dollars, or so much thereof as may be necessary, is hereby appropriated, out of any money in the Treasury not otherwise appropriated.

The interference of electrtc railroad with telephone wires, and methods of preventing this, were considered. On the latter question, F. R. Chinnick of the Edison company, and who was formerly connected with telephone companies in New York and elsewhere, was heard, and explained methods of preventing the trouble.

Officers for the ensuing year were elected as follows: president, Daniel F. Lewis, Brooklyn; first vice-president, John N. Beckley, Rochester; second vice-president, John S. Foster, New York; secretary and treasurer, William J. Richardson, New York; executive committee, John N. Partridge, Brooklyn, Charles Cleminshaw, Troy; C. Densmore Wyman, New York.

At 1 o'clock an adjournment was taken, after which the members had luncheon at the Rochester Club house. A trip to Charlotte over the electric road followed, and in the evening the members were entertained at the Genesee Valley Club house. The entertainment of the members while in this city was conducted by Secretary Beckley of the Rochester Railway Company.

The members present were: John W. McNamara, Albany; Wm. Richardson, W. J. Richardson, Dan'l F. Lewis, E. W. Bliss, Jno. A. Partridge, Brooklyn; Parker Norton, Henry M. Watson, Buffalo; C. Dinsmore Wyman, George Green, Chas. P. Emmons, Dan'l B. Hasbrouck, New York; Jno. N. Beckley, Arthur G. Lutchford, Rochester; Chas. Cleminshaw, Troy.



THOMSON-HOUSTON DYNAMO FOR INCANDESCENT LIGHTING.

The visitors and supply men present were: E. V. Cavell of Chicago; E. E. Higgins, Edw. Caldwell, F. L Blanchard, F. R. Chinnock, C. B. Fairchild, W. L. Candee, J. B. Taltavall, E. Peckham, New York.

The Rochester people could not have done more to make the visit of the delegation to that beautiful city more agreeable and pleasant. Mr. J. N. Beckley, secretary of the Rochester Railway Company, proved to be one of the jolly good fellows, and every man left Rochester with the impression that Mr. Beckley and his friends are highly deserving of their prosperity.

At the Street Railway Convention held at Rochester, the Thomson-Houston Electric Co., Short Electric Co. and the General Edison Electric Co. were all ably represented by gentlemen who proved to be good talkers. The street car people cross-examined the three representatives for about an hour and a half, during which time they secured all the points they were after. It is needless to say the three companies will profit by this meeting.

Mr. E. Peckham, representing the Peckham Car Wheel and Axle Co., of New York City, was also present to explain the merits of his late improved truck.

Captain W. L. Candee was on hand representing the well known Okonite wire and making many acquaintances.

INCANDESCENT LIGHTING.

We illustrate herewith a dynamo which is known as the Thomson-Houston Incandescent Dynamo. It is of the direct system type and is placed where all the lighting is done by incandescent lamps.

The regulation of this machine, which is absolutely automatic, is not accomplished by means of external resistances, which necessitate so much attention, as in other systems, but is effected by means of inclined series coils disposed around the armature.

It is absolutely indispensable that a dynamo for such work shall maintain a constant pressure on the lines, no matter what the load may be, and the fact that this requirement is most emphatically complied with in this dynamo, makes it especially adapted to use where the dynamo can receive only the occasional attendance of the one who has it in charge.

With this system of regulation, a large proportion of the lights may be extinguished without causing the annoyance of sparking and cutting at the brushes, so noticeable with some systems. Neither is the brilliancy of the lamps caused to vary, a fact which has much to do with their long life. The dynamo has to be oiled and cleaned as does any other piece of machinery, and there are other details of its operation with which an ordinary mechanic cannot easily familiarize himself. This type of dynamo is made in nine sizes, from 30 to 400 lights' capacity, and each dynamo furnishes current for ten lights of 16 c. p. to 1-horse power consumed.

The Cincinnati Corrugating Co., of Piqua Ohio, by means of their special machinery, are now corrugating sheets as heavy as No. 12, and in lengths up to 10 feet, for which there has been such a demand in engineering and building circles, for special construction. The attention of architects and builders, generally, is called to this as a new feature in special construction and it will no doubt be appreciated, especially for arches.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Sept. 20, 1890.

Mr. D. J Cartwright, the well-known electrical inventor will spend a deserved vacation of two weeks at Willow Dale, Mass.

S. B. Paine of the firm of Paine & Francis, has been appointed sole agent for the sale of Edison fittings in New England.

The Newton Aldermen have ordered the Newton Street Railway Company to remove their tracks from the side to the centre of River street, West Newton.

The Fitchburg Street Railway Company petitioned the selectmen of Lunenburg for permission to use electricity as a means of propulsion on its lines in that town.

The Rockville, Conn. Gas and Electric Company will place at their works next week, the largest gas engine ever built in this country. It is 1,000 h. p., and weighs 30,000 pounds.

The electric road between Great Falls and Dover, N. H., is completed, and cars are running every forty minutes, with extras every pleasant day to accommodate the crowds. This is the first electric road in New Hampshire.

The Eastern Electrical Supply and Construction Company have had a large force of carpenters at work, and the fittings in their commodious store at 63 Oliver street, are now in place. They have now a large number of orders to fill, and business with them starts with a boom.

The Kimball Manufacturing Co., manufacturers of electrical wood work have purchased a large and commodious factory in Charlestown where they will move immediately. By the move the company will treble their capacity. The officers of the company will remain as now, on Portland st , this city.

Stephen E. Barton, of the Electric Mutual Insurance Company, attended the Minneapolis convention. Capt. Brophy of the same company, read a paper at the convention of the Fire Chiefs at Lawerence, a few days since. His subject was "The best method of handling live electric light wires at a fire."

At Lynn the L. & B. R. R. Co. has made arrangements for a temporary electrical plant to give it additional power for operating the lines it is now equipping. Two generators have been placed in the rear of J. G. Brown's factory on Union st., in the engine room of the Central Power Co. This will give them 125 horse power additional. By three weeks more they expect to have four cars wired ready to run from Houghton st. to Wyoma. By next fall the company expects to have its whole Lynn system running by electricity. President Breed estimates that it costs $1.25 per hour to run electric cars, while with horses the expense is $1. The electrics will run eight miles per hour and horses six. This, he thinks, equalizes the expense.

Dr. Mason of the Simplex Electrical Company, at his office 620 Atlantic ave., this city, proudly exhibits a piece of simplex wire that had been for four years in the dye house of the Riverside Worsted Mills, at Providence, R. I., and which was yet perfect, although exposed to hot steam heavily impregnated with acid for ten hours each day during that time. Samples of other wires used in the same place and for a shorter period were also shown but the insulation was either destroyed altogether or rendered entirely worthless, and the wire affected so that it was broken. The screws which held the procelains on which the wire was fastened were also shown and the effect of the hot steam and acid can but be judged when it is said that nothing was left of the screws but a streak of rust. These samples together with a large order for more "simplex" were sent unsolicited by Herbert Wiswall, one of the officers of the Riverside Company.

The Standard Electric Company of Vermont have just completed the installation of the following isolated plants: Republican Press Association, Concord, N. H., 300 lights ; A. W. Sulloway, Franklin Falls, N. H., 300 lights ; Winnipiscogee Paper Co., Franklin Falls, N. H., 100 lights; National Needle Works, Springfield, Mass., 300 lights ; Cardiff Mills, Millbury, Mass., 300 lights. This company has the contracts for and are now installing a large number of isolated plants throughout New England.

LYNN. — Work upon the foundation of the Thomson-Houston's new factory commenced this week. The castings for a 2,400 light dynamo machine are in Factory K ready to be assembled. This will be 260 horse-power, ten more than that of the big generator now being tested in the welding works.

The company has placed an experimental conduit between its electrical railway tracks on Federal street. It is a Thomson-Houston invention, embodying the ideas of several heads. The overhead system is favored by the company, but they propose to be so well prepared that they can lay conduits in cities where the drainage is such as to make it practicable.

Rudolph M. Hunter has patented a device for electric railways consisting of the usual combination of an electric conductor, an electrically propelled vehicle, a contact device consisting of a part hinged or flexibly connected to the vehicle and laterally movable at its free end to or from the conductor spring devices to hold it in the line of travel and contacts on the free end making connection with the conductor. Another patent of Mr. Hunter's covers in an electric railway. A slotted conduit of considerable depth, a movable metallic plate adapted to be secured across the conduit near the top, connecting the side walls thereof, upwardly extending insulators carried by said cross plates, and a working conductor electrically independent of the cross plate.

C. J. Van Depoele's new reciprocating electric drill is working very satisfactorily. He has shown great ingenuity in his invention, having, by a peculiar arrangement of brushes harnessed the alternating currents of the usual type of dynamo, so as to secure the necessary reciprocal action in the drill. The whole apparatus is an assured success. The only work now in progress is the perfecting of certain accessories. Tripods and other devices to hold the drills when in actual operation in the mines have yet to be built. It will be a year, some time during the present month, since Mr. Van Depoele secured the services of Electrician Fiego and commenced the construction of his first drill at his home on Highland square. If the manufacture of the drills had commenced at this time he would not have been able to supply the demand already made for these machines. The industry is bound to become one of great importance.

The pith of the paper read by Capt. Wm. Brophy at the meeting of the Massachusetts State Firemen's Association, in Lawerence, September 12, He began by alluding to the dangerous elements of the electric currents. "The law of the electric current is as simple as hydraulic power, and to any one of ordinary intelligence, it would be a foolhardy attempt to grasp the wire of a fifty horse power engine. It would be equivalent to attempting to stop a 35 horse power engine." He drew a diagram, showing the simple circuit of arc lights, the generation and return circuits, then arc, the volt, the unity system and the ampere, and explained the pressure on arc lights and the amount of friction caused by their maintenance to grasp a wire, or to be cut or broken would undoubtedly cause instant death, and metal cutters with wooden handles should not be used. The electric current would send about 3 1-10 horse power through a person's body, which is all he could resist. Wires that go into stores supplying a few lights would not produce fatal results. Perfect freedom from metallic circuits is necessary.

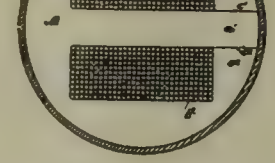
He spoke of the dangers attending coming in contact with dead wires: "The careful superintendent of electric wires will be careful to remove every possible cause of danger. There is no danger from wires which furnish incandescent lights for houses. I would advise that the wires shall be placed under the control of the fire department, when fires occur and switches provided in localities where the engineers could cut off the current when necessary. Do not go between parallel wires if you can avoid doing so. When cutting wires use insulated cutters and wear gum boots. The trolley wires are more dangerous, and much care should be used in meddling with them. It would be extremely disastrous to a person to interfere with them. Electric cars have come to stay, but time will make the dangers less than they are now. Accidents have gradually decreased, and will become less in the future."

W. J. P.

NEW ELECTRIC CONVERTER.

Mr. George Westinghouse has recently been awarded a patent for an Electrical Converter which is described as follows:

The combination of primary and secondary conductors enables to be placed a core of soft iron plates circular in form, each plate having two openings for receiving the coils, the metal about each opening being cut apart, and a



NEW ELECTRIC CONVERTER.

cylindrical inclosing-case for the same. Provision is made also for a core of circular soft iron plates or disks, and an inclosing tube of soft iron, also a core of soft iron cylindrical in form and composed of thin plates, in combination with a lamp-post of iron, having a cylindrical opening containing the same and in magnetic connection therewith.

In a circular issued by T. W. Ness, the well-known electrical establishment of Montreal, Que., our leading editorial on the telephone which appeared in the issue of Sept. 13th, is printed in full. This establishment manufactures telephones of all descriptions, as it is well known that the Bell people have no patents in Canada.

The subject of electric train lighting is still giving the railroad magnates something to talk about. They desire the electrical people to solve the question for them. They desire very much to have their trains lighted by electricity and hope soon to have some simple and feasable plan brought to their notice. They appear to think the placing of a dynamo on a train is too great an expense, for the reason that an electrical engineer must accompany each train.

The annual convention of the American Street Railway Assocation will be held at Buffalo, N. Y., October 15, 16 and 17th. It promises to be an important meeting. A great deal of time will be devoted to the electric motor and many interesting exhibits will be shown.

If has been asserted by numerous newspapers that a Judge in New York city had recently decided in a case before him that a contract made by telegraph was not binding When asked how he could possibly make such a ruling, he replied that he had never made any such decision. He added, "I never in that or any other case made a rule that contracts by telegraph were not valid."

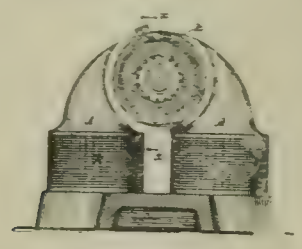
ELECTRICAL PATENTS ISSUED SEPT. 19TH, 1890.

435,967. Electric Lamp. William D. Graves, Cleveland, Ohio, assignor of one-half to Frank J. Stafford, same place. Filed Apr. 30, 1890.

435,982. Regulator for Dynamo-Electric Machines. William Stanley, Jr., Great Barrington, Mass. Filed Oct. 17, 1888. Renewed Apr. 26, 1890.

435,983. Electrical Traction Apparatus. William Stephens, Santa Rosa, Cal. Filed Mar. 21, 1890.

435,985. Rheostat. Frank Thone, Oskaloosa, assignor to the Hawkeye Electric Manufacturing Company, Davenport, Iowa. Filed Aug. 1, 1888.



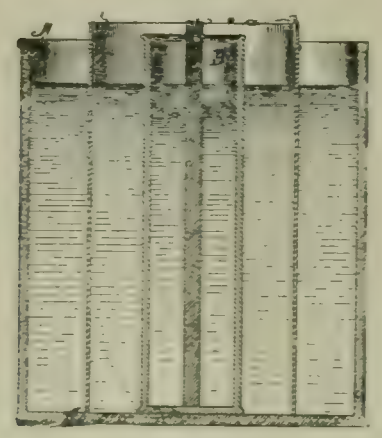
NO. 435,982. REGULATOR FOR DYNAMOS.

436,001. Electrolyte for Galvanic Batteries. Frank K. Irving and Frederick M. Hill, Brooklyn, assignors of one-third to Theodore W. Bayaud, New York, N. Y. Filed Jan. 3, 1890.

436,023. Electric Detonator or Primer. Henry J. Smith, Pompton, N. J. Filed Dec. 14, 1889.

436,030. Electric Burglar or Automatic Fire Alarm. Edmund R. Wilder, Kansas City, Mo. Filed Nov. 29, 1889.

436,050. Secondary Battery Plate. Thomas P. Whittier, Saginaw, Mich. Filed May 24, 1890.



NO. 436,001. ELECTROLYTE FOR BATTERIES.

436,080. Reciprocating Snap-Switch. Jacob S. Gibbs, Manchester, and Charles G. Perkins, Hartford, Conn. Filed March 3, 1890.

436,087. Cut-Out for Electrical Translating Devices. Charles G. Perkins, Hartford, Conn. Filed Nov. 27, 1886.

436,102. Cable Railway. John H. Pendleton, Brooklyn, assignor to the Rapid Transit Cable Company, New York, N. Y. Filed Mar. 18, 1890.

436,104. Cable Railway. John H. Pendleton, Brooklyn, assignor to the Rapid Transit Cable Company, New York, N. Y. Filed Mar. 27, 1890.

436,105. Grip Mechanism for Cable Railways. John H. Pendleton, Brooklyn, assignor to the Rapid Transit Cable Company, New York, N. Y. Filed Mar. 27, 1890.

436,106. Cable Railway. John H. Pendleton, Brooklyn, and Cornelius Tiers and Andrew Bryson, Jr., New York, assignors to the Rapid Transit Cable Company, New York, N. Y. Filed June 19, 1890.

436,107. Electric Switch. Charles G. Perkins, Hartford, Conn. Filed Oct. 30, 1889.

436,113. Magneto-Electric Machine. La Motte C. Atwood, St. Louis, Mo., assignor to the Atwood Electric Company, same place. Filed May 17, 1890.

436,119. Electric Soldering-Iron. Charles E. Carpenter, Minneapolis, Minn., assignor to the Carpenter Nevens Electro-Heating Company, same place. Filed June 21, 1890.

436,120. Insulator-Bracket. H. Eugene Chubbuck, Springfield, Ohio. Filed Nov. 4, 1889.

436,122. Double-Pole Snap-Switch. Howard H. Crowell, Syracuse, N. Y. Filed May 22, 1890.

436,125. Electric Lighting and Heating Apparatus for Electric Railways. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed Mar. 14, 1890.

436,127. Electric Motor. Thomas A. Edison, Llewellyn Park, N. J. Filed May 24, 1890.

436,154. Electric Signal for Railroads. Frank C. Schroen, Baltimore, Md. Filed May 13, 1890.

436,168. Electric Danger and Safety Signal for Railroads. Edward M. Burt, Paris, Ill. Filed Mar. 29, 1890

436,191. Railway Signal. James Richardson, Bayard, Ohio. Filed May 26, 1890.

436,200. Electric Converter. George Westinghouse, Jr., Pittsburg, Pa. Filed Jan. 11, 1887

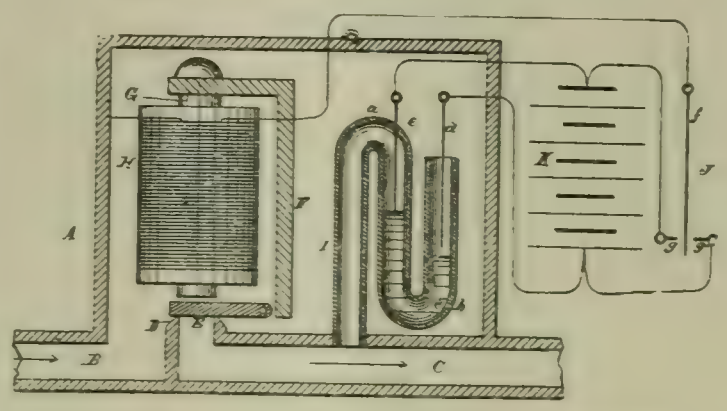
436,219. Electric Valve-Controller. Harry W. Deeds, Indianapolis, Ind, Filed Mar. 20, 1890.

436,238. Lightning-Arrester. George D. Hoop, Jackson, Ohio. Filed July 7, 1890.

436,275. Pulsating-Current-Battery System. Charles J. Van Depoele, Lynn, Mass. Filed Apr. 9, 1890.

436,276. Adjustable-Current Reciprocating-Engine System. Charles J. Van Depoele, Lynn, Mass. Filed May 14, 1890.

436,277. Electric Power Hammer. Charles J. Van Depoele, Lynn, Mass. Filed May 23, 1890.



NO. 436,219, ELECTRIC VALVE CONTROLLER.

436,281. Portelectric. John T. Williams, Mount Vernon, N. Y. Filed Sept. 12, 1889.

436,316. Electric Incandescent Lamp. John S. Potter, Newton; David J. Cartwright, Boston, and Benjamin B. Keyes, Chelsea, Mass.; said Cartwright and Keyes assignors to said Potter. Filed July 5, 1890.

ON UNITS OF LIGHT AND BRIGHTNESS.*

BY PROF. DR. LEONHARD WEBER, BRESLAU.

Unit of superficial brightness: Important, but neglected. Suppose a luminous point be the source of light, the intensity of which is, I say, so many candles; then at the distance, *d*, the *quantity* of light which falls on a surface (at right angles to the rays of light), the superficial area of which is *a*, may be represented by $q = I a d^{-2}$. But if we take into account the superficial brightness, or brilliancy, of the source of light, we must substitute for the term I, or intensity of the source of light, another term—namely, A·B., or the product of the *area* and the *brilliancy* of the source. Similarly, we may consider the brilliancy of illumination of the area illuminated; and this brilliancy (which we may represent by *b*) is found by dividing the quantity of light falling on the whole of that area by the area itself; that is, $b = q/a$. Thus we have three simple algebraic equations connecting the terms of our statements: these being (1) $q = Ia/d^2$; (2) $I = A \cdot B$; (3) $b = q/a$. To use these equations it will be necessary to fix our units of reckoning. Suppose we use, as the unit of bright or illuminated area, the square centimetre, and as the unit of distance the metre, then the second equation shows that the brilliancy B of an extended source of light is unity when it gives as much light per square centimetre (off its own area) as a luminous point of unit intensity would give at the same distance; and by combining equations (1) and (3) above we get the equation $b = I d$, which means that the brightness of the illuminated surface is unity when it gets as much light from the source as it would have got from a unit source of light at one metre distance; this being the basis of measuring illumination, as distinguished from light, in "metre candles" (or "foot candles"). If we start from a unit of brilliancy instead of a unit of intensity we will arrive at corresponding values, but in every case we must distinguish between the actual intensity of a source of light, or quantity of light, falling on an illuminated area on the one hand, and the brilliancy of the source, or brilliancy of illumination, on the other. Now, the great difference between the platinum unit and the candle is that the latter is a standard of actual intensity only; while the former, since it defines the area of the source, is a standard both of intensity and of brilliancy. The amyl-acetate lamp gives a flame of about 2.27 sq. cm. in effective area; so that its actual lighting power being so-and-so in platinum units, its brilliancy will be less in the ratio of 2.27 to 1.

The range of brightness or brilliancy is extreme. A sheet of printed paper which we can just read is some thousand millionfold less bright an object than the sun at noonday; but the estimation of brightness is a matter of increasing importance, both with regard to the source of light and to illuminated objects; and the use of a standard of brightness will help to make clear our comparisons. From this point of view, the actual light from a platinum unit being about 20 times that of an amyl-acetate lamp-flame, and the area of that flame being 2.27 sq. cm. the brightness of the platinum may, if we please, be represented as 20 in amyl-acetate units, and that of the flame itself as 0.4. On the same basis the brightness of the sun is about 160,000, that of the sky 0.1 to 1, that of a printed paper which we can barely read 0.00006, and that of a barely visible surface 0.000001.

A convenient subsidiary unit of comparison is the brightness of a piece of white paper at a distance of one metre from a unit source of light, and itself serving as a source of light, the brilliancy of which may be taken as a standard. But perfectly white matt surfaces cannot be obtained, and only approximate results could be reached in this way. It might also be of great advantage to use multiples of the unit of brightness, micro- and macro-units, as is now done with other units of measurement.

If the amyl-acetate lamp be adhered to, it might be used as a unit standard of brightness by taking only one sq. cm. of the flame; then other flames would be equally bright if one sq. cm. emitted the same quantity of light, and so on in proportion

The following data, partly obtained in the laboratory here, and partly due to Dr. Michalke, Trebnitz, will illustrated this matter.

For red light (wave-length = 640 ten millionths of a centimetre) 1 pt. unit=15.75 amyl-flames; for green light (w.-l. = 541) 1 pt. unit = 20.4 amyl-flames. Sperm candle = 1.12 amyl flame (Weber) 1.17 (Liebenthal). Violle makes the pt. unit equal in respect of white light to 18.5 sperm candles; whence it would be equal to 20.7 amyl flames (Weber) or 21.6 (Liebenthal): [its *brightness* will therefore be to that of the amyl-acetate lamp flame in the ratio of 20.7 to 0.4, or 83 to 1]

* From the *Journal für Gasbeleuchtung*, abridged.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Sept. 20, 1890.

Georgetown, Colo., is to have electric lighting. The plan contemplates running wires to Silver Plume and lighting that town also.

Mr. W. C. Hayes, Treasurer of the National Carbon Company of Cleveland, Ohio, was in the city looking out for business this week.

The South Chicago Avenue and Jackson Park Street Railway Company has been incorporated by Ira Holmes, David J. Lake and Charles D. Cole.

BASEBALL IN WELL INSULATED HANDS.—A lively game of baseball was played at Washington Park, on September 13th, by the Okonites, of the Central Electric Company, and the Kerites, of the Western Electric Company, resulting in a score of 28 to 9 in favor of the Okonites.

MR. C. A. CONE has just been appointed western agent for the Clark Wires. This, in addition to a fine line of batteries, cut-outs and specialties, and the agency for the Baxter motor will give Mr. Cone an excellent opportunity to indulge his well known propensity for "hustling."

A neat circular, in three colors, printed on heavy coated paper, has been received, calling attention to the rawhide pinions of which the Electric Merchandise Company make a specialty. These pinions, it is claimed, will wear about as long as those made of metal while they do away entirely with the objectionable noise made by the latter.

An electric railway will be built connecting the cities of Davenport, Rock Island, and Moline, the Thomson-Houston system being employed. The Illinois Electric Material Company have captured the order for poles for this equipment, amounting to 2,500, or over thirty car loads. This is one of the largest orders in this line ever given for street railway use.

THE Western office of THE ELECTRIC AGE is now located in very pleasant quarters at 1001 Opera House Block where all friends and members of the electrical fraternity will find themselves welcome. The office is a pleasant room on the tenth floor and commands a fine view of one of our busiest streets, and being among the upper elements good air and light are present in abundance.

A new invention is that of a collapsible railway car in which the principle of air cushions is applied to prevent dangerous accidents in case of collisions. The car will be in two compartments, one larger than the other and empty, so that when a collision occurs the smaller section will be forced into the larger, the air in which will act as a cushion and relieve the occupied section of the sudden shock.

The Great Western Supply Co. have just received a shipment of nineteen deer heads from the Yellowstone National Park. They are fine, mounted specimens, and, when fitted up with lamps, will give a number of handsome elkhead electroliers, similar to the one which we spoke of a few weeks ago. We understand that the most of these have been sold, and will be sent out as soon as they are wired up.

The Pullman Company has unsurpassed facilities for the manufacture of street cars. They have now in process of building more than three hundred cars, all for use on electric systems, and have twice had to increase their facilities in this department within the past two years. They have just completed the equipment of an electrical experimental line, of about one mile in length, which will afford excellent opportunities for testing cars as they are turned out and for experimenting with new systems.

The Rock Island, Davenport and Moline Railway, mention of which was made in a former issue, is to be ready for operation by December first. The rolling stock will consist of fifty cars to run on thirty-two miles of track. The line will cross the Mississippi River on the bridge between Davenport and Rock Island. The Thomson-Houston people, who are to furnish the electric equipment, take no little pride in this fact since the road is under the control of C. B. Holmes, the street railway magnate of Chicago, and the selection of their system by so eminent an authority is a commendation of value. The road, it is said, will be one of the finest in the country.

A NEW INCANDESCENT LAMP.—Prof. Charles B. Thwing of Evanston, Ill., is the inventor of a new lamp which is to be placed on the market by the Thwing Electric Company of this city. This company has just been organized with a capital stock of $500,000. Incorporators: Wilber J. Andrews, Charles E. Piper and Charles B. Thwing. The new feature of the lamp is the filament which is especially adapted to withstand the strains of high candle-power lamps. Lamps of 300-candle power have been constructed and are burning with a consumption of only 450 watts of energy, or about 1½ watts per candle-power. In small sizes, about 2½ watts per candle power is required.

NEW COMPANIES, with headquarters at Chicago:—Chicago Electric Supply Company, to sell electrical goods and patent same; capital stock $100,000.

Stark Car Motor and Manufacturing Company, to manufacture appliances for transportation; capital stock $25,000.

The Whiteside and Fuller Electric Manufacturing Company, to manufacture electric machinery and appliances; capital stock, $100,000.

Electric Railway Supply and Construction Co., to manufacture electrical goods; capital stock, $100,000.

Dyer Light, Heat and Power Company, of Illinois, to do a general lighting, heat and power business; capital stock, 2,000,000.

The visit of George Westinghouse, Jr., to Chicago, last week, was the signal for the announcement, on the part of the daily papers, of the Westinghouse-Pullman combination. The parties concerned, however, deny that there is any combination or will be, and the Pullman people call attention to the fact that they are making in their shops, at the present time, more cars for use with both the Sprague and Thomson-Houston systems than for use with the Westinghouse. That Mr. Westinghouse's visit did have in view the locating of works in the vicinity of the Pullman shops is not denied by either party concerned. Such an arrangement would probably facilitate the street railway motor work which the Westinghouse company has recently commenced and will probably be an accomplished fact in the near future.

The Railway Department of the Westinghouse Company have their new offices in the Pullman Building, now completely set in order, and Mr. J. L. Barclay is quite proud to show them. They are well lighted and beautifully furnished, and probably no finer offices can be found in Chicago. Mr Barclay's private office faces Adams street, from which it is separated by a glass front. It is also lighted by a handsome electrical chandelier. Another large and beautiful room is set apart for the entertainment of visitors, and here a phonograph is educated to discourse of the merits of the Westinghouse system, on demand. The various other rooms are arranged for convenience, and one is being fitted up with a complete station equipment, and will have a couple of trucks with motors in position, on exhibition. The Westinghouse Company are to be congratulated on the elegance of their new quarters.

The Owens Electric Belt and Appliance Co., have an exhibit, at the Electrical Exposition, which attracts considerable attention. In the centre of their space a covered vehicle, the sides of which contain advertising matter, runs upon a circular track. A safety bicycle is attached to the front of the car. The motive power is from three Pumpelly storage cells, which drive a C.C.C. motor, all being inside the car. A display of the various belts and devices made by this company complete the exhibit.

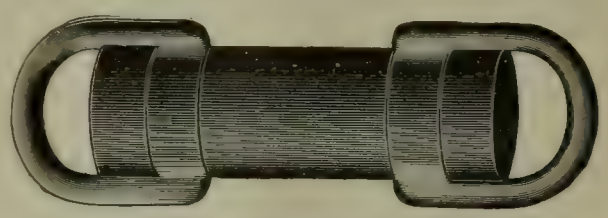
An interesting exhibit is that of a geometrical wood carving machine, the invention of C. L. Goehring, of Pittsburgh. The machine weighs nine tons, and its use is the carving of wooden panels, wainscoting, and the like. A thousand different patterns can be made by one machine by the mere adjusting of the gearing. The machine turns out from the rough lumber from ten to thirty feet of finished material per minute.

F. M. I.

ENGLUND'S CENTRE CURVE INSULATOR.

The insulator shown in the accompanying cut is for use where unusual strains have to be met. The managers of the Electrical Merchandise Company, Chicago, who are the owners of this patent, have, during the past few years, experimented very largely with a view of securing a center curve insulator which, while being neat in appearance, would have the requisite strength needed for all demands.

The objection to those heretofore made has been that to get the needed strength it has been necessary to have the insulator so heavy that it has been unwieldy to handle and heavy in



CENTRE CURVE INSULATOR.

appearance on the line, while if attempts have been made to lighten it, openings have had to be made which, filing with rain and snow, have destroyed the insulation.

All objections are done away with in the insulator illustrated. Apparently it is a solid but very neat coil of rubber of but nine inches in length, and when placed on the line is scarcely discernible. It is however protected on the inside of the rubber so securely that it will stand any strain which may be put upon it *even to holding the extreme ends of the line.* As a perfectly reliable device both for strength and insulation, it has no equal.

SIAMESE TELEGRAPHS AND TELEPHONES.—The Siamese telegraph service has lately been considerably improved. The department is under the control of a Siamese prince, and most of the *employés* are either German or French. New telegraph stations have been established at Rathburi, Petchaburi, and Bangtapham. A system of telephones has been laid down in Bangkok, with connections and exchanges on both sides of the river. All the large firms and trading houses, and many private individuals, are subscribers.

The Detroit Electrical Works has issued a very interesting circular letter describing what is now generally known as the Rae Electric Street Railway System. It is said that one of the features of this system is its absolute freedom from noise while in operation. Notwithstanding that over seventy cars have been in use for some time on different roads throughout the country, it is said that not one armature or field upon any of the cars has been lost from any electrical cause whatever, and in fact they go further and state that during the past six months none have ever been lost from any cause.

THE RESIDUAL CHARGE OF CONDENSERS.

In an article in *Comptes Rendus* M. Bouty describes his two methods of measuring the residual charge of condensers. In the first the condenser, after having been charged for three or four hours, was short circuited for a time θ and insulated for a time t, after which the charge liberated in this time was measured. In the second method, which was less direct but more exact, the condenser A to be tested was joined up in series with a subsidiary condenser B, and with a battery of small resistance and constant electromotive force E. The auxiliary condenser B was short circuited for a time θ, after which the condenser A was allowed to charge B, in cascade, for a time t. If x and y are respectively the potentials of the condensers A and B, and if the capacity of A is K, while that of B is unity.

(i.) . . . . . $x + y = E$

(ii.) . . . . $d\,K\,x = d\,y$:

or since E is constant we have

$$d\,x - d\,y = 0$$

$$K\,d\,x - x\,d\,K = d\,y :$$

From these we obtain

$$d\,K = \frac{K+1}{E-y}\,d\,y.$$

or since y corresponds with the residual charge, and is very small compared with E,

(iii.) . . . . $$d\,K = \frac{K+1}{E}\,d\,y.$$

It is, then, sufficient to measure the charge $d\,y$, acquired by B in a short time, to deduce the increase, $d\,K$, of the capacity of A, and the increase, $E\,d\,K$, of the residual charge during the same time.

The times θ and t varied between 0.001 seconds and 4,000 seconds. For the longer intervals the commutations were made by hand, but for the other a torsions pendulum with mercury contacts was employed. A capillary electrometer was calibrated and used to measure the potentials.

The results of the experiments are briefly as follow :

1. The residual charge liberated between the times θ and $\theta + t$ with the first method is identical with that absorbed by the same condenser in the second method between the same times θ and $\theta + t$.

2. The residual charge is proportional to the electromotive force of the battery used.

3. For a subdivided condenser the total residual charge is equal to the sum of the residual charges of the different parts, but these are not necessarily proportional to the capacities of the corresponding subdivisions.

4. For a Carpentier condenser, the residual charge R, liberated between the times θ and $\theta + t$, is given by the formula

$$R = A \left(t + \theta - \theta \right) :$$

or between 0 and t,

$$R = A\,t^{n},$$

where A is a constant.

5. The residual charge is small compared with the total charge. Taking the latter as unity, M. Bouty finds the following values for the residual charge of a Carpentier microfarad condenser :

[illegible]

These results are only exact if the battery employed has a small internal resistance. If a resistance is introduced into the circuit, or if a Latimer Clark cell of high resistance is used, the results are no longer precise. The batteries employed were very large so as to have small resistance.

M. Bouty points out that errors arise in the determination of specific inductive capacity owing to uncertainties caused by residual absorption, and proposes to apply his results so as to obtain new and more accurate measurements. The investigation is also of value in determining the construction and mode of use of standards of capacity.

DETROIT NOTES.

Labor movements are not always failures. The telegraph messengers of the Postal Office, at the Board of Trade, locked that company out for a short time the other day because one of their number was discharged. The company capitulated and reinstated the youngster.

The Fisher Electrical Works report a brisk demand for their dynamos. They have recently put in a light plant on the steamer Maryland which is the largest steam vessel on the lakes. The plant consists of 400 lights, and is the largest ship installation the company has turned out of the factory. Their smallest plant is on a yacht and supplies 20 lights. The Fisher Electrical people are using Grimshaw wire altogether, and say that they find it so good they are satisfied to let well enough alone.

The Detroit Motor Company are just completing a model factory on the corner of Cass avenue and the Michigan Central Railroad. The building, which is of brick, is L shaped, the Cass avenue side being three stories high, with a superficial area of 50 x 100 feet, while the length of the side parallel with the railroad is 250 feet. One of the most striking features of the building is the great abundance of light. When ready for operation it will be one of the most thoroughly equipped factories that can be found in the land. A large fireproof vault has been provided for the preservation of models, etc., and nothing has been left undone to make the factory a model of its kind. When in full operation 300 persons will be employed. The company makes motors of power varying from ½ to 40 horse power, and they report that their motors are being extensively used for elevator work.

The Detroit Dynamo Company report an active demand for their dynamos particularly for plating. The "King" dynamo, which is the name given the machines manufactured by this company after the name of their electrician, Mr. W. R. King, is said to be a remarkably efficient machine, and the company claim to have indisputable evidence to substantiate their claims.

Rapid transit is a subject that is engaging the attention of the citizens of Detroit at the present time. Everybody is complaining of the slow horse cars, and are hoping for a more rapid system of transportation of some sort. The city railway has made a proposition to introduce electricity as motive power, but objection to the overhead wires, which system they would adopt, seems to be strong in some quarters. The local press are agreed that some system of rapid transit is a great necessity, but are opposed to overhead wires. They are in favor of the storage battery, or underground conduit system, both of which, they assert are perfectly practicable.

The Detroit Telephone Exchange officials vied with each other in their endeavors to afford the members of the Telephone Exchange Association as much enjoyment as possible, during their stay in this beautiful city, and the praise bestowed upon them by their guests was generous and hearty. They made many friends, and their hospitality will always be a pleasant memory. They are a fine body of gentlemen, which sentiment was voiced by all who had the pleasure of being their guests.

Detroit is very proud of its electric light system, and well it might be, for lights are plenty. There are no less than 112 light towers distributed throughout the city, each tower supporting four arc lamps. The light from these towers sheds its rays for many blocks.

The New York delegation to the Convention created a very favorable impression on all with whom they came in contact. It was remarkable for the number of young men it contained, but that they were men of great intelligence was evidenced in debate during the meetings. They are all active workers, and much of the efficiency of telephone practice of to-day, is due to their enterprise and ingenuity. Young blood is the life of the telephone, and New York has a good deal of it.

ST. LOUIS ELECTRICAL EXHIBITION.

One of the most striking exhibits, as indicating the great advance of home manufactures, is that displayed by Queen & Co., of Philadelphia. This enterprising firm show a full line of their Standard Electrical Test Instruments, and for the benefit of those who have not the opportunity of viewing the exhibit, we will say a few words regarding what may be seen.

First should be mentioned the collection of Resistance Boxes, which is probably the finest assortment of American make ever placed on exhibition. The "Queen" Standard Resistance Box, No 1 : Standard Hegolm Box, No. 2, and a full line of their new Portable Testing Sets make a showing that will interest every electrician. These testing sets appear to possess valuable peculiarities, used only by Queen & Co.; and there is a great demand for them.

Ammeters and voltmeters for all classes of work are attractively shown. Well known types are to be seen, such as the "Ayrton and Perry," "Deprez Carpentier," Cardew Electro-dynamometer and also Queen's new "Magnetic Vane" Meters, which, while but recently placed on the market, are finding many friends. They are adapted for central stations, electric railways, marine plants, isolated plants, etc., and the low price at which they can be obtained place them within the reach of all.

Reading telescopes, galvanometers, speed indicators, testing batteries and other instruments, together with those mentioned above, go to make up an exhibit that reflect great credit upon Queen & Co.

STREET RAILWAY STATISTICS.—According to census bulletin 11, devoted to street railway statistics, it is shown that Jan. 21, 1890, the street lines of the 56 principal cities, comprising 286 lines or companies, were operated as follows :—

	Miles.	Per Cent.
By animal power	2351.10	74.62
By electricity	260.36	8.26
By cable	255.87	8.12
By steam (elevated)	61.79	1.96
By steam (surface)	221.81	7.04
Total	3150.93	100.00

Thus no less than a quarter of the city railway mileage and much more than one quarter of the track mileage and traffic have already passed beyond the horse stage of development.

ELECTRIC TRACTION IN GERMANY.—The Berlin *Tageblatt* says that the question of electric railways is about to be taken up seriously in Germany.

The Rochester Electric Light Company's station is situated immediately adjoining the falls, at Rochester, N. Y. It is one of the best locations for a power and light station that could be selected. There is a fall of 85 feet which operates four 23-inch water wheels of the Leffel pattern. There are four 8-inch belts connecting these wheels with the dynamos, which are on a level with the street and some 90 feet above the water wheels. Each belt is 187 feet in length. The belts run at the rate of 1¼ miles a minute. Twenty six Weston dynamos are in constant use to furnish light for 450 arc lamps scattered around the city and 1400 incandescent lamps. In addition to this, current is furnished for power in all parts of the city. This is undoubtedly one of the most economical plants in America.

Telephone Companies, Supply Houses, Bell Hangers, Physicians, and all users of open circuit batteries are requested to write the

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THE WESTON STANDARD
Voltmeters and Ammeters



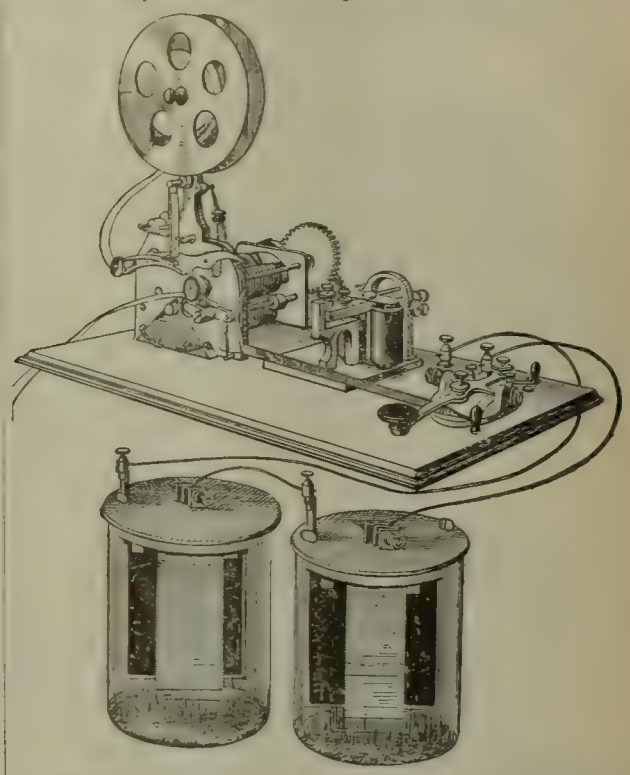
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SEND FOR CIRCULAR.
See cut of styluses in June 21, 1890, issue.

Mr. G. W. Hart, of Kansas City, Mo., was at Minneapolis with an eye on business. He represented the Hart Snap Switch, manufactured by the Hart & Hegeman Manufacturing Co., of Kansas City.

Mr. Robert Coleman was present in the interest of the Indurated Fibre Company, of New York.

MINNEAPOLIS EXPOSITION NOTES.

Much of the success of the Exposition is due to the energy of Mr. Wm. M. Reagan, the secretary and general manager. Mr. Regan is a man of genial disposition, and makes many friends. The members of the electrical press who were in Minneapolis in attendance at the Edison Convention, received many courtesies at his hands, which were gratefully appreciated. Mr. Reagan is a quiet and unassuming gentleman, but is a man of great ability as an organizer and a manager.

The Thomson electric welding machines attract a great deal of attention and excite great wonder and interest among those who witness their operation. How inch and a half bars of steel can be welded by electricity in less than a minute, without any hammering, etc., is enough to excite the wonder of anyone, when the facility of accomplishing such work is compared with the old methods. The operation of the machines is already so familiar that any explanation here would be out of place.

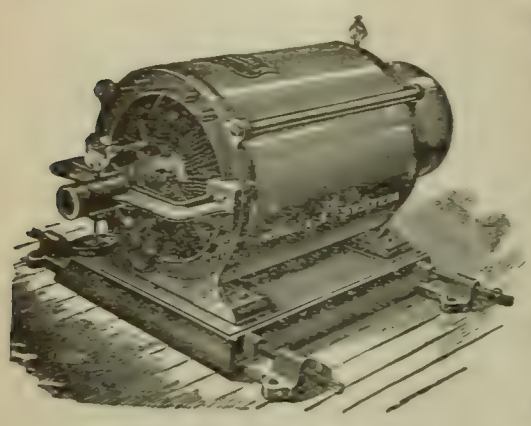
An exhibit which attracted the attention of the housekeeper more than any other was that of the Carpenter Nevens Electro Heating Company. The exhibit was a very complete one, and showed the many applications of electric heating to domestic work. Water was made to boil, and flat irons were heated to the proper degree for ironing. Pan cake bakers and ovens were also in operation, and cakes, etc., that were cooked were devoured by the more gritty ones of the crowds of on lookers. Some were rather skeptical about doughnuts and cakes being baked by electricity, lest there might be some of that subtle fluid mixed in with the dough, and, in their minds, the consequences of eating electricity might be awful.

The Edison Electric Illuminating Company of Brooklyn has filed at Albany a certificate of increase of capital from $600,000 to $1,500,000 for the purpose of extending its plant. The existing debts and liabilities of the company are $167,440.

Awar[illegible]eHighest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889

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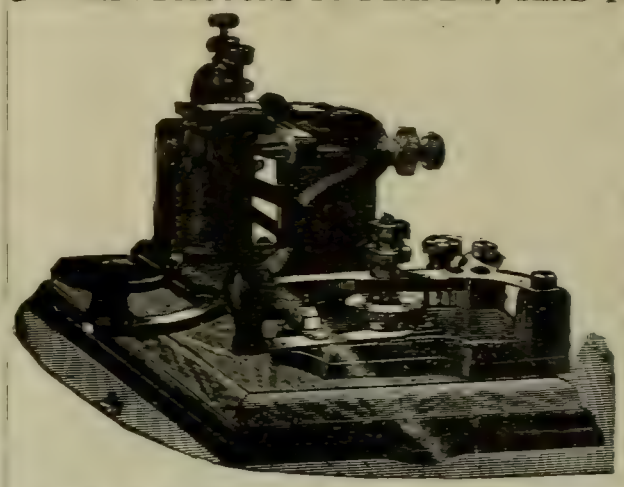
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THE FUTURE OF THE ELECTRIC RAILWAY.

It really begins to look as if Mr. Villard's prediction that in five years electricity would supplant steam on railroads would be realized. The great electric railway system in Minneapolis and St. Paul; the road between Davenport, Iowa, and Rock Island, Ill., and the projected road of 45 miles in length, between Seattle and Tacoma, Wash., are great steps towards the realization of the prophecy. Step by step the great future of the electric railway is being developed.

The great peculiarity about a prediction is that it carries us from the present time to the future in one jump without any reference to what may be done during the interval. It is for this reason that predictions oftimes seem rash and impossible of realization, but when it is remembered that all great improvements are the result of gradual development, and that one step in advance leads to another, the prediction referred to seems a rational one after all.

Those who doubt the possibility of using electricity as the motive power on long lines of railway make a mistake in limiting future possibilities to present knowledge, but when we see and note the rapid strides made in the development of the electric railway we are constrained to believe that there is a reasonable basis for the prediction.

FARMERS AT THE MINNEAPOLIS EXPOSITION.—The exposition at Minneapolis affords at this time an extraordinary opportunity for the farmer element of the Northwest to go to the city and see the sights, and not a few of them seize it. Once in the building their eyes bulge out when they behold the wonderful things produced by the inventive genius of this great country, and many of the inventions our farmer friends see for the first time arouse great curiosity and wonder in their minds. Electricity, naturally, is the most wonderful thing of all, and the attendants in charge of the various electrical apparatus tell very funny stories of the questions asked them by these unsophisticated visitors concerning the machines. Dynamos have been taken for cider mills, printing presses, mangles, and various other devices, and when told their real object the expressions of wonder and astonishment on the faces of these people would form an excellent study for the painter.

RAILWAY LAMPS.—The demand for an efficient lamp for use on electric railways for car lighting, has led the Edison General Electric Company to produce such a lamp. Manifestly a 100-volt 16 candle power lamp could hardly be expected to render efficient service on a 500-volt circuit, but this very thing has been the practice in the past. So great was the disproportion between the current for which the lamp was designed and that on which it was used, that, naturally, unsatisfactory results were the consequence. The "railway lamp" is especially designed for use on 500-volt currents or less, and it is gratifying to see that some effort has been made to remedy the existing evils in this direction.

ANOTHER VIEW OF EDISON.—A Chicago paper recently allowed considerable latitude in its description of Mr. Thomas A. Edison, who, the paper states, honored Minneapolis by his presence at the recent convention in that city. "The man's personality has never been discussed," says the gifted writer. Then he goes on to describe the man whose personality has never been discussed. Edison, he says, "is a small, wizen-faced, dyspeptic looking man," etc., etc. This description of Mr. Edison's appearance is amusing to those who know him, and the writer of the article may be greatly surprised to learn that Mr. Edison is a pretty large and healthy looking dyspeptic, and anything else but the man he is in this instance pictured to be.

ENTERPRISE OF THE ELECTRICAL PRESS.—Has it ever struck electricians, remarks a daily contemporary, that their journals are head and shoulders above those of any other trade or profession extant? It is true. Their illustrations are always of the finest that art can produce; their leaders are the product of the pen of thoroughly versed scientists and good writers, and nowhere else is there the enterprise manifest in these bright, newsy exponents of electricity. What other classes of journals take the trouble or go to the expense of sending for stenographic reports of all the special conventions held in the interest of the science?

FIRE ON AN ELECTRIC CAR.—The unbelievers in electric railroads have now what they will think is another good point for argument against electric roads. An electric car in Meriden, Conn., took fire the other day through the short circuiting of the current. Occurrences of this sort are very rare, but that will make no difference to those who have a reason, or think they have, for decrying electric railways. It would be well for these persons to bear in mind, however, that kerosene lamps in street cars are the cause of a greater number of fires in such vehicles than electricity is.

SUBSTITUTE FOR COPPER.—Some of these days the world of electricity may be surprised by the announcement of the discovery of a perfect substitute for copper for electrical purposes. The vast and increasing consumption of this metal, and the copper trust in this country and in Europe are incentives to experimentation on the part of chemists to produce a substitute for the metal. Copper is by far the most expensive item in every electrical plant, and he who succeeds in finding out how to produce as good results by the use of some other material, at less cost, need not die in poverty.

HYDRAULIC ENGINE.—On another page we describe and illustrate a valuable combination of a water motor with a steam pump, whereby power may be obtained from the water for the purpose of driving machinery. It will particularly interest electric light managers to read this article carefully and consider the possibilities of this new and economical method of obtaining power for running dynamos, etc.

TOWER OF LIGHT AT THE PORTLAND, ORE., EXPOSITION.

We are in receipt of the following interesting letter, dated Sept. 27th, from Mr. F. R. Upton, General Manager of the Lamp Manufacturing Department of the Edison General Electric Co., at Harrison, N. J.:

"ELECTRIC AGE, New York:

Gentlemen—You are probably aware that at the Exposition now being held in Portland, Ore., a tower, very similar in constructon and appearance to the one which was called the 'Tower of Light' at the Lenox Lyceum last spring, has been erected, and lighted with Edison miniature lamps. This is set in a large bank of flowers. The tower of festoons contain about 3,000 lamps of 4 candle power each. We have received a telegram this morning from Portland, Ore., stating that the tower was completed in time to be lighted on the opening night and was a great success, giving entire satisfaction to the management and winning much applause from the public."

THE EDISON-EICKEMEYER MOTOR.—The adoption by the railway department of the Edison General Electric Company of the Eickemeyer armature for railway motors, is an important and significant step, the details of which are given on another page. The record of the Eickemeyer dynamo is a most excellent one, and the peculiar construction of the armature has been found to be of special advantage in motor work. With this important change there is no doubt that the railway motor of the Edison General Electric Company will be greatly improved, and its efficiency will be brought up to a high degree. In the Siemens armature, which has been used heretofore, the crossing of the wires at the ends has always been the weak point. Short circuiting is liable to occur, particularly in railway work, where there is necessarily more or less jarring which is detrimental to the stability of the coils. In the Eickemeyer armature, however, no such danger exists. There is no crossing of wires, the coils being wound separately on a form, then assembled on the armature core. It is therefore possible to remove any one coil from the armature in case of trouble, without having to unwind all of the wire and re-wind it, as is necessary with the Siemens armature. This feature of the Eickemeyer armature is a valuable one, and will be found specially so in railway work. Owing to the peculiar method of winding the coils, the liability to short-circuiting is greatly diminished, and the two years record of the Eickemeyer dynamos, we understand, does not show a single case of burning out.

UNDERGROUND WIRES IN BUFFALO.—The Brush Company's wires in Buffalo are now all underground. It cost the company $40,000 to place them under the surface.

ALUMINUM.—The Pittsburg Reduction Company, the only manufacturer of aluminum for commercial purposes in the United States, is preparing plans for the erection of an immense new plant. Several sites up the Allegheny and Monongahela rivers are now under consideration, and one is likely to be decided upon in time to begin work this fall. Nearness to the natural gas or soft coal fields is the most important requirement for the new site, and the one offering the greatest promise in this respect will be selected. It is proposed to erect a plant with 10,000-horse power, and to give employment to a large additional force of men. The present works of the company have a capacity of between 300 and 400 pounds of aluminum a day. There are but six aluminum plants in the world, one in Pittsburg and five in the old country. One of the latter, located near Manchester, England, began operations last month under the Pittsburg Company's patents.

THE SHORT ELECTRIC RAILWAY SYSTEM.

On August 28th last, the White Line Street Railway Company, of Dayton, Ohio, put into operation on their line some electric motors bought of the Short Electric Railway Company, of Cleveland, Ohio, and the results have been most satisfactory, and have amply demonstrated the superior qualities of that system of electric propulsion. The reputation that the Short Company's motors have for economy of current, quiet running, freedom from heating and immense reserve power, has been fully sustained in this instance, as the reports from the scene of operations show.

Each motor car draws one to three trailers, and the average daily run of each is 112 miles. The average daily work performed by the motors with trailers is equivalent to that of 35 horses. The road runs through the business part of the city out to the Soldiers' Home, and the work imposed upon the motor is excessively great, it being nothing unusual for the cars to carry 300 or 400 passengers each trip, during pleasant weather. To add to the work of the motors there are 5 and 6 per cent. grades, four or five hills being mounted on a stretch of a few miles.

During the severe storms in that section of Ohio, on Sept. 5th, every motor on the road excepting those protected by the Short lightning arrester was disabled. The fuses of the Short arresters were blown six times, and the lamp fuses once, but by the prompt action of the motor-man in replacing the burned out wires, the electrical machines were not damaged.

The first of the accompanying illustrations gives a view (from a photograph) of a Short Electric Motor Car on the Dayton line.

The second illustration, also from a photograph, is of a Short Electric Car in operation on the Citizens Street Railroad, Indianapolis, Ind. On July 25th last, the Citizens Street Railroad Company, sent by telegraph to the Short Electric Company an order for 5 motor car equipments, and on August 11th the first car was run out over the road. This speaks well for the despatch with which the Short Company fills its orders, and the Indianapolis equipment has given perfect satisfaction from the initial run. No trouble of any nature has occurred to delay the operation of the cars, and not a single trip has been lost.

The road is 6.5 miles in length and leads to Fairview Park, the popular resort of the city. The track is fine and very high speed is demanded of the motors, the average run when loaded being 15 miles an hour. From this road especially good reports are heard of the economy of the motors, the average current consumed by two 15 horse power motors drawing trailer, being a little over 18 amperes, or about 9 amperes each. When it is remembered that 36 wheels are under these cars, and the high speed mentioned is made, it will be seen that the claim made by the company for great economy in the motors is fully sustained.

The officers of the Street Railway Company are greatly pleased with the efficiency and quiet running of the motors.

Evidence of the increasing popularity of the Short motors and car equipment is shown in the many orders for additional equipment received from companies operating other systems.



FIG. I.—SHORT ELECTRIC CARS ON WHITE LINE STREET RAILWAY, DAYTON, O.

KEMMLER'S DEATH INSTANTANEOUS.—A microscopical examination of the blood taken from Kemmler immediately after his execution, by Dr. Miller of the Niagara University shows, said Dr. George C. Fell before the meeting of the American Society of Microscopists, held in Detroit, that the criminal's death was instantaneous and painless. The blood showed interesting changes. His theory is, and he says it is well established, that death is not due to the lesion of the tissues but is due to a shock such as often results from surgical injury.

EXCELLENT WORK ON AN ELECTRIC ROAD.—The Park Electric System of the Buffalo Street Railway Company, has been doing some remarkable work this summer. Four cars are running on this branch a distance of about one and three-quarter miles. The traffic on pleasant Sundays is extremely heavy, and each car is required to draw two trailers for a large portion of the day. This road is equipped upon the Edison system and has been in operation now for about fifteen months with remarkable results, the repair bills have been merely nominal, although the service called for has been excessive, particularly in the summer. The largest load ever carried was a little over twenty housand, the occassion being a large picnic, and the time being two days after the road commenced operation in July, 1889. But three motor cars were in service on that day, and this remains the greatest record ever made by an equal number of cars up to the present time.

NEW BOOK.

"Technical Telegraphy" is the title of a neatly gotten up book of 85 pages just from the press of the London *Telegraph Journal.* The author is Mr. William Connolly, Honorman and Silver Medallist, City and Guilds of London Technological Institute, and the contents of the book, by chapters, are: Introductory; Static Electricity; Magnetism; Electromagnetism-Units; Batteries; Internal and External Resistance; Instruments (three chapters); Static and Dynamic Induction; Improved Systems; Repeaters and Telephones; Telegraph Construction; Measurements and Tests, and Causes and Discovery of Faults.

The book is well printed and is illustrated in a very clear manner. The language used is plain, so that a beginner may, with comparatively little effort, easily acquire an elementary knowledge of electricity as applied to telegraphy. Altogether it is an excellent little book and is possessed of valuable information.

A FEAT IN ELECTRIC RAILWAY CONSTRUCTION.

A remarkable feat of electrical railway construction has recently been completed in Elmira, N. Y. On the 30th of July the Elmira and Horseheads Railway Co. placed a contract with the Edison General Electric Company for the equipment of seven thousand feet of track, six motor cars, and a full station equipment. At the same time a contract was placed with the John Stephenson Car Company for six new cars of solid and elegant construction. The contracts were made in both cases with the strong guarantee to the effect that the road should go into operation on the first day of September in order to accommodate the Great Interstate Fair which was to open on that day. A full history of the efforts made by both supply companies to fullfil the guarantee would be interesting reading, as it called for the quickest time ever made in electrical railway construction. Both the Edison Company and the Stephenson Company put their best men upon the work, and forwarded supplies with the utmost possible dispatch. On or about the 15th day of August the Stephenson Company informed the Sprague Company that its cars were ready for equipment, and at about the same time the motors were shipped from the great Schenectady Works of the Edison Company, which have a capacity of from 15 to 20 street car motors per day. The strike on the New York Central at this time bid fair to cause very serious delays, as the cars were to be equipped in New York. A special consultation of the Edison Company and the Stephenson Company was held at Schenectady, with the result of causing the motors to be shipped via a roundabout route, which necessitated special cars and unusual expedition. On about the 20th of August the completed cars began to go out from the Stephenson factory, two being shipped each day. In the meantime a contract had been placed with the Simplex Company, of Boston, for the feed wire, the Edison Company had forwarded all line material and supplies, and everything was on the ground but the poles, which were held in northern New York, awaiting the arrival of cars which had been delayed on account of the New York Central strike. In this emergency every one turned in to help. Poles were gathered about Elmira, and at twelve o'clock on the night of August 23rd the street construction work commenced. Provision for the dynamos and appliances had been made by engaging a part of the Westinghouse station at Elmira. On August 31st notice was sent to the Railway Campany that the road would commence operations on the following morning, and promptly at six, A. M. on the first day of September the road carried its first passengers. For the next few days the tests of the machinery were excessive, the cars requently having to carry two loaded trailers, and to remain in service from early morning until late at night. The largest number of passengers carried by these electric cars, with their complement of trail cars, was a little over twenty-five thousand. The road was entirely satisfactory in every respect, and the present owners of the road have every reason to be grateful to both the Stephenson and the Edison Companies.

THE EDISON-EICKEMEYER STREET RAILWAY ARMATURE.

One of the most striking advances in railway motor construction which has recently been made is announced this week by the Edison General Electric Company, which has secured the use for its railway system, of the Eickemeyer patents for winding armatures. It will be remembered that the Eickemeyer Dynamo, for lighting purposes was brought out about two years ago, and created much discussion and favorable comment in the press. Since that time it has been actively exploited, and it is said that not a single dynamo armature wound on the Eickemeyer plan has ever burned out. The Edison Company have made a thorough examination of this winding, with a view to adopting it for its railway motors, where it will be particularly valuable.

The armature now used by all the leading electric railway companies are wound on what is known as the Siemens system, which has proved entirely suitable for dynamo work, but has some disadvantages in railway motor construction. In the Siemens armature the wire is so wound that when completed there is an irregular, cone-shaped mass of wires at the ends which have more or less motion among themselves. This motion has a tendency to abraid the insulation of the wires, causing short circuits of adjacent coils which may carry the maximum difference of pressure generated by the armature, and it is in this way that burn-outs frequently occur. Moreover, as the wire is wound in two complete layers, and as burn outs more frequently occur on the under than on the upper layer, the expense of repairing a burn-out usually amounts to nearly as much as that of re-winding the entire armature, since all the coils originally put on after the burned out coils have to be taken out in order to reach the latter.



FIG. 2.—SHORT ELECTRIC CARS ON CITIZENS' STREET RAILROAD, INDIANAPOLIS, IND.

ELECTRIC SNOW SWEEPERS.—The Short Electric Railway Company have received an order from the Rochester Railway Company for twenty-four 25 H. P. motors to be placed on the snow sweepers now being constucted by the Lewis & Fowler Mfg. Co., of Brooklyn, N. Y. These sweepers, six in number, will be heavier than any yet made by this company, and the motors are large and powerful. Two of them will be needed to operate the truck and one to run each broom, making four motors to each sweeper.

The Eickemeyer system of winding is radically different from the Siemens. Each armature coil is wound upon a form of peculiar construction, and comes out standard and interchangeable in every respect. (See Fig. 1). In building an armature originally, the laminated iron core is first prepared as in the Siemens armature, and upon this are loosely placed the necessary numbers of standard coils which are locked in places around the armature by means of the wooden pegs shown in fig. 2. The result is a square end, both front and rear, instead of the cone shaped end of the Siemens armature. The coils are held firmly in place with absolutely no chance for motion, and there is no

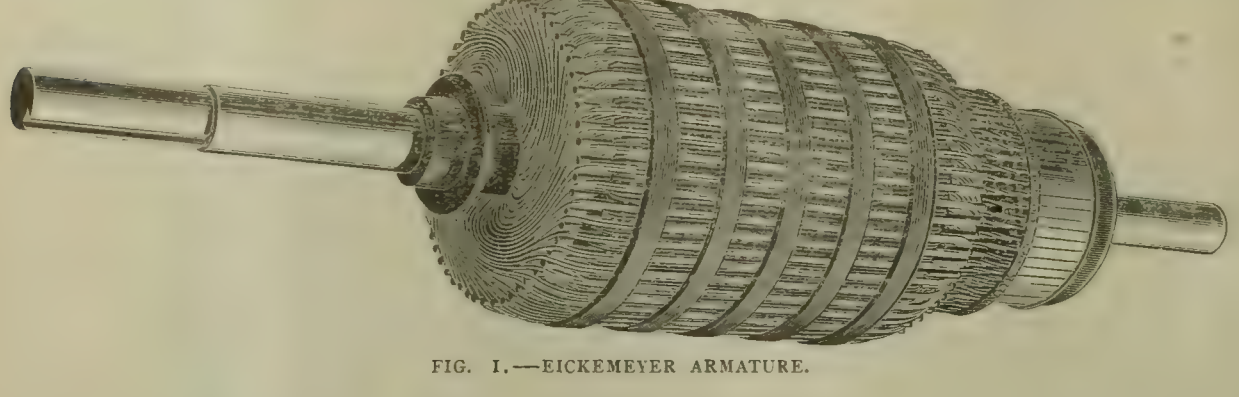


FIG. 1.—EICKEMEYER ARMATURE.

mechanical pressure from coil to coil which would tend to cause short circuit. The armatures are necessarily of standard diameter, and interchangeable, and it is believed that the Eickemeyer armature will never burn out except from dead overload causing melting of the wire, from accidental mechanical injuries, or from short circuit due to outside causes. If, however, an armature coil

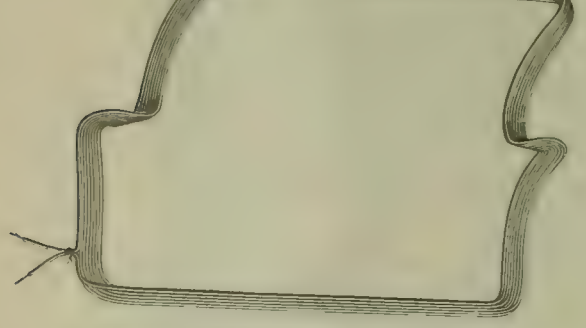


FIG. 2.—EICKEMEYER ARMATURE COIL.

should burn out from any of the causes mentioned it could be replaced without difficulty by any ordinary mechanic and without return to the factory, the whole operation consuming about a day's time and a small amount of materal. The Railway Company would be provided with a sufficient number of standard coils held in reserve.

From the cut (Fig. 2) the peculiar curvature of the coils at the rear is easily seen; the same curvature is found at the front end. The whole armature is perfectly ventilated, particularly at the front where difficulty has frequently occurred.

It is the strong belief of the Edison Company that one of the most serious difficulties that has been met with in electric railway work is entirely overcome by the new armature which they are now prepared to offer to their patrons.

LIGHTNING ARRESTER.

The lightning arrester illustrated herewith is that of the Sperry Electric Company of Chicago. It is automatic in operation and has been known to take care of fifteen charges of lightning in an hour without requiring attention. The operation is similar to that of the arrester described in the ELECTRIC AGE of April 26, its chief advantage over that form being less liability to form a short circuit of the dynamo current. The parts are mounted upon a wooden base, are well insulated and metallic portions are nickel-plated, making a handsome piece of station equipment.

THE ERWIN HYDRAULIC ENGINE.

A valuable and serviceable combination of power machinery is that described and illustrated herewith. The combination is formed by the attachment of an Erwin Water Motor to any of the various styles or sizes of steam pumps whereby the pump may be made to perform the twofold duty of a steam pump and high pressure engine. The motor attachment in no way conflicts with the ordinary use of the pump, but greatly enlarges the field of usefulness, in being able to drive all kinds of machinery.

By the opening and closing of the proper valves the water in the pump, when the latter is in operation, is driven with great force against the motor wheel, causing a rotation thereof of great speed with the production of great power. By reversing the position of the valves the pump may be used in the ordinary way for pumping purposes.

A valuable feature of this arrangement is, that motors can be readily attached to any pump now in use, resulting practically in the addition of a fine high speed engine at a small additional cost—that of the motor.

In addition to the twofold use of this device, already mentioned, it has many great advantages as an engine alone.

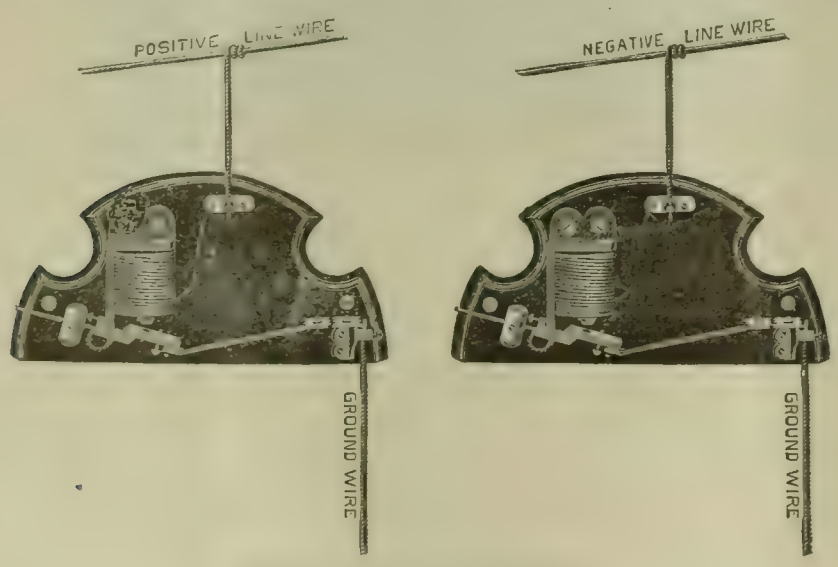
First—It runs noiselessly and with steady, uniform movement. Second—Owing to the rotary movement there is no vibration and expensive foundations are unnecessary. Third—Engineers are not needed to operate the engine. It is simple and durable and requires no more attention than an ordinary pump. Fourth—Dynamos may be attached directly to the driving shaft, belts dispensed with, and but small space required. Fifth—Any given motor may be used for greater or less H. P. by changing size of nozzles furnished.

By the use of this combination a dwelling or store may be supplied with *water, heat, power and electric light,* while the pump may be simultaneously used for feeding the boiler with water.

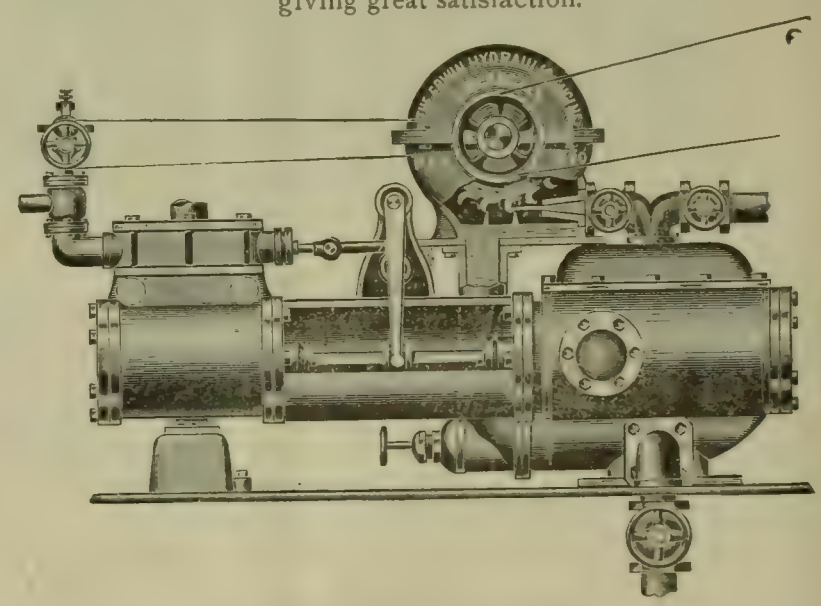
Another valuable application of this combination is in connection with municipal water works. There are in the United States a large number of city water works, erected and maintained at a great cost, which are used principally, if not solely, for fire protection. As thus used they represent a vast amount of non productive capital, which, by this invention may be put to a highly remunerative use. At a comparatively small additional cost many of the high duty steam pumps now made, as well as those hereafter made, may by this motor combination be transformed into high speed engines having no superiors for running dynamos, through the medium of which cities may be supplied with electric light and power, and the great expense of a separate additional plant for such purpose thereby avoided.

As to the power and efficiency of the hydraulic engine, careful break tests show that it has an efficiency of 85 per cent. of the pump, and accurate tests of the water motor show that it has a higher efficiency than the best heretofore made. With such an engine in the basement, power can be transmitted to any and every floor for the purpose of running fans, or doing any other kind of work. The absence of vibrations makes this engine especially adapted for running dynamos on express trains, and the engine has received the endorsement of the Pennsylvania Railroad Company as being just what is needed for train service.

This interesting and valuable engine is manufactured by the Erwin Hydraulic Engine and Steam Pump Company, 51 South Canal street, Chicago, and from all reports from users they are giving great satisfaction.



SPERRY LIGHTNING ARRESTER.



ERWIN HYDRAULIC ENGINE.

HE WAS WRONG.—In 1878 Mr. Edison stated that carbon would not answer for the filament of an incandescent lamp, and that platinum was the only reliable substance to use. That experience has proved his deductions to have been wrong his present lamps are evidence. He now uses carbon altogether.

THE MINNEAPOLIS ELECTRIC RAILWAY.

Work on the immense power house of the Minneapolis Electric Railway is progressing very favorably and the magnitude of the plant is a surprise to those who recently had an opportunity to inspect it. The plant complete will include 138 miles of road in Minneapolis, 75 miles in St. Paul, three 1,000 horse power engines in the Minneapolis power house, seven like engines in the St. Paul power house, and twelve 200 horse-power Edison generators. The road equipment will consist of 120 motor cars, each having two 15 horse power motors, and the necessary number of trailers. This road is the first one to use underground feeders, which are laid in conduits constructed by the Interior Conduit and Insulation Company, of New York. Another feature in the building of this road and one which has called forth a great deal of inquiry and speculation is the fact that the feeders are devoid of any insulation whatever, and are laid bare in the conduits, which, as is well-known, are themselves constructed of excellent insulating material. Hence, it is argued, if the conduits themselves furnish adequate insulation, there is no need of insulating the electric conductors. There are now in use 6,600 feet of this underground conduit and 26,400 feet of wire. The feeders are led up to the trolley wires at stated distances through the hollow poles which support the wires.

The poles are set in the middle of the street, are made of iron and are very ornamental in appearance. From an æsthetic standpoint no objection can be raised against these poles.

The operation of the motor cars on the portion of the road now completed is all that could be desired, and the speed is varied with great facility.

The 1,000 horse-power Atlas engines to be used in the power houses at Minneapolis and St. Paul are huge affairs. They are of the compound condensing type, and the flywheel of each is about thirty feet in diameter. The face of the fly-wheel is six feet across, and the belt which is to be used at the Minneapolis power house is now on exhibition at the Industrial Exposition held in that city. The belt is seventy-three inches in width and is said to be the largest ever made.

The work on this road is being pushed forward as rapidly as possible and when the system is in complete working order St. Paul and Minneapolis will have a railroad between them that they may well be proud of.

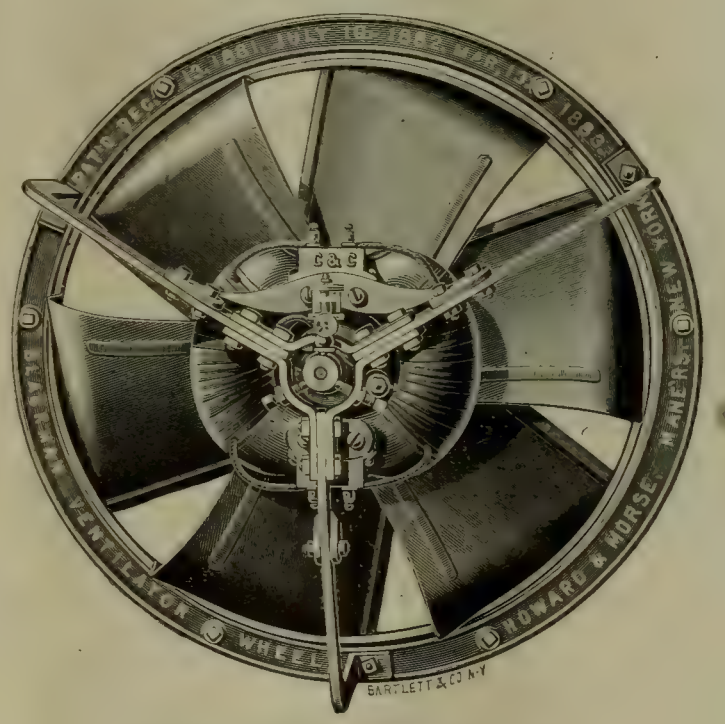
ELECTRIC LIGHT WIRES.

In his address on electric light wires before the recent convention of firemen, in Lawrence, Mass., Captain Brophy, chief inspector of the Electrical Mutual Insurance Company, said:

"The generation of the electric current or the production of light and power is not surrounded with that degree of mystery that most of those who do not, and some of those who should know better, would have the public believe. The law of the electric current, its generation and distribution is just as simple as are the laws of hydraulics or mechanics. The electric light is the result of the conversion of the energy of the steam engine or other source of power. A 2,000 candle power arc light absorbs something less than one horse power while burning, or to be more precise say 67-100 of an electrical horse power. Fifty arc lamps in series would require thirty three and one-half horse-power independent of the power required to overcome the resistance of the wire and friction of the moving parts of the engine, dynamo and shafting. To say to any one of ordinary intelligence that it would be possible for any human being to resist the pressure of a thirty-five horse-power steam engine, would seem superfluous and unnecessary, for to almost any one that is a self-evident fact. To grasp the cross-head, crank-arm or rim of the fly-wheel while the engine is running at speed would be a foolhardy act and one that no sane person would attempt. For certain reasons to place one's self in circuit with a fifty light arc dynamo when delivering current to that number of lights would prove no less disastrous. To point out the dangers of closing a high potential circuit through the body by taking hold of the ends of a broken wire is a comparatively easy task, but unfortunately there are many other ways by which just as great danger can be incurred, and that too without the knowledge of the victim. To place one's self in the path of the current from a fifty light arc dynamo would be equivalent to attempting to stop a thirty-five horse power engine as before described. No one as yet has made a successful attempt to do so."

A COMPACT ELECTRIC VENTILATING FAN.

Ventilating fans are about as necessary in large buildings as light, and much attention and time has been devoted by electrical engineers to the designing of such apparatus. One of the latest of these is shown in the accompanying illustration, which is reproduced from a photograph taken of an electric ventilating plant installed by the "C. & C." Electric Motor Company, in the new building of the Union Trust Co., on Broadway, this city. The outfit is a combination of the well-know "C. & C." motor with a Blackman Ventilating wheel, the latter being a thirty-degree disc exhaust fan. The motor is mounted directly on the shaft and supported by the fan brackets. It revolves at a speed of 600 revolutions a minute and delivers 20,000 cubic feet of air in the same time.



COMPACT ELECTRIC VENTILATING FAN.

There is a large demand for outfits of this character on account of the noise and dirt which are necessary accompaniments of the use of a motor belted to a pulley on the fan. Another great advantage this style of ventilating apparatus presents, particularly to electric light men and contractors, is the facility with which it may be installed. It may be placed in position without regard to belting or shafting. An essential requirement of a machine of this class is compactness of design in order that the motor may obstruct the draught of air as little as possible. It is believed that this machine attains this object to a greater degree than any other yet devised for a similar purpose.

HUNTINGTON SEARCH LIGHTS.

That the manufacturers of the Huntington Search Light have struck an era of prosperity is plainly evident from the large number of orders they are constantly receiving from all parts of the country. So great is the demand, that, notwithstanding the fact that their factory is worked to its fullest capacity, they are unable to supply the wants of their customers with as much promptness as they would wish. This, however, will be remedied as soon as the plant can be enlarged. The number of lights with which ocean steamers and vessels plying the Hudson River and the Sound have been provided is sufficiently large to give the Scott Electrical Manufacturing Company good cause for congratulations upon its phenomenal success in catering to the wants of those in the maritime world.

Not content with this however, the company has for some time been experimenting with a light of 40-candle power for night work in the yards of the Central Railroad of New Jersey, at Communipaw, with such satisfactory results that already several companies are discussing the advisability of adopting it for similar purposes.

The amount of time and money that could be saved to a railroad corporation were its wrecking cars fitted up with search lights is almost incalculable. Indeed some of the foremost railroad men in the country who have looked into the matter have instructed the company to proceed with the manufacture of a light for that particular purpose.

In a few weeks two of the finest boats plying Long Island Sound will be supplied with search lights when a novel experiment will be made to further demonstrate its utility by flashing telegraph signals from one vessel to the other, etc.

The Scott Electrical Manufacturing Company has been recently incorporated under the laws of the State of New Jersey, with an authorized capital of $250,000 of which 200,000 has already been issued. The officers of the company are J. Graham Scott, president and general manager; Thomas I. McLeod, secretary and treasurer; B. B. Ward and Louis Hills, electricians. The board of directors is composed of J. Graham Scott, Edward Mulgrow Broom, Palmer Broom and Bertram H. Weber. The business office of the company is located at 26 Liberty street.

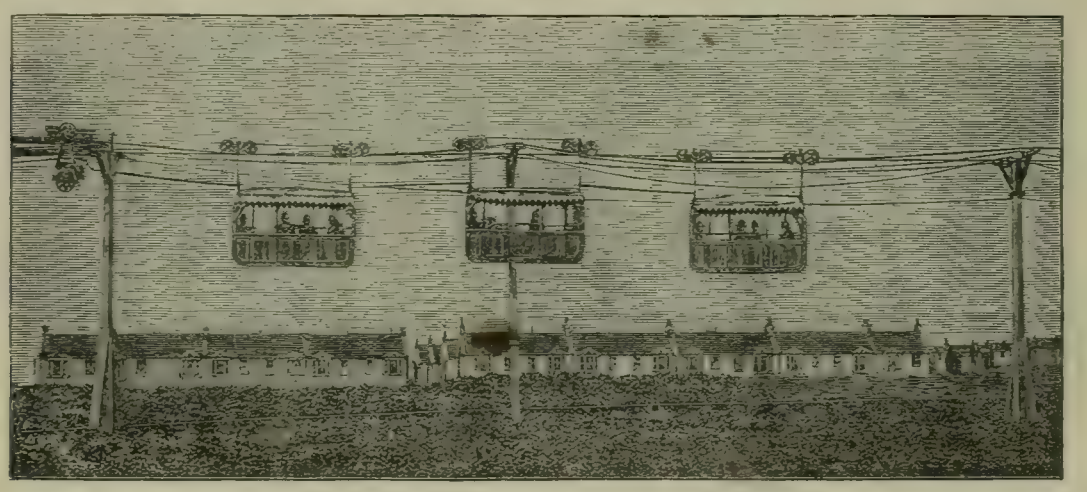
HEALTH IN THE ELECTRIC LIGHT.—It has been remarked, as showing what a powerful element of health the electric light is, that the general health of those who use it improves, their appetite and their ability to sleep increase, and the visits of the doctor become less frequent. This is especially apparent in the statistics of the attendance of working people in factories and other places. In the savings bank in Queen Victoria street, London, where 1,200 persons are employed, the absences from illness have been so far reduced that the extra labor gained is said to have paid for the electric light. The influence of artificial light on the eyes has also a very important sanitary bearing. It has been asserted that the injury to the eyes, of which the growing shortsightedness of the day is but one result, is due to the heat rays and not to the light rays. If that be so, the electric light is less injurious than any other. If the eyes are exposed to the strong light of the arc lamp its ultra-violet rays have a painful effect, but no one has ever complained of the influence of a steady glow lamp upon the sight and it is possible to read and write for many hours by such a light without experiencing the least fatigue.

KILLED.—A lineman in the employ of an electric light company in Omaha, Neb., cut a live wire on September 24th and was instantly killed.

TELPHER LINE.*

The telpher line put up at the Edinburgh Exhibition by the Electrical Engineering Corporation, shows the most recent improvements, and is arranged so as to carry passengers as well as demonstrate the advantages of the system for this transport of goods.

The Edinburgh line consists of over a quarter mile of track, the flexible portion of it being constructed in spans of 50 ft. and the rigid ends in spans of 15 ft. The stand ropes on which the locomotive and carriages travel are of crucible steel and 1¼in. in diameter. These are tightened, so that with a full load on the line there is a sag of about 2 ft. 4½ in. on the spans covered by the train. The arms supporting the stand rope are arranged so that they move in either direction, allowing the sag in the rope to follow the train as it moves along, thus not putting any undue strain upon the posts themselves. The stand rope at its junction with the rigid rail passes from a special descent junction saddle so arranged that the train rises from the rope on to the rigid rail without any jerk or unsatisfactory movement. From the junction saddle the stand rope passes direct to a structure termed the abutment post; this is fastened to the substantial anchorages in the ground by flexible steel ropes 5in. in circumference. The strain upon the ends of the stand rope with a fully-load train is about five tons, and the strain upon the anchorages about eight tons. The current is conducted along a conductor which is not attached to the insulators on which it rests at any point, but merely rests upon them. From the locomotive a rigid arm projects underneath the conductor, but above the insulators, and slides along under the conductor, lifting it off the insulators as the arm passes them, allowing it to rest on them again after it has passed. This method of collection is recommended in the proposed "Waller-Manville" system of electrical traction.



TELPHER LINE AT THE EDINBURGH EXHIBITION.

The train, as will be seen from the illustration, is a very practicable one; the cars, with which the plant and the rest of the equipment were made at the works of the Electrical Engineering Corporation at West Drayton, are built much in the fashion of railway carriages, each car having two compartments and holding four persons, and each compartment being entered from a door with a railway latch. The whole of the car is suspended by iron hangers from two bogie trucks, the bodies of which latter consist of mitis iron castings resting on the axles of the wheels at each end. The hanger does not depend directly from the body of the bogie truck, but rests upon two vertical springs contained in boxes on each side of the body.

The locomotive consists of what is termed by the Corporation a swinging tub, and the motor drives a small countershaft, to one end of which is attached an electrical governor to maintain a set speed; the other end of the countershaft has upon it a chain wheel, which drives directly upon a larger chain wheel contained on the upper frame. The motor is suspended from the upper frame by a hanger, so arranged as to allow the whole to swing, the swinging movement thus allowed not interfering with the motion of the chain, as it is a movement radially to the centre of the large chain-wheel on the upper frame. The upper frame contains, in addition to the large chain-wheel, two driving wheels with malleable cast-iron tyres to grip the rope, each attached to a chain-wheel driven from the shaft supporting the large central chain-wheel.

This new method of cheap transport has, it is needless to say, attracted considerable attention at the Edinburgh Exhibition; and, in view of the many instances where telpherage might be advantageously employed, the Electrical Engineering Corporation has shown great enterprise in bringing the system so prominently before the public.

* *London Electrician.*

MECHANICAL METER.

In the paper of Messrs. A. E. Kennelly and R. S. White, read at the meeting of the Association of Edison Illuminating Companies, held in Minneapolis, September 16th, a mechanical meter recently completed by Mr. Thomas A. Edison is described. The apparatus is constructed on the pattern of one of Mr. Edison's early patents in that direction, and is a small motor of delicate construction. The armature commences to rotate as soon as one lamp in the supplied circuit is turned on. The rotation accelerates as more lamps are lit until at the full load of 20 lamps the speed is 600 revolutions per minute. A counter worked from the armature shaft records the number of rotations, and on duly proportioned dials, the supply. The field magnets are kept charged by a feeble current from the mains, while the main current passes through a shunt as in the electrolytic meter, and from the shunt terminals wires pass to the armature. The drop of potential in the shunt at full load is 1.5 volts. The model, though complete in itself, will be slightly modified in detail to suit commercial use, and will then be available for such cases where a mechanical meter is desirable. Mr. Edison does not consider that a mechanical meter can possibly be as cheap or as reliable as the electrolytic meter; firstly, owing to the necessary frictional error which makes the record too low for very light loads and low speeds, and secondly, owing to the mechanical wear and tear of the working parts which will need attention and exchange from time to time. But there are cases in which a direct reading mechanical meter will be an advantage and he expects that from the tests and behavior of this model it will serve the purposes.

GALILEO'S PROPHECY.—Galileo in one of his dialogues on the rival astronomical systems, written in 1623, puts into the mouth of one of his speakers a reference to a secret art by which through the sympathy of the magnetic needle it would be possible to converse over a space of two or three thousand miles.

ON ALTERNATE CURRENTS IN PARALLEL CONDUCTORS OF HOMOGENEOUS OR HETEROGENEOUS SUBSTANCE.*

BY SIR WILLIAM THOMSON, F.R.S.

This paper consists of a description of some of the results of a full mathematical investigation of the subject, which I hope to communicate to the *Philosophical Magazine* for an early number:

1. Two or more straight parallel conductors, supposed for simplicity to be infinitely long, have alternating currents maintained in them by an alternate-current dynamo or other electromotive agent applied to one set of their ends at so great a distance from the portion investigated that in it the currents are not sensibly deviated from parallel straight lines. The other set of ends may, indifferently in respect to our present problem, be either all connected together without resistance, or through resistances, or through electro-motive agents. All that we are concerned with at present is, that the conductors we consider form closed circuits, or one closed circuit, and that therefore the total quantities of electricity per unit of time at any instant traversing the normal sections in opposite directions are equal.

2. We suppose the period of the alternation to be very great in comparison with the time taken by light to traverse a distance equal to the greatest diameter of cross-section of our whole group of conductors. This supposition is implied in the previous assumptions of parallel rectilinearity of the electric stream lines, and of equality of the quantities of electricity traversing, in opposite directions, the several areas of a normal section.

3. We farther suppose that the length of our conductors and their effective ohmic resistances are so moderate † that the quantities of electricity deposited on and removed from their boundaries to supply the electrostatic forces along the conductors required for producing the alternations of the currents, are negligible in comparison with the total quantity flowing in either direction in the half-period. This supposition excludes important practical problems of telegraphy and telephony, the problem of long marine cables, for instance; but it includes the problem of electric lighting by alternating currents transmitted at high tension through considerable distances; as, for example, from Deptford to London.

4. The general investigation includes as readily any number of separate circuits of parallel conductors as a single circuit, but, for simplicity in describing results, I suppose our system of conductors to be so joined at their ends as to constitute a single simple circuit of two parallel conductors. ‡ It may be either two parallel conductors or one conductor, one of which may or may not surround the other, as shown in Figs. 1 and 2, representing cross-sections. Each conductor may be single, as in Figs. 1 and 2, or either may be multiple parallels.

5. We suppose each conductor to be homogeneous in substance, and in cross-section from

* Author's abstract of a Paper read before the British Association, in Section A, Leeds, September, 1890, in London *Electrician*.

† The circumstances in which this condition is fulfilled may be usefully illustrated by considering the important practical cases of submarine cables, and of metallic circuits of two parallel wires insulated at a distance anything less than a few hundred times their diameter. For all these cases the numeric expressing the electro-static capacity of either conductor per unit of its length (the other supposed for the moment to be at zero potential) is between 2 and 0.1, and for our present rough comparison may be regarded as moderate in comparison with unity. On this supposition the condition of the text requires for fulfilment that the mean proportional between the velocity which expresses in electro-magnetic measure the resistance of one of the conductors and the velocity of a body traveling the length of the conductor, in a time equal to half the period of alternation, shall be exceedingly small in comparison with the velocity of light.

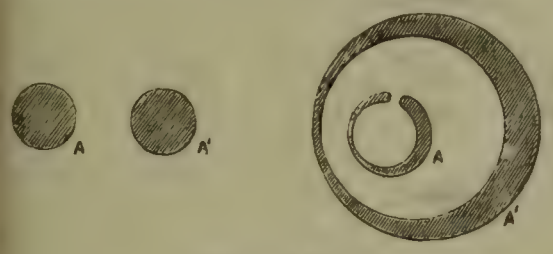
‡ The case of a single circuit made up of parallel conductors, so joined at their ends that to travel once round it we must go and come two or three or more times along separate conductors, joined by their ends in series, so as to make one circuit, is specially considered in my Paper on "Anti-Effective Copper in Parallel or in Coiled Conductors for Alternating Currents," to be communicated presently to Section A.

end to end, but not necessarily homogeneous in different parts of the cross-section. Thus the two conductors, or the different parts of either, may be of different metals, or either conductor or any part of either conductor may consist of two metals (as iron and copper, or iron and lead) laid parallel and soldered together.

6. We shall call A and A′ the cross-sectional areas or groups of areas of the two conductors respectively of the other. All the different portions of A are connected metallically at their two ends, and are thus all of them at one potential at one end and another potential at the other end; and similarly for A.′ The homogeneousness of the material and of the cross-sections along the length of the conductors and the uniformity of the total currents assumed in § 3, implies that all the different parts of A in one cross-sectional plane are at one potential, even though A consist of mutually isolated parts, or A′ consist of isolated parts. If, as in Figs. 1 and 2, all the parts of A are in mutual metallic connection, and all the parts of A′ are in mutual metallic connection, this would entail uniformity of potential through A, and uniformity of potential through A′, even without the limitation of our subject laid down in § 3.

7. The following are some of the most noteworthy results of the full mathematical treatment of the subject.

I. When the period of alternation is large in comparison with 400 times the square of the greatest thickness or diameter of any of the con-



FIGS. 1 AND 2.

ductors, multiplied by its magnetic permeability, and divided by its electric resistivity, the current intensity is distributed through each conductor inversely as the electric resistivity; the phase of alternation of the current is the same as the phase of the electro-motive force; and the current across every infinitesimal area of the cross-section is calculated, according to the electro-motive force at each instant, by simple application of Ohm's law.

II. When the period is very small in comparison with 400 times the square of the smallest thickness, or diameter of any of the conductors, multiplied by its magnetic permeability and divided by its electric resistivity, the current is confined to an exceedingly thin surface-stratum of the conductors. The thickness of this stratum is directly as the square root of the quotient of resistivity, divided by magnetic permeability, of the substance in different parts of the surface. The total quantity of the current per unit breadth of the surface is independent of the material, and, except in such cases as those referred to at the end of II. below, varies in each cross-section in simple proportion to the electric surface density of the static electrification induced by the electro-motive force applied between the extremities for maintaining the current. The distribution of this electric density is similar in all cross-sections, but its absolute magnitude at corresponding points of the cross-section varies along the length of the conductor in simple proportion to the difference of electric potential between A and A,′ and is zero at one end, in the particular case in which the conductors are connected through zero resistance at one end, while the electro-motive force is applied by an alternate current dynamo at the other end. On the other hand, the surface distribution of electric current is uniform throughout the whole length of the conductors, and it is only its distribution in different parts of the cross-section that varies as the electric density.

The proportionality of surface intensity of the current to electric density, asserted above, fails clearly in any case in which the circumstances are such that the distance we must travel along the surface to find a sensible difference in electric density is not very great in comparison with the thickness of the current-stratum. Such a case is represented in Fig. 3, which is drawn to scale for alternate currents of period $\frac{1}{80}$th of a second in round rods of copper of six centimetres diameter. The spaces between the outer circular boundaries and the inner fine circles indicate what I have called the mhoic thickness, being 714 of a centimetre for copper of resistivity 1611 square centimetres per second. The full solution for such a case as that represented in Fig. 3 belongs to the large class of cases intermediate between I. and II., and could only be arrived at by a kind of transcendent mathematics not hitherto worked. But without working it out, it is easy to see how the time-maximum intensity of the current will diminish inwards from the surface, and will be, at any point of either of the inner fine circles, about one-half or one-third of what it is at the nearest point of the boundary surface; and that at points in the surface, distant from B B′ by one-half or one or two times the mhoic thickness, the current intensity will be much smaller than it is at B B′.

III. In case I. the heat generated per unit of time, per unit of volume, in different parts of the conductors, is inversely as the electric resistivity of the substance, and directly as the square of the total strength of current, at any instant. In Case II. the time-average of the heat generated per unit of time, per unit of area of the current stratum, is as the time-average of the square of the quantity of current per unit breadth, multiplied by the square root of the product of the electric resistivity into the magnetic permeability.

IV. Example of III: Let the conductor A be a thin flat bar, as shown in the diagram (Fig. 4), A′ being a tube surrounding A, or another flat

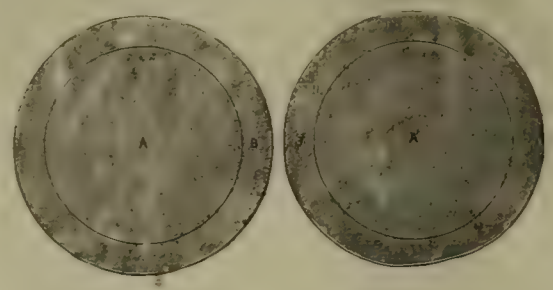


FIG. 3.

bar like A, or a conductor of any form whatever, provided only that its shortest distance from A is a considerable multiple of the breadth of A. The thickness of A must be sufficiently great to satisfy the condition of II., and its breadth must be a large multiple of its thickness. (For copper carrying alternating currents of frequency 80 periods per second, these conditions will be practically fulfilled by a flat bar of 4cms. thickness and 30 or 40cms. breadth.) The current in it is chiefly confined to two strata extending to small distances inwards from its two sides. (For copper and frequency 80 periods per second, the time-maximum of intensity of the current at the surface will be about ε^2, or 7.4, times what it is at a distance 1.34cms. in from the surface.) The quantity of current per unit breadth, or, as we may call it for brevity, the surface-density of the current in each stratum, is determined by the well-known solution of the problem of finding the surface-electric-density of an electrified ellipsoid of conductive material undisturbed by any other electrified body. The case we have to consider is that of an ellipsoid, whose longest diameter is infinite, medium diameter the breadth of our flat conductor, and least diameter infinitely small. In this case the electric density varies inversely as $\sqrt{(O\,B^2 - O\,P^2)}$. The graphic construction in the drawing shows $(P\,Q = \sqrt{(O\,B^2 - O\,P^2)}$, and we conclude that the time-maximum of the surface-density of the current varies inversely as P Q. The infinity, which in the electric problem we find for electric density of the ideal conductor, is obviated for the electric current problem by the proper consideration of the rectangular corners or the rounded edge (as the case may be) of our copper bar, which, though exceedingly interesting, is not included in the present communication. Suffice it to say that there will be no infinities, even if the corners be true mathematical angles.

V. Example of Cases I. and II.: Let A consist of three circular wires, C, L, and I, of copper, lead, and iron respectively. In Case I. the quantities of the whole current they will carry and the quantities of heat generated per unit of time in them will be inversely as their resistivities. In Case II., if the centres of the three circular cross-sections form an equilateral triangle, the quantities of heat generated in them will be directly as the square roots of the resistivities for C and L, and for I. would be as the square root of the product of the resistivity into the magnetic permeability, if the magnetic permeability were constant and the viscous or frictional resistance to change of magnetism nothing for the iron in the actual circumstances. This last supposition is probably true approximately with a permeability of $\frac{1}{60}$ for iron steel, according to Lord Rayleigh, if the current is so small that the greatest magnetizing force acting on the iron is less than .1 C.-G.-S.

VI. The dependence of the total quantity carried on extent of surface, according to the electrostatic problem described in II., justifies Snow Harris, and proves that those who condemned

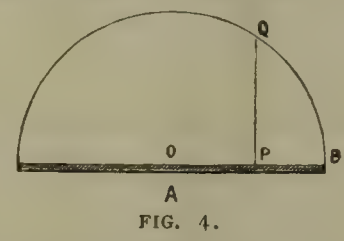


FIG. 4.

him out of Ohm's law were wrong, in respect to his advising tubes or broad plates for lightning conductors; but does not justify him in bringing them down in the interior of a ship (even through the powder magazine) instead of across the deck and down its sides, or from the masts along the rigging and down the sides to the water. The non-dependence of the total quantities of current on the material, whether iron or non-magnetic metals, seems quite in accordance with Dr. Oliver Lodge's experiments and doctrines regarding "Alternative Path" and lightning conductors. The case of alternate currents is, of course, not exactly that of lightning discharges; but from it, by Fourier's methods, we infer main conclusions of II. and V., whether the discharges be oscillatory or non-oscillatory, provided only that it be as sudden as we have reason to believe lightning discharges are.

DISCUSSION.

Professor Rowland said that he had considered these alternating currents in parallel conductors, and he believed he gave a theorem with regard to the distribution in the case of perfect conductors. He thought that that was the only case in which the problem could be solved. In that case the distribution was exactly the same as it would have been if they had been charged with electricity at rest; and there was some theorem, which he had almost forgotten now, with regard to the self-induction and the capacity. Of course, that was a much more limited problem than that Sir William Thomson had given, but he thought it led to interesting results. It guided them in their ideas with regard to the distribution, because in the case of perfect conductors the distribution of the current was exactly the same as the distribution of the density in the case of conductors at rest, so making the conductivity a little less than that; and they were guided to some extent by that theorem. He did not know that any solution had ever been obtained in the case where the conductors were not perfect, but Sir William Thomson, he considered, had found a solution of that nature.

SUBWAY RENTALS TOO HIGH FOR ELECTRIC LIGHT COMPANIES.

The skirmishing which has been going on between the electric light companies on one side and the Consolidated Telegraph and Electrical Subway Company, backed by the board of Electrical Control, on the other, is about to develop into a fierce and open warfare.

The Subway Company insists on $1,000 a year per mile rental for three-inch electric light ducts, and the companies insist that $500 is an exorbitant price, and $1,000 simply prohibition to arc lighting. Three-inch ducts will accommodate, it is claimed, but three electric light wires, and as electric circuits are what is known as "metallic" circuits beginning and ending at the dynamos instead of in the earth, two wires are required for each circuit. Therefore a duct only accommodates one and a half circuits, and the expense for rent would be $666.66 per mile for the circuit.

The extra expense would make it impossible for any company to furnish electric lights in some of the streets when it is most needed and would add from $35 to $75 a year to the expense of lighting each arc lamp in the circuits where there are the greatest number. To put up the lamp-post and make the connections to each lamp costs from $75 to $100. Therefore the expense, exclusive of providing the current and caring for the lamps and wires, would be from $110 to $175 for the first year, and as the city only pays about $115 a year for the lights, there will probably be a return to gas lamps unless subway rentals are modified.

Last fall a reliable company offered to build subways and charge no more than $750 a mile rent for ducts, and it is asserted that in Philadelphia the ducts are rented for $250 a mile. The electric light companies claim that every effort has been made by them to have the Board of Electrical Control fix the rentals, as it has a right to do, at a reasonable figure, but in vain.

The first formal complaint against the Subway Company in this matter was made March 24, by the East River Electric Light Company in a letter addressed to Mayor Grant and Commissioners Hess and Moss, of the Board of Electrical Control. The company protested against the rate of rentals charged for ducts, and said it had been unable to continue a contract with the city for lighting a portion of Sixth avenue because the duct rental would absorb $50 of the $127.75 paid for each lamp, and an additional cost of $75 would be entailed for making each lamp connection. The letter continued:

"From these figures you can see that electric street lighting, when there is only a small commercial business to be done in connection with it, if the present rentals are to continue, cannot be done only at a greatly increased cost to the city; the same applies to light used by the citizens of New York in the conduct of their business. That the present rentals are exorbitant and unjustifiable may be proven by statements made by the Consolidated Company through its counsel. Mr. Cohen, in open court before Judge Andrews, that the present cost of electric light ducts was $1,640,000, and we find on page 11 of the third annual report of the Board of Electrical Control, adopted Jan. 8, 1890, that the number of miles of electric light ducts to date is 454, making the cost per mile of duct $3,612.11. Mr. William Maver, jr., the electrician of the Consolidated Telegraph and Electrical Subway Company, stated recently at a meeting of the American Institute of Electrical Engineers, held in this city, that the average cost of ducts was about $3,000 per mile. And these costs are for work which was largely experimental and in difficult and trying places. It is fair to assume that the construction in future will be more economically performed and less difficult to do. This cost, too, it must be remembered, includes a profit of 15 per cent. on the actual outlay of the sub-contractors and an additional profit of 15 per cent. on the sub-contractor's bill to the Phœnix Construction Company."

The latter called attenton to the fact that the city uses about one-fourth of the electric arc lights in operation here and says reliable parties have stated that ducts are rented in Philadelphia for $250 a mile. Attention was also called to the fact that reliable parties had proposed to the Board of Electrical Control to build subways and furnish the ducts at not to exdeed $750 a mile rental. The protest was referred by the Board of Electrical Control to Col. Kearney, its engineer, "to take testimony in respect thereto and report the same to the Board."

The first hearing occurred April 26 and the second and last August 26, and the report is to be presented. Vice-President and General Manager Ridgway appeared for the Subway Company and the Electric Light Companies were represented by their respective officers or by counsel. Ex-Judge Kelly, on behalf of the East River Company presented an estimate of the cost of the ducts which he said was based on figures submitted to him by competent and reliable parties. This estimate fixed the cost of ducts in a thirty-duct subway at $2,181.60 per mile; in twenty-duct subways at $2,481.80, and in ten-duct subways at $3,326.40. Judge Kelly requested that it be ascertained whether 15 per cent. had been added to the cost of the work by Sub-Contractors Crimmins and Reilly, and then on top of that another 15 per cent. by the Phœnix Construction Company. The representatives of the company joined in this request and also wanted the figures from the Consolidated Subway Company's books showing the exact cost of construction. The companies claimed that $300 or $400 per mile was a sufficient rental to reimburse the Subway Company and leave a big profit on its investment. A demand was also made for an explanation of the arrangements between the Subway Company and the Edison Electric Light Company. Mr. Ridgway said the Subway Company could "furnish any information that is required by the Board of Electrical Control," but he declined to furnish any at the hearing before Col. Kearney. He said some of the ducts laid cost the Subway Company $11,000 a mile and the average was over $5,000. There was a great deal of discussion and wrangling, but no other material points were brought out.

It was agreed that all parties should submit statements, and this has been done, but the electric light people charge that while they have not been allowed to inspect the Subway Company's statement, the officers of that company saw theirs before making any. They also claim that Col. Kearney's report has been largely made up by Col. Beckwith, who occupies the dual position of engineer to both Subway Company and the Phœnix Construction Company. The companies have no hope of learning the actual cost of the subways from Mr. Ridgway's report. They have some hopes in this direction however from Comptroller Meyers. They say the law gives him a right to inquire into the matter, not only to see that the city gets all the profits in excess of ten per cent., but that it is not charged an exorbitant price when the time arrives under the law for buying the subways. The contract requires the Subway Company to report annually, or oftener if required by the Comptroller, as to the work it is doing, but the only species of report that has been made thus far is the one setting forth

> That up to the date named no revenues have been received by the Company for or on account of the use of any of the subways or structures under said agreement; that no dividend has been paid; and that the work of construction has not been completed and is still in progress.

The fight will not probably be confined to the subject of rentals for ducts, but will embrace many other points. The Metropolitan Telephone Company owns 55 per cent. of and manages the Subway Company, and the electric light people want to know what the Telephone Company is paying for the ducts it uses and also what the Edison Company, which has its wires in ducts apart from the other electric light companies, pays. The Edison Company is said to have subscribed for $600,000 of the Subway stock and made an arrangement to pay up its stock by building its own subways as a sub-contractor to the Phœnix Construction Company. The electric light companies other than the Edison intimate that they are being charged exorbitant rates while the Edison Company and the Metropolitan Telephone get much better terms. They say that the law stipulates that all tenants of the subway shall be treated alike, and the limit of 10 per cent. profit contemplates this and does not mean that certain companies shall pay 20 per cent. in order that others may have their ducts free of rent. It is charged that the Subway Company has practically abandoned the outside companies to take care of two interested in it.

Subway work for the outside companies has been practically stopped already this year. Fifteen miles of trench and fifty-five miles of duct have been built for these companies and nine miles of trench and twenty-three miles of duct for the Edison Company. A large amount of telephone subway has also been built. The work on the subway on the west side of Broadway, about which there was so much haste last Spring to prepare for repairing, has stopped at Houston street, leaving all the work to the Battery to be done yet. The new subway in the east side of the Bowery and Third avenue, which was to run to Fifty-ninth street from Chatham Square, was suspended at Canal street. Fifth avenue, in which the other companies were refused subways, is to be turned over to the Edison Company. The outside companies were last Spring required by the Board of Electrical Control to give bonds to insure the Subway Company the payment of rentals for any subways thereafter built. The three Westinghouse Companies filed a bond of $100,000 and the other companies $25,000. They have now been informed by the engineer of the Board, that their bonds are not sufficient to satisfy the Subway Company and more bonds must be given or no more ducts will be built. The companies will refuse to give additional bonds and will also make a fight on this point in court.

The Phœnix Construction Company is a New Jersey corporation, and it is claimed the charter was obtained there to prevent the New York City authorities demanding the production of the company's books. Another evidence of alleged favoritism to the Telephone Company that will be pointed out is a permit granted at the last meeting for a new line in Eleventh avenue, from Thirteenth to Seventy-third street. The Board has positively refused to allow the electric light companies to put up a new pole anywhere in the city. It is charged that the Board of Electrical Control compelled the Fire and Police Departments to put their wires in the same duct to help the Subway Company, as the city pays no rent for ducts. When the wires of one department need repairing those of the other department will have to be withdrawn from the ducts also, and the two departments made strenuous efforts to get separate ducts but without avail.

The electric light companies have been preparing for the fight for some time and have many points in addition to the above which they say they will make a fight on in court. They say they feel confident of making such a showing as will secure a redress of their grievances all around, and also establish the status of the Subway Company and Board of Electrical Control with regard to the Telephone and Edison Electric Light companies.

Mr. William Richardson, the well-known street car magnate of Brooklyn, N. Y., in a conversation recently, made the statement that out of 64 different mayors who had been asked for their opinion concerning electric railroads, all but four replied favorably. They stated that the electric roads over the old horse car lines was the greatest kind of an improvement and was much welcomed in all localities.

NEW YORK NOTES.

"The Western Union Fire" is the title of a neat pamphlet, just published in the interest of the Edison Lalande battery, of which Mr. James F. Kelly is the sales agent at 19 Dey street. This title was given because the pamphlet contains the illustrations published in the ELECTRIC AGE a few weeks ago, showing the ruins of the Western Union operating room after the recent fire, and the one showing the damage to the exterior of the building. The descriptive matter as published in the same issue of the ELECTRIC AGE is used in connection with the illustrations, as is also a paragraph which was published in this paper some time since, setting forth some of the valuable features of the Edison Lalande battery. The pamphlet also shows a diagram of the arrangement and subdivision of a battery of these cells used in Philadelphia by the Pennsylvania Railroad on their wires. This interesting and valuable little work may be procured on application to Mr. James F. Kelly, the general sales agent of the Edison-Lalande battery, 19 Dey street.

Hiram S. Maxim, the well-known electrician and inventor, is at present on American soil. He is stopping at the Windsor Hotel, in this city, which he makes his headquarters.

A new electrical organization, which is known as the Coulomb Association, has been established in this city. The membership is composed of men engaged in electric lighting and general electrical business in this city and vicinity. Several meetings have already been held, and much good has been accomplished, every member taking genuine interest in the welfare of the Association. The subjects discussed at each meeting cover everything of a practical nature pertaining to electricity. The meetings will be held regularly and various instruments will be described, testing apparatus will be operated upon, and all makes of cable will be tested before the members, so that every one may receive the full benefit of tests and experiments made.

Mr. G. W. Hebard has been elected vice-president of the Sawyer-Man Electric Co., and P. F. Kobbe, treasurer, in place of Messrs. P. H. Alexander and C. H. Barney, resigned.

The new electrical house of Messrs. Alexander, Barney and Chapin, at 20 Cortlandt street, will be opened probably during the first week of October. The date of the opening cannot yet be settled, however, as the place is still in the hands of the carpenters, but if all promises are kept, October 6th will be about the date. The room to be occupied by the firm—which, by the way, has adopted as its trade-mark a black diamond on which the letters A. B. C. in white are effectively displayed—is 185 deep by 25 wide, and the fittings, shelves, counters, etc., will be in ash. In one corner in the rear the book-keeping department will be located. One of the features of the new establishment, and one which will be appreciated by the patrons of the firm, is a reception room, or electrical headquarters, at the front of the store. It is located at the side of the main room, forming a sort of recess, and is partitioned off from the main store. In this room will be found all the electrical periodicals, writing materials, etc., etc., for the convenience of patrons, and a check-room will be provided so that customers may check their hand-bags, umbrellas, etc., if they so desire.

Alexite is rapidly coming to the front as an insulating material. While it is said to be equal to rubber in its electrical properties, it is also claimed to be superior to it in one important respect, and that is, it cannot be ignited by overheated wires. For this reason it is an excellent material for cut out bases, switch bases, etc., where non-combustibility is an essential quality. The new firm of Alexander, Barney and Chapin are the sole dealers in this material, and they report having already received orders for the goods to the value of $35,000. A sample of Alexite is being tested by Mr. Pickernell of the Long-Distance Telephone, with a view to its substitution for hard rubber, which does not answer every requirement in telephone work.

A sure place to find assembled the electrical fraternity on Monday next will be the new supply store of Alexander, Barney and Chapin, at 20 Cortlandt street, in the Telephone Building. The firm has sent out formal announcements of the opening, enclosed with a handsomely designed "Menu," which, in itself, is a gastronomic revelation.

The lamp works of the Edison General Electric Company, at Harrison, N. J., are being enlarged, and when the improvements are completed, the works will have double the present capacity. The demand for lamps is so great and steady, that it was necessary to enlarge the facilities for production. Two large brick buildings formed part of the old works, and they were separated from each other by quite a large space. By the improvements now going forward, this space will be built over, thus connecting the two detached buildings, and forming one large structure.

J. R. Keating, of the S. T. Smith Co., has just returned from a well earned vacation, and judging from appearances, his outing did him a great deal of good physically.

R. J. G.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,

CHICAGO, Sept. 20, 1890.

An ordinance passed the South Omaha, Neb., City Council on September 22d, creating the office of City Electrician, with a salary of ten dollars per month.

The Electric Date and Time Stamp Co., of East St. Louis, Ill., has made an assignment to George E. Dodge, of Dalton, Ill., in favor of creditors. The liabilities are about $6,800

Prof. H. T. Eddy has been selected to succeed Dr. T. C. Mendall as president of the Rose Polytechnic Institute, at Terre Haute, Ind.

The village of River Forest, Ill., is soon to have electric light. The River Forest Water, Gas and Electric Light Co. has been incorporated by H. E. Broughton, Frank C. Smith, and H. Steuble with capital stock of $75,000.

NEW COMPANIES.—The Elliott Electric Co., to manufacture and operate all kinds of appliances relating to electric railways; capital stock, $100,000; incorporators, M. W. Elliott, Francis W. Parker, C. P. Chapman.

Northwest Chicago Electric Street Railway Company, to construct and maintain a street railway; capital stock, $300 000; incorporators, William Boldenweck, Patrick J. Maginnis and George Lill.

The Columbian Exhibition and Transit Company, to exhibit motors for street railway propulsion, establish street railway lines, trams, etc.; capital stock, $100,000; incorporators, B. J. McMahon, E. V. Hitch and H. C. Caulkins.

Consolidated Electric Company, to manufacture and sell storage batteries; capital stock, $300,000; incorporators, Harry Lampert, L. B. Langworthy, and E. J. Dahurs, all with headquarters at Chicago.

An effort is being made to provide cheap telephone service in Chicago. The Subscribers Telephone and Service Company, composed largely of druggists and physicians, is before the City Council, with an ordinance, promising to make a rate of $75 per year to general subscribers and $5 to the police and fire departments, and to place all wires underground. The new company claims to have an instrument as good as or better than the Bell Telephone, but will not yet make it public.

A new switch embodying some unique features is promised shortly by the Great Western Electric Supply Co. It works on a new principle and the Great Western people expect that it will create something of a sensation. A new fire-alarm system is also being prepared for the market by this firm, especially designed for use in small towns.

An exhibit of interest at the Interstate Exposition, now being held in this city, is that of a new engine well adapted for electric light purposes. This is the Erwin Hydraulic Engine described elsewhere in our columns. Two of these motors are exhibited, one driving a small incandescent dynamo and the other running a 36-inch blower, and also throwing a stream of water. These engines are attracting considerable attention on account of their freedom from jarring.

The first and second numbers of the *National Corporation Reporter* have been received. The new journal is a weekly published at 122 La Salle street, Chicago, and is a pioneer in the field to which it is devoted. A valuable feature of the *Reporter* will be the complete list of new corporations formed in all the States, which will be published weekly. It is also noticed in the prospectus that this paper will devote space to electrical matters. Mr. Adolph Moses, president of the United States Corporation Bureau, is editor of the new journal, and Mr. L. B. Hillis, manager. As the paper is in the hands of such noted corporation lawyers, the legal department cannot fail to be full of much valuable information.

WORLD'S FAIR PROGRESS.—Again the National Commission has met and again adjourned. And they have placed their seal upon the first great step in the work, the selection of a site. Not satisfied with the great double site tendered them, they demanded a greater, and they got it. When Chicago asked Congress for the Fair she pledged her honor to let nothing be wanting for its success. It was not then supposed that the occasion would require the surrendering up of the city's choicest public park, and it was not without some hesitation that this sacrifice was made. The site as finally adopted comprises the greater part of Jackson and Washington Parks, and the Lake Front Park. Chicago acts on the principle that nothing is too good for her guests of 1893; she has given the best. Wednesday the National Commission adjourned, but before doing so passed a series of resolutions condemning the efforts said to have been made to discredit the Exposition abroad, and stating in unmistakable language that Chicago had fulfilled every promise made to Congress, and their belief that she would make a grand success of the World's Columbian Exposition of 1893.

F. M. I.

UNSIGHTLY POLES.—Although New York is in most respects the chief city of the United States she can learn a good many things to her andvantage, of other places. In the matter of telegraph poles, for instance. One of the most noticeable features of the Chicago streets to a person from New York is the entire absence of electric wire poles, of any description. When will New York ever reach such a state?

ELECTRIC RAILWAYS.—Electric railways are projected or in the course of construction at the following-named places: Alton to North Alton, Ill.; Halifax, N. S.; Terre Haute, Ind.; Houston, Tex.; St. John, N. B.; Durham, N. C.; People's Railway Company, Syracuse, N. Y.; Citizen's Railway Co., Waco, Tex.; Waltham, Mass.; Oakland to Haywards, Cal. A street railway is to be constructed at Toledo, O., by the Consolidated Street Railway Company. A line of electric railway is to be constructed between Seattle and Tacoma, Wash., a distance of forty-two miles.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Sept. 27, 1890.

The Union Street Railway Co. of Dover, N. H., opened its electric line to Sawyer's Mills last Thursday morning.

S. E. Barton, during his trip to Minneapolis, secured business for "the three" companies to the amount of nearly $3,000,000.

Mr. Frank T. Robinson, of the Johnston Electric Train Signal Company, starts west again in a few days in the interest of that company.

A novelty is to be seen in a Washington street window in the shape of a large spider and fly, made with incandescent lamps set in an iron frame.

The town officials, with the officers of the Whitman Electric Road Company, paid a visit to Boston this week to inspect the difference between T and groove rails.

The Edison Electric Light Company, at Newport, R. I., will probably be reorganized next week under the name of the Newport Electric Light Company, whose charter they recently purchased.

The Western Union Telegraph Co., the Postal Telegraph Co. and the New England Telephone and Telegraph Co. were sufferers by the fire at Palmer last Tuesday, a large number of their wires being burned, and crippling the service.

Fred. E. Cobb, private secretary to President Whitney of the West End Railway Company, is soon to sail on a voyage around the Horn to China. He will be absent about a year, with the expectation of returning in improved health.

The Ware Electric Light Company for furnishing light, heat and power in Ware and Hardwick, with a capital of $20,000, and F. D. Sitley as president and F. D. Gilmore as treasurer, filed articles of incorporation at the State House on Saturday last.

The Cambridge aldermen gave a hearing to the residents of Wallace street on claims for damages said to have been caused by the erection of telephone poles in that street. The total estimated damages are $7,749. The board adjourned until next Monday.

Cards are out for the wedding, on October 8th, of Miss Lottie J. McKenney to Mr. Charles W. Cartwright of the Consolidated Electric Manufacturing Co. After an extended trip Mr. and Mrs. Cartwright will receive on Wednesdays, November 5th and 12th at their new home No. 72 Glendale street, Dorchester.

During the fair season the buildings of the Massachusetts Charitable Mechanics' Association will be brilliant with electric lights as the two hundred arc lights suppled by the Boston Electric Light Company will be supplemented by about one thousand incandescent lights from the Mather Company who will run their plant on the storage battery system.

The Thomson-Houston Company are laying a 500-foot track on Federal street and Western avenue, in Lynn, for experimental work on conduits. The conduit is in the centre of the track and the rails rest on cradles. The new Armington and Sim's engine in factory K was turned last Monday night for the first time. A big 3,000-light alternator is being assembled and will soon be belted to this engine.

The Bell Rock Electric Conductor Co. has opened a factory for the manufacture of its conductors on Eastern avenue, Maplewood. The wire is run through a machine and receives a thick coating of a substance that much resembles rubber. This substance is very cheap and a perfect insulator and will receive a very high polish. At present the company's machines are capable of making 150 feet of this insulated wire per minute.

The Board of Selectmen of Revere gave a hearing to the Boston and Revere Electric Railway Company in the Town Hall, last Wednesday evening, to enable the directors to show cause why the road should not be run the year round, according to the terms of the charter. This is a beach road, its patronage being mainly summer pleasure seekers and if the road is compelled to run during the winter months it cannot do so without great loss.

There was a conference between the Selectmen and representatives of the Street Railway Co. in Natick last Monday, and matters were adjusted in a manner satisfactory to both parties. The Electric Railway Co. has filed its acceptance of the franchise and will build a road from South Natick to Natick. The joining together of Natick and South Natick means connection with Boston by electricity, as Natick will soon extend her tracks through Wellesley and join with Newton.

W. J. P.

DETROIT NOTES.

The Lockwood Instrument Company report an active demand for their electrical measuring instruments, of which they make a fine grade at low price.

The Detroit Electrical Works expect to soon move into their new factory at the corner of Woodward avenue and Railroad Crossing. The new works are very conveniently situated and are fitted with every convenience and appliance necessary to turn out goods with dispatch. The greatly expanding business rendered it imperatively necessary that larger works should be established. Their new factory is of brick and is well equipped with machinery of latest design. The company hopes to be able to give proper attention to the filling of orders when they get into their new quarters.

Brownlee & Co., the well-known makers of poles for electric wires, are doing a thriving business. They make a specialty of octagonal poles for electric lighting and railway purposes, and these poles are well finished and present a good appearance. The firm is now establishing an iron foundry in connection with their already large manufacturing plant. The iron foundry is for the manufacture of an iron pole of new design for street railway use. This new pole will be of the same strength as the wooden ones and will cost less money. They will also be much handsomer in appearance than those that are in present use.

ELECTRIC RAILWAY NOTES.

Among the recent railway contracts closed by the Edison General Electric Company may be mentioned the following: The Minneapolis Street Railway Company of Minneapolis, Minn. The Savannah Street & Rural Resort Co. of Savannah, Ga. The Dallas Consolidated Traction Company of Dallas, Texas. St. Johns City Railway Co. of St. Johns, N. B. James Street Belt Line Railway Co. of Seattle, Washington. St. Paul City Railway Co., St. Paul, Minn. Tacoma Railway & Motor Co. of Tacoma, Washington. Richmond City Railway Co. of Richmond, Va. Utica & Mohawk Railway Co. of Utica, N. Y. Elmira & Horseheads Railway Co. of Elmira, N. Y. Elgin City Railway Co. of Elgin, Ills. People's Street Railway Co. of Scranton, Pa. Fort Scott Railway Co., Fort Scott, Kansas. Louisville Railway Co., Louisville, Ky. Pittsburgh Railway Co., Pittsburgh, Pa.

The Edison General Electric Company has entered into a contract with the Louisville Railway Co. of Louisville, Ky. for a large station equipment, including four No. 60 generators of 150,000 watts (200 H. P.) each. It will be remembered that this road is now the property of the great street railway syndicate which is operating roads in Buffalo, Pittsburgh, Louisville, Newark, Rochester and elsewhere.

The Utica & Mohawk Railway Company which recently contracted with the Edison Company for five cars and station equipment, has now been in operation for about three months, with most satisfactory results. Its picnic business has been very large, the road on some occasions carrying ten thousand passengers per day. The wisdom of President Mann's new departure has been thoroughly demonstrated. It is worthy of note that under Mr. Mann's management this road has become one of the best equipped and best paying properties in the state.

The remarkable rapidity with which the Western Union Company re established its circuits after its recent fire, 300 being restored in a single day, has been commented upon by a leading French electrical journal, which recalls, by way of contrast, a very instructive historic incident which occurred in Paris during the Commune. When the Republican Government quitted the city, the operators at the central office contrived to mix up all the wires before leaving. The Communists, knowing little of telegraphy, found the task of unravelling the wires more than they could undertake, and during the two months they held the building they could make use of only the military lines. M. Fabre de Lagrange, who was compelled to carry out the duties of chief electrician to the Commune, was careful to keep the wires in the hopeless tangle in which he found them; and among other services to the State he sent misleading telegrams, and thus saved the destruction of many public and private buildings. These facts were clearly authenticated by the court matial which tried M. Lagrange, and he was honorably acquitted.

BUREAU OF ELECTRICAL INFORMATION.

It is a well-known fact that many valuable inventions have been allowed to fall into disuse, and never bear fruit for the simple reason that the inventor himself may have doubts as to the practicability of his device. It frequently happens, too, that an inventor becomes discouraged in his experiments because he has not sufficient knowledge of the laws involved in his invention to overcome what he supposes are unsurmountable obstacles, and what might be a valuable device is thrown aside possibly for some one else to take hold of and make a success. All inventors need more or less technical knowledge on the subject involved in their inventions; and if they do not possess it themselves, they can easily obtain help by applying to those who do. These facts apply to electrical inventions as well as any other, and probably more electrical devices never see the light because the laws of electricity are not so generally understood as those of other natural phenomena.

Our advice is, if you think you have discovered or invented something of real value, and are in doubt as to whether this thing or that thing will work under given circumstances and conditions, consult an expert who can tell you at once whether your invention is practicable or not. Such an opinion may be the means of bringing you a fortune, or it may save you much time and expense in experimenting with something that has no practical or commercial value.

"Be sure you are right then go ahead," is an excellent motto for inventors. A good many start wrong but go ahead just the same, to finally give up in disgust.

If you do not know all the points involved in your invention we probably can very materially aid you.

Information on electrical subjects furnished.
Electrical problems fully explained in writing.
Expert opinion furnished when desired.
All correspondence confidential.
Charges moderate.

Address ELECTRIC AGE PUB. CO.,
5 Dey Street, New York.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED SEPTEMBER 15TH AND 22D.

436,334. Telephone. William Burnley, North East, Pa., assignor of two-thirds to Charles A. Hitchcock, same place, and Lewis F. Watson, Warren, Pa. Filed Aug. 11, 1887.

436,335. Telephone. William Burnley, North East, Pa , assignor of two-thirds to Charles A. Hitchcock, same place, and Lewis F. Watson, Warren, Pa. Filed Aug. 11, 1887.

436,354. Electric Cigar Lighter. Mortimer M. Hayden, New York, N. Y. Filed Apr. 29, 1890.

436,371. Railway Signal. Preston C. Morse, Natick, and Henry D. Winton, Wellesley Hills, Mass., assignors by mesne assignments to the Hall Signal Company, Portland, Me. Filed May 22, 1889.

436,387. Socket for Incandescent Electric Lamps. Horace E. Swift, Boston, Mass. Filed Nov. 1, 1889.

436,408. Dynamo-Electric Machine. Stephen D. Field, Yonkers, N. Y. Filed Apr. 2, 1888.

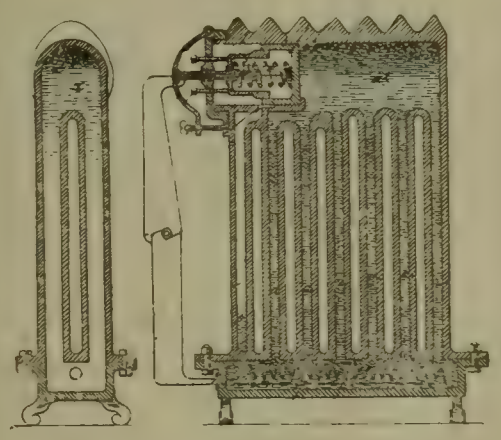
436,410. Electro-Magnetic Bell. John Geary, Philadelphia, Pa. Filed Dec. 18, 1889.

436,412. Electrical Switch. Frederick D'A. Goold, New York, N. Y. Filed July 15, 1890.

436,417. Rotary Motor. Ernst Hammesfahr, Solingen, Germany. Filed July 30, 1889. Patented in Germany, Dec. 9, 1887.

436,425. Electric Railway. Hosea W. Libbey, Boston, Mass. Filed Nov. 14, 1889.

436,432. Electric Conductor. William E. Oehrle, Philadelphia, Pa., assignor to Oehrle Bros. & Co. Filed May 28, 1890.



NO. 436,864. ELECTRIC HEATER.

436,439. Electric Motor Car. William Robinson, Boston, Mass., assignor to the Robinson Radial Car Truck Company, Portland, Me. Filed Apr. 12, 1880.

436,440. Electric Motor Car. William Robinson, Boston, Mass. Filed Sept. 16, 1889.

436,512. Telephone. S. Lloyd Wiegand, Philadelphia, Pa. Filed May 28, 1889.

436,513. Telephone. S. Lloyd Wiegand, Philadelphia, Pa. Filed May 28, 1889.

436,514. Telephone-Relay. S. Lloyd Wiegand, Philadelphia, Pa. Filed May 28, 1889.

436,516. Galvanic Battery. John F. Wollensak and William E. Gill, Chicago, Ill. Filed May 13, 1890

436,519. Method of Electrically Heating Bars, &c., for Welding and Working Purposes. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed June 9, 1890.

436,560. Electro-Mechanical Gong. George Doyle, Watertown, Mass. Filed Apr. 22, 1889.

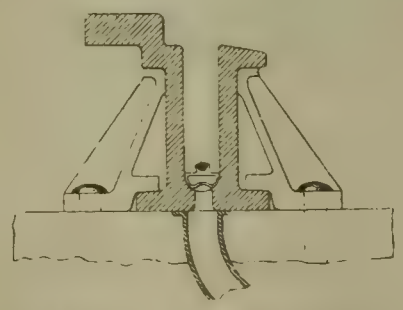
436,571. Trolley for Electrical Railways. David A. Ainslie, Richmond, Va. Filed May 8, 1890.

436,576. Graphophone. Joseph Daniels, Hartford, Conn., assignor to the Edison United Phonograph Company, of New York. Filed Apr. 30, 1890.

436,640. Electrical Automatic Fire-Alarm System. William F. Singer, Carthage, assignor to the Singer Fire-Alarm Company, limited, Buffalo, N. Y. Filed Mar. 11, 1889.

436,677. Electrical Head-Light. James Thorne and Ebenezer B. Burr, London England; said Burr assignor to said Thorne. Filed July 2, 1888. Patented in England, Feb. 12, 1887, No. 2,262, and May 13, 1887, No. 7,046; in Belgium, Apr. 30, 1888, No. 81,377, and in France, June 8, 1888, No. 189,824.

436,728. Motor-Armature Car-Wheel. Edmund Wagemann, Little Rock, Ark., assignor of six-sevenths to John D. Adams, Dean Adams, Oscar Davis, John W. Davis, Horace G. Allis, and John B. Jones, of same place. Filed Oct. 17, 1889.



NO. 436,923. ELECTRIC RAILWAY.

436,733. Insulating Material. James W. Easton, New York, N. Y., assignor to P. Minturn Smith, Plainfield, N. J., and William D. Perry, Brooklyn, N. Y. Filed Nov. 16, 1889.

436,743. Electric-Motor Car. William Robinson, Boston, Mass., assignor to the Robinson Radial Car Truck Company, Portland, Me. Original application filed Apr. 12, 1889. Divided and this application field Feb. 19, 1890.

436,777. Mechanical and Electrical Railway-Signal. Benjamin R. Davidson, Fayetteville, Ark. Filed Mar. 29, 1890.

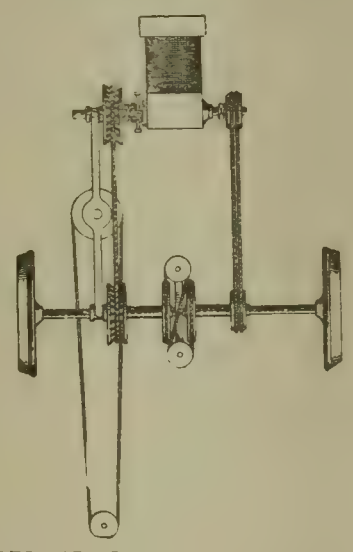
436,779 Electric-Motor-Car Truck. Elbert W. Goss, Amesbury, Mass. Filed Mar. 17, 1890.

436,781. Internal-Combustion Thermo-Motor. James Hargreaves, Farnworth, England. Filed Feb. 24. 1890. Patented in England, France, Belgium, Italy, Germany and Spain.

436,804. Electro-Osteotome. Milton J. Roberts, New York, N. Y. Filed Dec. 4, 1889.

436,814. Electric-Arc Lamp. Auguste Wagniere, Los Angeles, Cal. Filed Jan. 28, 1890.

436,843. Electric Controller for Power Mechanisms. Robert D. O. Smith, Mishawaka, Ind. Filed June 26, 1889.



NO. 436,970. APPARATUS FOR TRANSMITTING POWER.

436,857. Coupling for Electric Wires. Forrest R. Jones, Kearney, Nebr., assignor of one-half to James G. White, New York, N. Y. Filed May 22, 1890.

436,864. Electric Heater. Ernest Abshagen, Chicago, Ill., assignor, by direct and mesne assignments, of five-eighths to Alfred W. Brewerton, George M. Clark, Henry M. Hubbard, and William H. Hubbard, all of same place. Filed May 14, 1890.

436,874. Electric Contact Device. John J. Hoppes, Springfield, Ohio. Filed Jan. 30, 1890.

436,895. Process of Electro-Depositing Aluminium. John A. Jeancon Newport, Ky. Filed Dec. 30, 1889.

436,910. Electrical Weighing Machine. William Snelgrove, King's Norton, England. Filed Mar. 21, 1890. Patented in England, France and Belgium.

436,923. Electric Railway. Hosea W. Libbey, Boston, Mass. Filed Nov. 14, 1889.

436,952. Thermal Cut-Out. George H. Whittingham, Baltimore, Md., assignor to the Automatic Electric Switch Company, same place. Filed July 1, 1889. Renewed Feb. 20, 1890

436,961. Portable Electric Fire-Alarm. Francis R. Upton, Orange, N. J., and Fernando J. Dibble, Peabody, Mass. Filed Mar. 24, 1890.

436,964. Commutator-Brush. Charles Wirt, Orange, N. J., assignor of one-half to Francis R. Upton, same place. Filed Apr. 12, 1890.

436,968. Method of and Apparatus for Drawing Wire. Thomas A. Edison, Menlo Park, N. J. Filed June 10, 1884.

436,969. Method of and Apparatus for Drawing Wire. Thomas A. Edison, Menlo Park, N. J. Filed June 10, 1884.

436,970. Apparatus for Transmitting Power. Thomas A. Edison, Llewellyn Park, N. J. Filed June 10, 1890.

436,979. Electric Signal for Velocipedes. Charles G. Jiran, Chicago, Ill. Filed June 30, 1890.

437,008. Holder for Electric-Light Shades. Lewis J. Atwood, Waterbury, Conn., assignor to the Plume & Atwood Manufacturing Company, same place. Filed June 7, 1890.

437,010. Telephone-Exchange System. Edward M. Bentley, Boston, Mass. Filed Nov. 2, 1889.

437,011. Artificial Resistance. Edward M. Bentley, New York, N. Y. Filed Aug. 25, 1888.

437,012. Telephone-Exchange System. Edward M. Bentley, Boston, Mass. Filed Mar. 8, 1890.

437,044. Method of Impregnating Parts of Electrical Apparatus. Frederick L. Rawson, London, England, assignor to the Company Woodhouse & Rawson United, Limited, same place Filed Jan. 29, 1890.

437,069. Electric Distance Heat-Indicator and Alarm. Frederick W. Wiesebrock, New York, N. Y., assignor of one-half to Richard M. Bruno, same place. Filed Aug. 31, 1889.

437,079. Electric Belt. Lewis D. Ashbrook, Cardington, Ohio. Filed May 15, 1890.

437,111. Rheostat, Josephus H Gunning, New York. N. Y. Filed Nov. 15, 1889.

437,116. Coupling for Electric Wires. James J. Hinphey, Bound Brook, N. J., assignor of one-half to Benjamin B. Matthews, same place. Filed Mar. 5, 1890.

437,126. Underground Electric Conduit. Chas. E. Loth, Troy, N. Y. Filed Dec. 17, 1889.

437,158. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Original application filed Sept. 23, 1886. Divided and application filed June 1, 1887. Again Divided and this application filed Mar. 24, 1888.

437,160. Dynamo-Electric Machine or Motor. Max Mayer, New York, N. Y , assignor to David Hirsch, same place. Filed June 12, 1890.

ELECTRO-THERAPEUTICS.—A number of Philadelphia physicians and surgeons have organized an electro-therapeutic society for the discussion of questions of electricity combined with medicine and surgery. The main object of the society is to reduce the empiricism with which the practice of electro-therapeutics has hitherto frequently been associated, and to induce regularly certified practitioners to take up the subject on a scientific basis.

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PRIMARY BATTERIES.

The following communication explains itself:

NEW YORK, Sept. 25, 1890.

EDITOR ELECTRIC AGE:

Thinking that any information concerning the primary battery for light and power, would be of interest to you and your readers of the ELECTRIC AGE, I append the following:

On April 30th (in my own home), I set up and charged eight No. 11 cells, of the celebrated James H. Masuris primary batteries, and connected them on a circuit with nine 6 c. p. 12 volt lamps (Edison's type fitting regular sockets), distributed through four rooms; of course, using only 1 and 2 lights at any one time and from 2 to 4 hours per evening.

They worked without any depreciation in brilliancy for full seven weeks, and for five weeks after gave a light equal to a 4 c. p. 8 volt lamp, all from the one charge of solution.

I think this is an exceedingly pleasing result from a primary battery, and am confident it surpasses anything heretofore placed on the market for domestic electric lighting.

Have been using the batteries for almost a year and in every instance I have found them to do far better work than the inventor claimed.

Very sincerely,
WM. T. KNOX,
257 South Fifth street,
Electrician. Brooklyn, N. Y.

THE NEW ENGLAND PRINTING TELEGRAPH COMPANY.

The New England Printing Telegraph Company gave an exhibition of the work of the Essick Printing Telegraph Instrument, at their offices in Providence and Woonsocket, last Wednesday, under the direction of C. F. Hutchinson, the superintendent of the company. The line used was part of the 100-mile stretch the company have erected between Boston and New York. The Woonsocket office was in charge of Miss Alice M. Moat, and Providence office at 19 South Water street was in charge of Miss M. F. Gurney who will remain there permanently. The exhibition was a decided success, and every one who witnessed it expressed themselves as very much pleased. Besides the officers of the company, who were all present, ex-Governor Howard and many prominent men from New New Bedford, Fall River and other cities witnessed the exhibition. The present offices of the company are located at 113 Devonshire st., Boston; 19 South Water st., Providence; office of Woonsocket *Reporter*, Woonsocket, R. I., and office of P. S. Gage, 48 Bedford st., Fall River, Mass. Work is rapidly being pushed on the lines to New York and it is expected they will be finished by December 1st.

OF THE FIRST MAGNITUDE.—The Thomson-Houston Electric Company's pay roll embraces the names of 2,550 employes, and the number is constantly increasing, it is said.

The utility of the electric light in preventing theft and in improving the standard of night work becomes increasingly apparent. It is stated that the cost of an installation for the purpose of facilitating the work in a somewhat cramped goods yards of a London railway station was entirly paid for by the amount saved through decrease in the annual robbery of goods.

ELECTRICITY CAN'T KILL HIM.—A lineman in the employ of the telephone company in this city while repairing wires a few days ago, touched a wire which received a heavy current, probably through a cross. He was knocked off the pole, but suffered slight injuries. He received a burn on the neck, however. This is the third time he has been hurled from poles into the street by receiving similar shocks.

A FLYER.—The Short Motor which leaves the Union station every night at 11 o'clock is a "runner." Since it carried Vic. Backus from Washington street to Seventh street in 5 minutes and a half he has called it "the cannon ball."—Indianapolis *News*, Sept. 17, 1890.

MOONLIGHT SCHEDULE.—It rains alike on the just and the unjust, likewise does stormy weather prevail alike in communities lighted by the moonlight schedule and those enjoying all-night light. September has been a hard month on those centres of population lighted artificially in inverse ratio to the light of the moon.

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J. B. TALTAVALL, Business Manager,
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NEW YORK, OCTOBER 11, 1890.

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ELECTRIC COAL CUTTING MACHINERY. — In our issue of September 13th we published a paragraph from an English contemporary in reference to the coal cutting machine invented by Mr. E. A. Sperry, in which the statement was made that "reciprocating action is the wrong way to produce motion on a large scale by electricity." On another page in this issue we publish a communication from Mr. Sperry in which he describes his experiments two or three years ago with a view to ascertaining the mathematics with reference to the recovery of power from electricity when that power was of a reciprocating character. Mr. Sperry's experience has proved that better results can be obtain from the reciprocating motion in mine excavating than any other. This one fact is a valuable addition to the fund of knowledge on this subject, and whether reciprocating action is the wrong way or the right way to produce motion by electricity, experience apparently proves that it is the best way.

ELECTRICAL EXCERPTS.—At the meeting of the British Association in Leeds, last month, many valuable papers on electrical subjects were read, several well-known scientists contributing much additional information and throwing new light in different electrical directions. Most of the papers were rather lengthy, and all of them contained something of value to every electrician. The abstracts we printed in last issue, and those in this issue, are solid and valuable facts taken from the bodies of the various papers, and presented to our readers in brief form that they might not be lost as all facts are liable to be when covered up in the verbiage of a long paper.

ELECTRICITY IN MINING.—As an evidence of the great and important place electricity now occupies in mining operations we call attention to our report in this issue of the proceedings of the Mining Engineers' Association at their meeting in this city last week. The separation of ores by magnetism naturally received more attention than any other subject involving magnetism or electricity. Electric power transmission in mining operations was the subject of one paper. The reading of this and other electric papers served an excellent purpose beyond their application to mine operations. They gave those members, who are not practical electricians, an insight into the wonderful things electricity is called upon to do for the benefit of mankind.

ELECTRIC CARS.—The use of electricity as motive power on street railways seems to have fostered a desire on the part of the public for a superior class of cars than the old-fashioned street car. Much time, ingenuity and money are spent in efforts to improve electric cars in every way, and the result is we hear of elegant vestibule cars, finished in mahogany and with Wilton rugs, being turned out of the shops of car builders. We describe, in another column, such a car, which will be a model of elegance. There are a great many people who would be willing to pay extra fare on cars of this class if they were provided.

THE ELECTRIC CLUB —The New York Electric Club opened the Fall and Winter season on Thursday night last with an elegant dinner. The future of this club is a most promising one, and the good that its members will derive from the lectures, and other forms of entertainment during the coming season will assuredly be of the most substantial character. It is said that electricity is life, and as there is much electricity in the club in animate form, there must necessarily be a great deal of life, and that there is an abundance of life is evident from the way the club is made to fulfill its mission. Long live the Electric Club!

SUPERINTENDENT OF ELECTRICAL EXHIBITS AT THE WORLD'S FAIR.—The name of Gen'l C. H. Barney, of the firm of Alexander, Barney & Chapin, of this city, is being seriously considered in connection with the position of Superintendent of Electrical Exhibits at the World's Fair, and the sentiment in New York is strongly in favor of his appointment. There is no more popular gentleman in the country than the General, and none so well qualified to fill this important position.

RECEIVED 1,500 VOLTS AND LIVED.—Charles Skerrye, the night engineer at the electric light works at Waltham, Mass., received the whole current of the dynamo, 1,500 volts, while making some changes at the switchboard on the night of Oct. 1st. He was doubled up and thrown to the floor when his assistant knocked the plug from his hand. Skerrye's hands were badly burned, but he was out again the next day suffering from the shock, but not seriously injured.

MARRIED.—On Oct. 1st, Mr. Henry Durant Cheever, of the Okonite Company, of New York, was married in Boston to Miss Maud R. Barnard of that city. After the ceremony Mr. and Mrs. Cheever received their friends at the house of the bride's parents. They will spend their honeymoon in the South, and on their return will reside in New York City.

OPENING OF NEW ELECTRICAL SUPPLY HOUSE.—At the time this paper was on the press, the new firm of Alexander, Barney and Chapin, at 20 Cortlandt street, were entertaining their many friends at the opening of their new electrical supply establishment, on Monday the 6th inst., at the number mentioned. In our last issue we gave a general outline of what the place would be and what would be done on the occasion of the opening, and in our next issue we hope to give our readers a more extended account of this new establishment. The opening took place under the most auspicious circumstances, and as the members of the firm are well-known in the electrical field and have many friends, it is reasonable to assume that the new A. B. C. combination has a prosperous future before it.

SCIENTISTS AT THE EDISON LABORATORY.

On Friday Oct. 3d, over 400 persons, comprising delegates to the meeting of the Mining Engineers and British Iron and Steel Institute, being held in this city, and several ladies, visited the Edison laboratory, at Orange, N. J., where they were given an insight into the workshop of the famous Edison. A long special train left New York at 1 P. M. and on its arrival at the Orange station the party was driven in carriages to the laboratory, a distance of 1¼ miles. At the laboratory the guests were received and welcomed by Mr. Edison and his assistants, who explained everything of interest to the party. The library was handsomely and effectively decorated with potted flowers and plants for the occasion. The celebrated statue of the Genius of Light, which was brought from the Paris exposition by Mr. Edison, was the centre of a mass of floral decorations, and its beautiful proportions, were effectively and charmingly brought out, surrounded, as it was, by the green foliage of the plants. It faces the door of the library and holds in its elevated hand an Edison' light. On this occasion it seemed to be endued with life, and lighting the way for the distinguished visitors, it bade them welcome to the famous spot from which so many of the greatest inventions ever given to mankind have emanated.

An elaborate luncheon was served in the library which was crowded with the guests of Mr. Edison. After luncheon the ladies of the party were presented with souvenirs commemorative of the occasion, and then were driven through the beautiful Llewellyn Park.

The gentlemen of the party were conducted through the laboratory, workshop, dynamo room, and all the other departments which were of any interest to the visitors.

The entire party were pleased beyond expression with their visit and the opportunity of meeting Mr. Edison, and Mr. Edison himself derived great pleasure in conversation with his guests on subjects of interest common to both, and no doubt each member of the party who found the opportunity to converse with the host left with the feeling that the visit was a profitable one as well as exceedingly enjoyable.

A representative of the ELECTRIC AGE met Mr. Edison Friday while the library was being put in order for the reception, and he looked upon the work as it progressed with evident satisfaction. It was indeed a charming scene, and Mr. Edison knows how to appreciate the beautiful things of life as well as any one else.

Among the gentlemen in the party were Sir James Kitson and Prof. Lunge, the well-known professor of chemistry at the University of Zurich, and several other eminent scientists of fame from England, who are in attendance at the meetings.

Before the excursion returned to New York, Sir James Kitson made a short address, thanking Mr. Edison for the kind reception which they had met. Although, he added, it had been wrongfully said that Americans led the world in electrical invention, it was right to say that Americans were in advance of the world in the application of electricty. In the front rank of all American inventors was the man whose hospitality the engineers had enjoyed.

Professor Lunge, in speaking of the visit, said that the engineers were all surprised at the magnitude of the experimental works.

"But we were principally interested in seeing Mr. Edison himself," he added. "The man, you know, is greater than his works. With Sir James Kitson and several other favored ones, I had the pleasure of seeing much of the inventor. He explained the marvellous inventions, and exhibited the telephones and phonographs. The processes of welding, separating and concentrating of ores by electricity were of peculiar interest to us foreigners, and we were grateful indeed to the famous inventor for his courtesy. To me individually, his personality was of the greatest interest. The power of his eye is marvellous."

AUSTIN'S "NOVEL" HAND-DYNAMO.*

This hand-dynamo has been specially designed for experimental work, either in the laboratory or on the lecture table, for which it is admirably adapted, as from the manner in which it is wound, it will work under all circumstances; no matter whether the external resistance be high or low, the machine will give out a corresponding quantity of current. Great care has been taken in

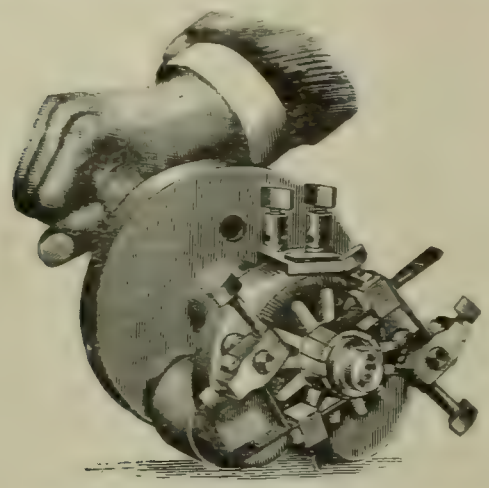


FIG. 1.—AUSTIN'S HAND DYNAMO.

the construction of these machines, so that as much as possible of the manual work expended in turning the handle is given out at the terminals as electrical energy. As will be seen from the illustrations, the machine is very compact, and has a pleasing appearance. Its output is equal to about six or eight quart Bunsen cells. The machine all complete weighs only 16 lbs. It can be fixed either temporarily or permanently to bench or table. Six different leverages

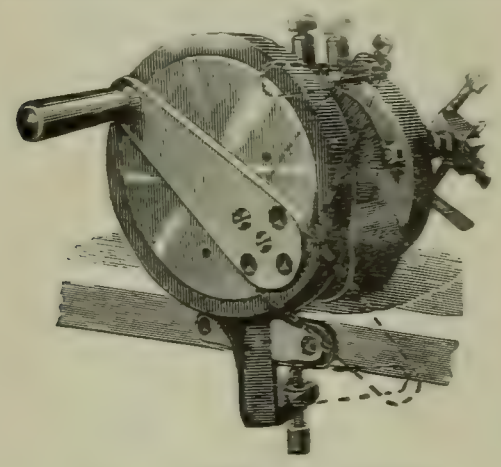


FIG. 2.—AUSTIN'S HAND DYANMO.

can be got by altering position of handle, three of the most important being shown by dotted lines. There are no belts, cords, or cogwheels used in gearing, which is constructed entirely of metal, working on the principle of rollers and traction—there is consequently very little friction. There are no complicated parts, every part being constructed in the simplest manner possible, and the material and workmanship are of the best.

VENTILATION IS THE REMEDY.—Professor Barrett, of the electrical department of Chicago, says that there have been no explosions from the subways in that city since they have been ventilated. The main down-town subways are ventilated through the city hall chimney, the electric light posts furnishing ventilation sufficient at other points. The explosions are not caused, Professor Barrett says, by leakages in the electric current coming in contact with gas. The gas itself is a creation of vegetable decomposition, and is known as marsh gas, being similar in its explosive nature to natural gas, and is ignited by elements in the atmosphere other than electricity. He thinks the explosions are caused by spontaneous combustion. The street department of Chicago, has ordered the electric light, telephone and telegraph companies to ventilate all their subways in order to prevent these explosions.

* London *Electrical Review*.

A FEW HISTORICAL FACTS IN ELECTRIC LIGHTING.

In November, 1886, the first central electric light station in America was started. It was at Greensburg, Pa., and the system used was the Westinghouse alternating. A 300-light dynamo, with converters, was installed. The station has given continuous service ever since and the first dynamo is still in use.

The first installation or exhibition in the world of series arc lights, as operated at the present day, was made by the Brush Electric Company, at the Mechanics Institute Fair in New York, September, 1878. In 1877 the same company operated single lamps from a dynamo. Several independent circuits were run from the dynamo, one to each arc lamp. The first series arc lighting was in 1878, as above mentioned.

On May 2, 1880, the first isolated electric lighting plant, under the Edison system, was started—it was on board of the steamship Columbia, of the Oregon Railway and Navigation Company.

The first Edison central station was put into public service Sept. 4, 1882, supplying 85 buildings with 2,323 lamps. This station was in Pearl street, New York.

In the autumn of 1880, the first commercial incandescent lighting plant in New York city was started by the United States Electric Light Company in the Equitable building, 120 Broadway.

In 1880 the first public lighting, by the tower system, took place. Union City, Indiana, has the honor of being the first place lighted by this method. Akron, Ohio, soon followed with a like system, then Cleveland, Ohio.

In October, 1883, the Sawyer-Man Illuminating Company established their first incandescent light plant. It was in the United Bank building, corner of Broadway and Wall street, New York.

The commercial manufacture of Edison incandescent lamps was commenced in Menlo Park, November, 1880. On April 1st, 1882, the present lamp works of the Edison Company at Harrison, N. J., were established.

The first vessel of the U. S. navy to be lighted by electricity was the Trenton, in 1883. Now about twenty vessels of the United States government have complete electric lighting equipments. The two wire system has always been used in the naval service, the ship never being allowed to form the return circuit.

In 1878 the office of the Bombay *Times*, Bombay, India, was lighted on the outside by an arc light.

The first lighthouse using electricity for lighting purposes was that at North Foreland, England, in 1854. A De Meriten machine was first used.

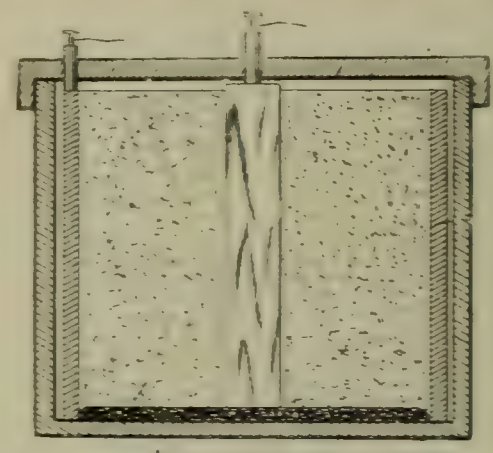
HYPNOTISM.—It has been discovered that a hypnotized person may be filled with joy and see beautiful things by placing the north pole of a magnet in his hands. On the other hand, he can be made to get a taste of future misery by taking hold of the south pole of the magnet, while by taking hold of both poles his emotions are neutralized, so to speak, and he does not experience any unusual feeling. This would indicate that a hypnotized person is negatively electrified and the sensations of joy and misery according to whether he takes hold of the north or south pole may be the effect of magnetic attraction and repulsion.

A DIMINUTIVE ELECTRIC LIGHT AND POWER STATION.—Collias, near Nimes, a village of 465 inhabitants, has just been lighted by electricity. The motive power for the 1,600-light dynamo is derived from a small waterfall. The streets are lighted by 25 lamps of 16 candle-power each. Besides lighting the village, the current is employed during the day in putting in motion the pumps for supplying certain parts of the village with water.

IMPROVED DRY BATTERY.

Mr. E. H. Crosby, of the Crosby Electric Company, of Boston, has just received a patent on a "dry battery," of which the following description and illustration will give a good idea. It possesses some new and valuable features.

The jar is made of paper stock, or a similar material, the outer surface being coated with



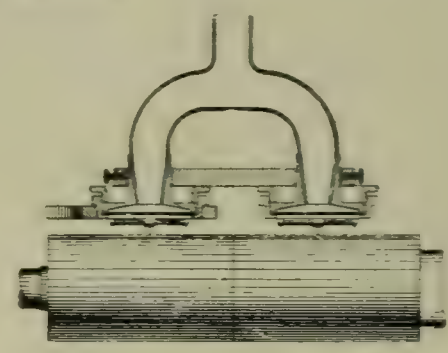
CROSBY'S IMPROVED DRY BATTERY.

shellac, and the inner surface with an acid-proof compound of paraffine and ozocerite.

The elements are zinc and carbon, the carbon plate resting on a pad of absorbent material saturated with an excitant, and the whole being surrounded by a packing containing the dry excitant. The dry packing which separates the positive and negative plates consists of sawdust or wood fiber mixed with an excitant in a dry or crystalline form

TWO-CYLINDER PHONOGRAPH.

As the phonograph becomes more and more used in business lines the necessity for some device whereby a double record may be made of the matter spoken into the machine becomes apparent. Mr. Edison, with his usual foresight, has provided means for accomplishing this object, and obtained a patent on the same last week.



EDISON'S TWO-CYLINDER PHONOGRAPH.

With the aid of the accompanying illustration and brief description of the device the invention will be fully understood.

The cylinder of the phonograph is made to receive two wax blanks, end to end, and two recorders are provided, one for each blank. The diaphragm of each recorder is independent of the other.

A SIGN OF PROGRESS.—One of the most characteristic signs of the progress which is being made by electricity is, says *La Lumière Electrique*, to be seen in the rapidly increasing size of the dynamo units adopted at central lighting stations. At the Electrical Exhibition of 1881 the most powerful dynamo was an Edison machine giving 800 amperes and 110 volts (120 horse-power). At the present moment the Berlin central stations have 500 horse-power dynamos running, and at Deptford a 3,000 horse-power alternator is at work and two 10,000 horse-power machines are building.

THE TELEPHONE IN GREAT BRITAIN.—The Central News says the expiration of the telephone patents in England will begin on the 9th of Dec. next, and the monopoly will soon cease.

ELECTRIC LIGHTING FOR BEGINNERS.

BY THE EDITOR.

Part VIII.—Separately Excited Dynamos.

165—What is a separately excited dynamo?

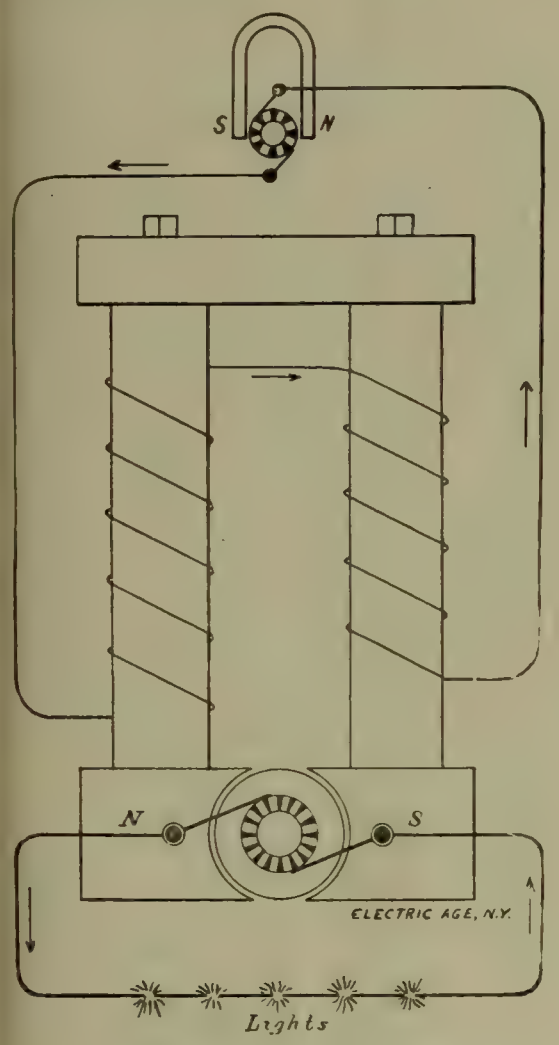
A separately excited dynamo is one in which the field magnets are wholly or partially excited by a current derived from a source external to the dynamo itself. The accompanying illustration is that of a separately excited dynamo whose field magnets are excited only by a current from an external source which in this case is a magneto generator.

166—How is the external current produced?

The external current may be produced by a battery, a dynamo, or a magneto generator—anything that will maintain a steady current.

167—What is a self-exciting dynamo?

A self-exciting dynamo is one in which a portion of the current developed in the armature is diverted around the field magnets for the purpose of exciting them.



SEPARATELY EXCITED DYNAMO.

168—Are separately excited dynamos much used at the present time?

Separately excited direct-current dynamos are used to a very limited extent now.

169—What machines other than those of the direct current class are separately excited?

Many alternating current generators are separately excited, but the separately exciting feature is being done away with.

170—How are the field magnets of alternating current machines excited when not excited from a separate source?

In a manner similiar to the self-excitement of the fields of direct current machines.

171—In the separately excited direct current dynamo, is the external source of current always connected with the dynamo in one way?

No; there are a variety of ways of combining the current from the external source with that produced by the dynamo itself.

172—Describe some of the different methods of combination.

One method is shown in the accompanying illustration. The auxiliary generator shown above the diagram of the dynamo is a magneto generator. The current produced by the revolution of the armature flows from one brush around the field magnets of the main dynamo and back to the other brush of the magneto generator. By referring to the diagram it will be seen that the field magnets of the dynamo are wholly dependent upon the magneto generator for their excitation. Another method is to connect the magneto generator directly in the main circuit of a series-wound machine (see Part V. of these articles for illustration of series-wound dynamo), and another is to place the magneto generator in the shunt circuit of a shunt-wound machine (see figure of shunt-wound dynamo in Part VI. of these articles).

173—What is the reason separate excitation of field magnets is being abandoned?

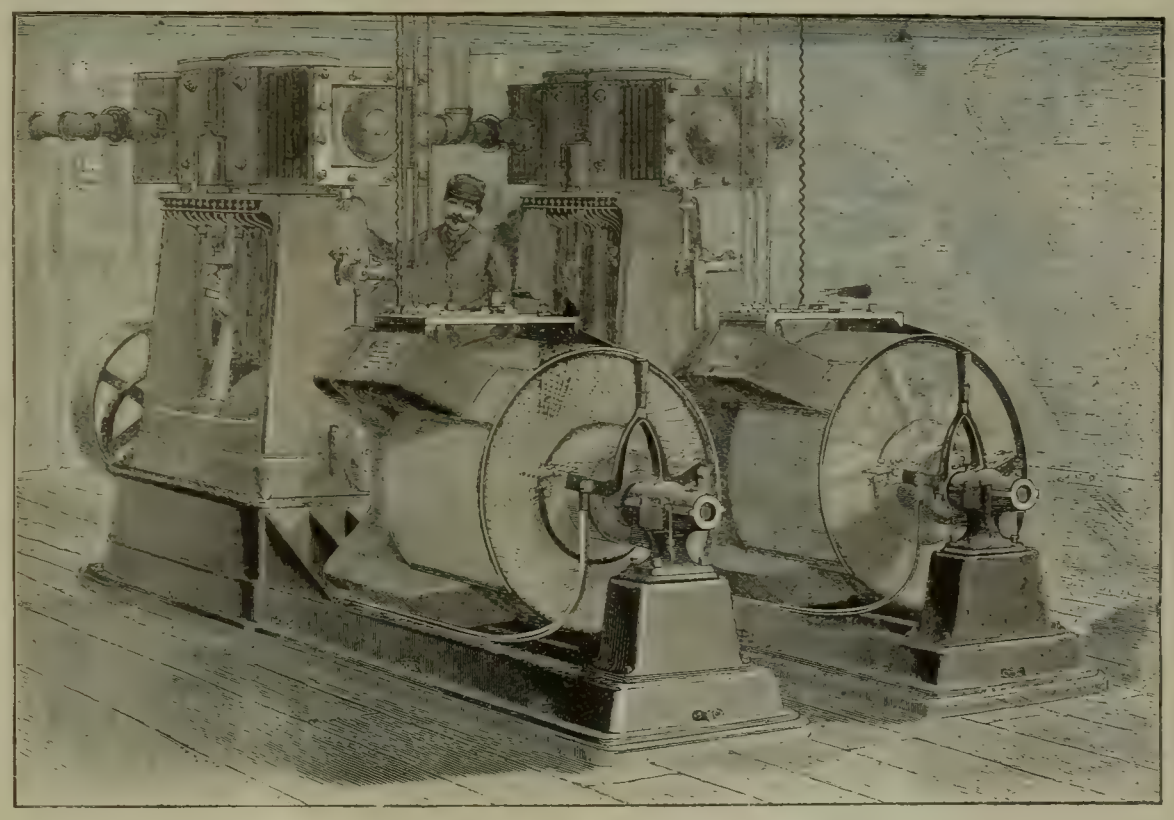
The first dynamos made were separately excited, but the discovery that a dynamo could be so constructed as to excite its own field is the reason for the abandonment of the separate exciting principle.

174—In the different combinations of the dynamo current and that from the outside source, what is the practical result?

The combination of the separate current generator with a series-wound dynamo gives a constant current; the combination of the same with a shunt-wound dynamo also gives a constant current, and the combination of a separately excited coil on the field magnets of a series-wound machine gives a constant potential. The combinations are for the purpose of producing constant current or constant potential according to the manner in which the combinations are effected.

(To be continued.)

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ELECTRIC LIGHT PLANT ON STEAMER "PLYMOUTH."

ELECTRIC PLANT ON THE STEAMER "PLYMOUTH."

The elegant new steamer of the Old Colony Steamboat Company, popularly known as the Fall River Line, made her trial trip on Oct. 2d. Her electric lighting plant possesses some interesting features, a general description of which is herewith given. The plant was put in by the Edison General Electric Company, under the supervision of Mr. W. H. Peirce. There are two 700 light dynamos, each having an output of 350 amperes, at a pressure of 115 volts. Each dynamo is driven by an independent compound Ball engine of 65 horse power, at a steam pressure of 120 pounds. The dynamos are connected directly to the engine shaft and are run at 400 revolutions per minute. The fields terminate in eight pole pieces, four on the outside of the ring and four inside. The armatures are of the Gramme ring type and rotate within the zone marked by the four internal and four external pole pieces. The core of the rings are laminated, and each armature weighs 1,950 pounds, while the weight of the dynamo complete is 6,563 pounds. The dynamos are compound wound, and their commercial efficiency is 89 per cent, while the heating is but 35° F. above the temperature of the atmosphere.

The installation is on the two-wire system. The dynamos are connected in parallel so that one or both can be used to supply the current. From the generating plant double transit leads are taken fore and aft, and branching so as to terminate at four cut-outs. From these cut-outs the lamps are supplied directly or by feeders. The main leads are not tapped. As more work might be thrown upon one main lead than on the other, equalizing mains are carried from each forward cut-out to each of the after cut-outs. This gives four distributing points. Risers are carried through the decks to supply the lights at different elevations.

Lead covered conductors are used in places where any moisture exists; elsewhere Habirshaw marine core wire is employed.

The vessel is lighted by 1,250 sixteen candle 110 volt lamps, and each lamp has an individual switch. The dining room lights are connected with a switchboard by which they can be turned off or on, ten at a time—being arranged in groups of ten each. The electroliers are beautiful specimens of metal work.

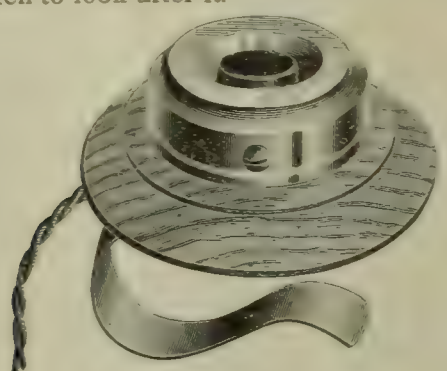
The accompanying illustration gives a very clear idea of the electric plant on board of the "Plymouth," which steamer represents the latest development of everything pertaining to safety and comfort in travel, as well as being herself a perfect specimen of marine architecture.

Among those on board on the trial trip were H. Ward Leonard, Chas. D. Shain and W. H. Peirce, of the Edison General Electric Company, and Mr. D. Chalmers, of the Empire City Electric Co.

PLATINUM.—The enormous increase in the use of platinum in the electrical industries has resulted in an increase of value of that metal, more than 60 per cent., in the past year. The manufacture of incandescent lamps calls for a large amount of platinum, and the use of it is constantly increasing.

A NEW DINING ROOM PUSH.

It would seem that so simple a thing as a push-button leaves little room for improvement or change, but this is not wholly true. In the case of pushes used in connection with a wall or floor connection and a flexible cord, the extension part of the floor push is now considered quite essential. Still the push-button which is in use may be on the table, or the lap of the hostess, or very likely on the floor, unless special pains are taken to look after it.



DINING ROOM PUSH.

But this is to be so no longer, for Mr. C. G. Armstrong has designed an attachment which holds the push in any desired place. It is evident from the cut that the new push can readily be slipped on to the edge of the table, or on one of the side panels, or even on a chair. Whether the push is uppermost, or is concealed by being turned downward, it is always just where you put it. Any style of push-button can be furnished with this improvement, and the Great Western Electric Supply Company, an acknowledged leader in matters of push, will undoubtedly find a great demand for it.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Oct. 3, 1890.

W. W. Castle, of the P. & B. Conduit and Construction Company, has been in Boston for a few days.

The Derby, Conn., Rubber Co. has bought the plant of the Electric Light Company at Shelton and made arrangements to enlarge it.

The following well known gentlemen have been appointed judges of the electrical exhibits at the Mechanics' Fair. C. J. H. Woodbury, A. L. Russell, B. S. Flanders and Frederick Lane.

The Merrimac Valley Horse Railroad officials have decided to use the single trolley system when the cars are operated by electricity and will be required to build the extension to Andover before October 1st, 1891.

Fred. Merritt, electrician for the New England Printing Telegraph Company, while directing some works at the Mechanics' Fair building, last Wednesday, fell from a step-ladder and sprained his ankle.

Mr. Wm. Johnston, of the Johnston Electric Train Signal Company, has the sympathy of the fraternity in the loss of his mother who died in Manchester, N. H., the past week, from a stroke of paralysis.

Mr. L. F. Jordan is receiving large orders for the "Best" Trolley Hanger in the West. This hanger is in successful use on the electric roads in Beverly, Danvers and Lynn, and has stood the severe test of the West End system in this city.

The Brown Electric Protector Company, although they have increased their capacity several times, are still behind in their orders. Their daily exhibitions are attended by large numbers of interested electrical people.

The city of Somerville is to have an electric fire engine.

Articles of incorporation have been granted to the Forrest Avenue Street Railway Company to build and conduct a street railway, two miles in length, in Brockton. The capital of the company is $25,000, and G. F. Bower is the treasurer.

The first car of the Essex Electric Road double trolley system ran from Peabody square to City Hall, Salem, on Sunday last.

The American Circular Loom Company have issued a new and very convenient price list. This company are rushed with orders and are compelled to double their capacity to keep up to the demand.

Last Monday the Naumkeag Street Railway formally opened the Peabody division under the electric system, and a party of 350 gentlemen, representing Peabody, Wenham, Danvers, Marblehead and the City Council of Salem were taken over the line and then to the Salem Electric Light Works where the power was inspected, and were then taken to the Willows where dinner was served.

At a meeting of the stockholders of the Cohasset Electric Co., last Saturday evening, the board of directors was increased to five members by the addition of John C. Howe, of Cohasset, and Silas Pierce, of North Scituate. The plant and system were formally turned over to the company by the original charter members and builders. The company has received applications from residents of North Scituate to extend the system to that town.

An electric motor car is being constructed at Springfield, which, it is claimed, will be noiseless. It will be about 10 feet long and will draw two cars. It will be furnished with 300 cells and two 20-horse power motors, which will give 100 horse power, sufficient for an entire day's work. The mechanism is so arranged that the car can be propelled by either the overhead system or storage batteries. The company making it, claims that it will do away entirely with overhead and underground wires.

The Armington & Sims mammoth engine, Factory K, went on duty a few days ago. Its load was the incandescent lights on the 2d floor of factory C. The engine is of 440-horse power with 240 revolutions per minute. Its speed at present is at the rate 220 revolutions. It is belted to the 2,600 light alternating machine which supplied the current for the test lamps. The construction of this began a year ago.

There will be four large Lynn and Boston railroad electric ploughs for the coming season. They are powerful machines and will be just enough and no more to cover all the electric routes this winter.

The officials at the Charleston Navy Yard have petitioned the navy department for electric lights in the barracks, and in all probability they will be put in, in a couple of weeks. W. J P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Oct. 4, 1890.

Prof. H. S. Carhart, of Ann Arbor, Mich., was in the city Friday.

The Iron Mountain Electric Light Company, of Iron Mountain, Michigan, are installing an alternating incandescent plant of the Brush system.

Mr. P. C. Burns, of the Findlay Glass and Carbon Company, was in town this week on business relating to their new factory at Peru, Ind.

The Davenport, Rock Island and Moline Railroad Company will use tandem compound high speed engines for driving their generators, preference being given to this type over the Corliss.

The Chicago Electric Battery and Power Company has been incorporated at Chicago to deal in electrical batteries; capital stock, $300,000; incorporators, G. A. Rollins, B. T. Foley and C. E. Gregory.

The Brush Electric Company, through their Chicago office, are busy installing plants in various parts of the West. Some of the more important plants are being installed at the following places: Anaconda, Montana; Crete, Missouri; Falls City, Missouri; Iowa Iron Works, Dubuque, Iowa; Lesure Lumber Company, Dubuque; McCosh Iron and Steel Company, Burlington, Iowa; A. H. Baker Woollen Company, Fairfield, Illinois. Large additions are also being made to already established plants, both in arc and incandescent apparatus.

Dr. John McKinlock, of the Central Electric Company, has been chosen to lecture on electro medical subjects in the International Dental College of this city. Dr. McKinlock, prior to coming to this city, was for a number of years a resident of Detroit, Mich., and for six years a member of the faculty of the Detroit College of Medicine. The International Dental College is to be congratulated on securing the services of so well qualified a gentleman. Dr. McKinlock will still retain his connection with the Central Electric Company.

Of the numerous forms of lamp-guards now in use, many need a shade-holder, and others have so coarse a mesh as to afford but little protection. Seeing this, Mr. Geo. Cutter has brought out a new form of expanding wire-guard which combines the good features of all the others. It has five rings surrounding the part of the bulb which most needs the protection, has sliding sleeves which adapt it to any 16-candle power lamp, and looks much neater than the older forms. The Great Western Electric Supply Co. are pushing this guard.

CHICAGO ELECTRIC CLUB.—Cards are out announcing the first regular meeting of the Club for this season, to be held in the club parlors Monday evening, October 20th. Mr. B. E. Sunny will read a paper, the subject of which is not yet announced. Following the scientific discussion a reading will be given by Mr. C. C. Haskins. The list of pending applications for membership is one of which the club may feel proud, as it has been some time since so many prominent names have appeared upon the board at once. The gentlemen are as follows: Geo. L. Seering, Thomas M. Brooks, W. J. Chalmers, vice-president of the Fraser and Chalmers Company; E. R. Gilman, president Northwestern Thomson-Houston Electric Company; J. P. Barrett, city electrician; Chas. A. Brown, manager Western Electric Company; Elisha Gray, Robert C. Clowry, vice-president Western Union Telegraph Company.

A deal of considerable importance locally was consummated this week in the purchase of the plant of the Sun Electric Light Company by the Chicago Arc Light and Power Company. The Sun Company's plant was one of 300-light capacity and operating nearly that number of lights, all apparatus being of the Sperry make. The Chicago Arc Light and Power Company has already in operation about 2,150 lights, having the largest commercial lighting station in the United States. They have apparatus of a number of different styles, but use principally the Thomson Houston system.

A decision has been rendered by the United States Court at Grand Rapids, Mich., holding that the act of Congress permitting the Western Union Telegraph Company to use all the government postal routes to string their wires is permissive only, and that the occupancy and use of streets is under the regulations of the police powers vested in the several States. The hearing was on an injunction asked by the Western Union to prevent the city authorities from interfering with their lines, and the injunction was refused. F. M. I.

MINING ENGINEERS.

At the meeting of the American Institute of Mining Engineers which is being held at Chickering Hall, in this city, electricity and magnetism, as applied to mining operations, occupy an important place in the discussions.

"Magnetic Concentration at the Michigamme Iron Mine, Lake Superior," was the title of a paper by John C. Fowle. In comparing the Buchanan and the Wenstrom separators, the author says:

The Buchanan separator is very well built; it has a much larger capacity than the small Wenstrom machine and makes richer concentrates. It carries a current of twenty-three amperes, and is wound with heavy copper wire. The Wenstrom machine, on the other hand, can carry only ten amperes, and is wound with wire of one-third the size.

In conclusion Mr. Fowle said:

I consider the concentration of magnetic ores by electricity to be still in its infancy as to cost,

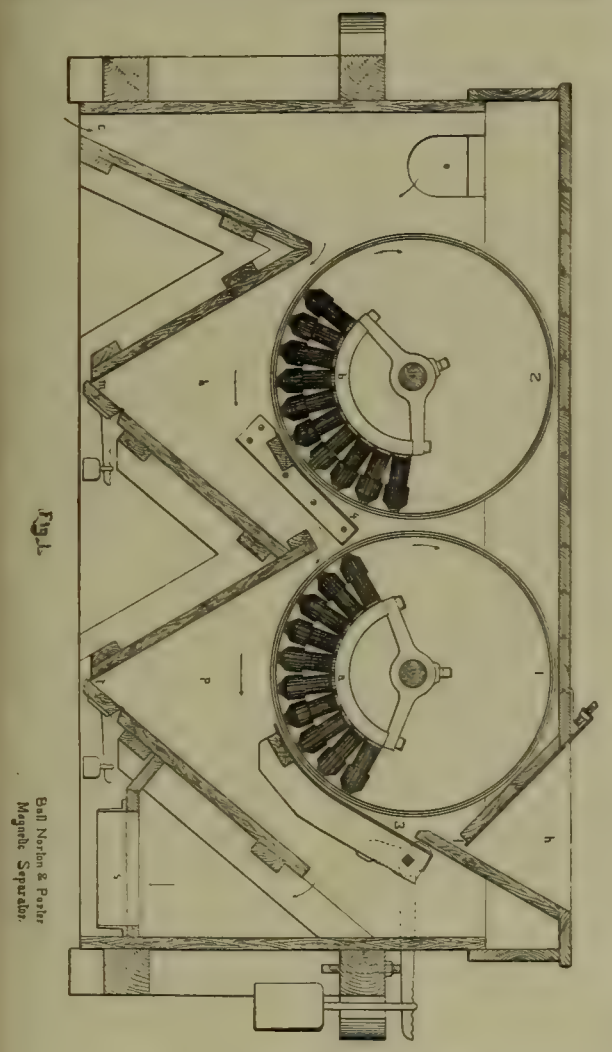


FIG. I. MONARCH SEPARATOR.

capacity and quality. Our experience has been exclusively with separators having one or more drums, and I claim no knowledge of practice with other forms of apparatus. The many mills now in operation in the East will undoubtedly, during the present year, work out new methods for concentrating iron ores, whereby the cost will be reduced and the output still further increased.

Mr. F. H. McDowell was the author of a paper on "Ore Dressed by Electricity at the Tilly Foster Mine," on which he gave the results of the experience at this mine in this method of dressing ore.

"The Magnetization of Iron Ore" was the subject of the next paper, read by Clemen Jones, of Hokendauqua, Pa.

Modern ingenuity, he says, has utilized the principle of the magnetic ore-particles from the rock which has previously been crushed. This process recovers the ore in the state of a concentrate very rich in iron and in some cases desirable for Bessemer purposes.

This paper was in the main a discussion of the classification and the elementary construction of the various magnetic minerals.

A paper by C. M. Ball, of Troy, described the Ball and Norton "Monarch" magnetic separator, of which a working model was on exhibition in the hall:

"This machine is the joint invention of Sheldon Norton, of Hokendauqua, Pa., and myself, and has been patented in the United States, Canada and other countries.

The apparatus consists of a partially closed chest, having an opening from the feed-hopper, through which the ore is delivered to the machine from an ore-pocket or storage-bin provided with means for regulating the flow of ore, so that, when the machine is in operation, the hopper is kept always full. Other openings are provided for the discharge of tailings, of middlings, and of concentrates. The openings are kept sealed against ingress of air by means of hinged and weighted valves, which discharge the products from the hoppers continuously, and in the same proportion as received from above, when a sufficient weight has accumulated upon the inside to cause the contents of the hoppers to leak by the valves.

The machine is also provided with two drums, turning upon shafts. These shafts, together with the magnets, which they also serve to support,

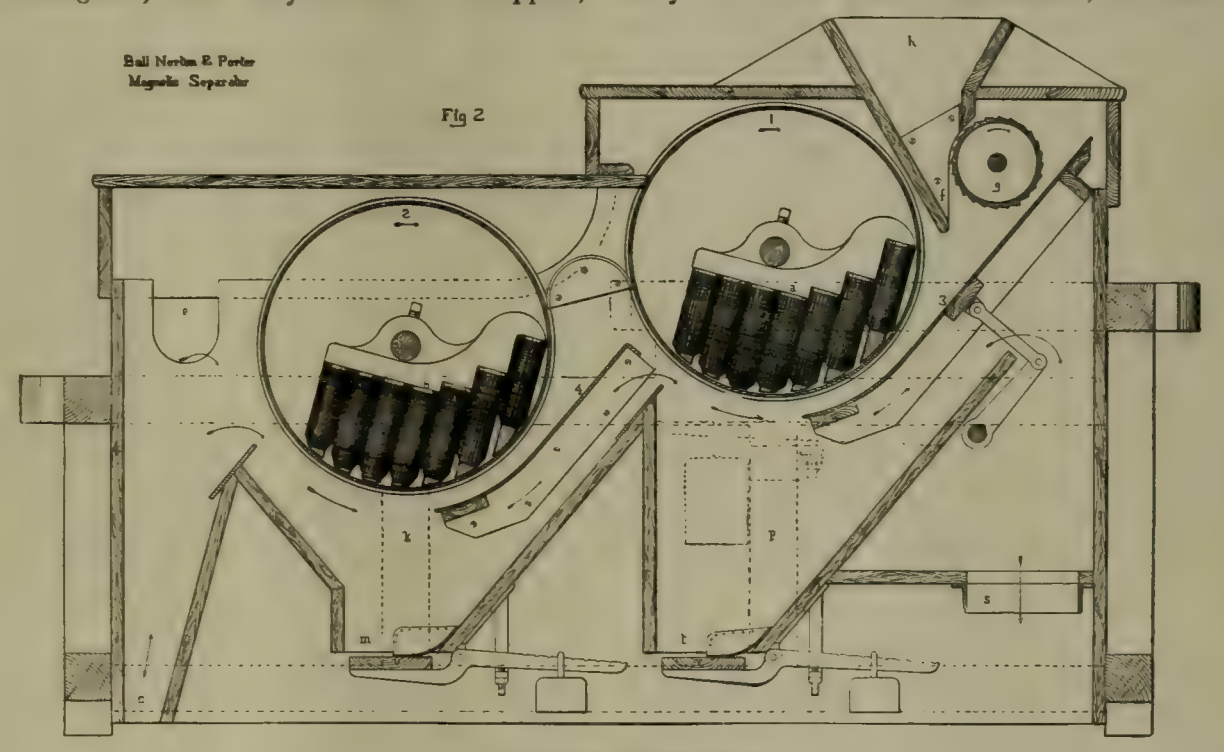


FIG. 2. MONARCH SEPARATOR.

stand still, while the drums may be rapidly revolved around the magnets and out of contact therewith. The magnet occupies a section of the drum, the proportions being such that, approximately, one-third of the periphery of the drum is within the influence of the magnetic field, while the upper two-thirds is outside of the field and removed from the magnetic influence. The magnet is so constructed as to present a series of poles of alternately opposite polarity near the inner surface of the drum. In accordance with the well-known phenomena of magnetic attraction, which in the case of powerful magnets is exerted at a considerable distance from the magnetic poles, any magnetizable matter brought near the outer surface of the drum, within the arc covered by the magnet, will be powerfully attracted and drawn into firm contact with the outer surface of the drum.

These drums are composed of a non-metallic and neutral material, such as wood, paper, etc.

Just below the wood-hopper an apron of neutral metal is arranged, curving downward and forward in the direction of the rotation of the drum, its lower portion describing a short arc concentric to the surface of the drum. This serves as a shute to direct the stream of ore falling from the feed-hopper within the influence of the first two or three poles of the magnet. A similar but somewhat shorter apron is arranged in like relation to the second drum and magnet. The provisions for applying and directing the air-current, which fullfils an important function in the process of separating ore as developed in this apparatus, are complete. The air may enter freely at the openings and is drawn through and out of the chest by the action of a powerful exhaust-fan."

After describing in detail the process of separation, the paper concludes:

"The preparation of any particular ore being wholly dependent upon its physical and chemical characteristics, its final separation would depend upon the efficiency of the separator, which would constitute the last and supporting link in the chain of operations. It is believed that this machine offers a practical solution of the problem of concentrating magnetic ore such as has not been hitherto provided."

At Tuesday's session "Electrical Power Transmission in Mining Operations" was the subject of a paper by H. C. Spaulding, of Boston, and the reading of the paper was listened to with great attention and interest.

"The mining engineer," says Mr. Spaulding, "looks with interest upon the statement that 258 electric roads in the United States alone, with 1,927.26 miles of track, and 3,024 cars are in daily service or under construction, and then compares the demands of street-service with those found in mining practice, looking meanwhile for practical suggestions from those who have 'been there' and can hold up a warning or beckoning finger to the traveller in this unfrequented path. It is the object of this paper to present briefly some of the work already due toward the application of electrical apparatus to mining processes, as well as to embody some practical suggestions and statements from those who have had personal experience in the operation of such apparatus."

A number of electric mining plants in actual operation were described by Mr. Spaulding.

The power-plant at the Erie Colliery, near Scranton, Pa., consists of a standard Armington and Sims engine capable of developing 60 horse-power, and a 50 horse-power Thomson-Houston generator wound for a current of 220 volts potential, and the necessary appliances for its operation. The engine and dynamo room at the top of the shaft are in charge of the engineer and assistant, who operate the other mining machinery.

From the dynamo to the foot of the shaft the current is conducted by No. 0 Clark wires, inclosed in gas-pipes to protect them from damage. From the bottom of the shaft the wires are carried overhead, about twelve inches outside of the low rail of each track, and are suspended

Continued on page 9.

A MODEL ELECTRIC CAR.

No greater evidence that electricity has taken a firm hold on street railway managers all over the country is necessary than a visit to the workshops of street car builders. A representative of the ELECTRIC AGE recently visited the works of the John Stephenson Company (Limited), the well-known car builders, and there learned that over 25 per cent. of the cars now in the course of construction by that company are intended for electric railways in different parts of the country.

As many improvements are made in electric cars as are made in those intended to satisfy the desire of the most fastidious travellers on through lines of railroad. It is a noticeable fact that electric cars are becoming more and more luxurious in their appointments, and the time would seem to be nigh at hand when the people will become so accustomed to seeing and travelling on electric cars of the most elegant design and finish that the slow-going, patched-up and ugly affair known as a horse-car, will have to go, and pass away from fact to history.

The Stephenson Company are now constructing a vestibule car for the Georgetown and Tenallytown (D. C.) Railway which surpasses anything of that class of vehicles ever constructed, and is equal in finish to a brand new Pullman car. It is finished in mahogany, and the floor is covered with Wilton rugs.

The electrical equipment consists of two 20 h. p. motors, a total of 40 h. p., and the car is beautifully lighted with five 16-candle power lamps, making the interior at night as light as day. The general appearance of the car, inside and out, is most pleasing, and the citizens of Tenallytown and Georgetown will have a car that they may well feel proud over. The Stephenson Company shows great enterprise in keeping up with the times in the production of such a beautiful specimen of modern street car building.

There are nine electric cars running regularly on the Georgetown and Tenallytown road.

ELECTRIC CURRENTS IN RELATION TO THE HUMAN BODY.

A series of observations were made by H. Newman Lawrence and Arthur Harries, M. D., of England, with reference to the effect of alternating and continuous electric currents on the human body, and the results of their investigation formed the subject of a paper recently read. They give the following conclusions:

When the human body, with the skin in its normal unmoistened condition, comes into contact for an appreciable time with bare metal conductors of a dynamo-generated continuous current passing at 100 volts in such a way that the current passes from hand to hand, and the total contact area is about 90 square centimetres, a current of about 0.016 amperes will pass through it

This current can be borne without discomfort for 15 to 30 seconds.

After about 30 seconds unpleasant burning sensations become marked and quickly increase.

The subject is perfectly able to release himself at will during any portion of the time of contact.

When the human body comes into contact with dynamo-generated alternating currents, alternating at about 60 to 70 per second under the same conditions as above.

A current of about 0 025 ampere will pass through it.

This current is *six times greater* than that which produces discomfort.

Instantly the subject is fixed by violent muscular contraction and suffers great pain.

The subject is utterly unable to release himself, but remains exposed to the full rigor of all the current that may be passing.

When circuit from electric light or power conductors is accidentally completed through the human body, the danger of serious consequences is many times greater when alternating than when continuous currents are passing at equal voltage, and this is still to a large extent true if the voltage of the continuous current be double that of the alternating.

With both forms of current a reduction of contact area materially reduces the amount of current strength that passes.

With the alternating current, if the rate of alternation be reduced below 50 per second, the sensations of pain accompanying muscular fixation will be increased, while if the rate of alternation be increased, the pain will be diminished.

Finally, we would remind those gentlemen who so commonly speak as if voltage were the chief or only factor in the danger of accidental contact, that *current strength is the important item*, and that according to Ohm's law current strength is dependent not only upon E. M. F., but upon the total resistance in circuit at the time of accidental contact.

ELECTRIC CLUB BANQUET.

The Fall and Winter meetings of the Electric Club, New York, were inaugurated by an elegant banquet at the rooms of the club, 17 East 22d street, on the night of October 2d. There were over one hundred persons present, and never before, in the history of the club, has there been so much enthusiasm and good fellowship shown at any of the former dinners as on this occasion. Every one went to have an enjoyable time, and no one failed in his purpose. It was acknowledged by all present to have been the most successful and largely attended dinner the club has ever given, and the club's reputation for social enjoyment of the most refined character was not only amply sustained but more strongly emphasized. The character of its members, of course, form the character of the club, and the character of the individual members, is too well known to need reiteration. Suffice it to say, that there cannot be found anywhere in the world—we do not limit ourselves to our own country, but to the world—a finer body of men, as regards intelligence, good looks and good fellowship. The Electric Club, of New York, represents the broad electrical field of the country, and has as its members those who are experts in every branch of electrical industry—theoretical and practical—and the club, through its meetings, is exercising a great influence upon the welfare of the community at large.

The rooms were brilliantly lighted, and the scene presented, as the members sat down to enjoy the good things provided for their entertainment, was, indeed, a delightful one. Covers were laid for over one hundred persons, and shortly after 7:30 o'clock the members took their seats. The menu was an elaborate one, and the dinner was pronounced to have been most artistically and judiciously devised. The steward succeeded most successfully in pleasing all present.

During the dinner a mandolin club, and a quartette furnished music. One of the features was the reproduction, by long distant telephone, of music played at the telephone exchange, 18 Cortlandt street. A Pickernell receiver was used on this occasion and reproduced every note of the original music with great accuracy and effect. The trumpet to the receiver was effectively arranged in the front electrolier, and it was almost hidden from view by the pendants and other decorations. The effect of this arrangement was most charming, the music floating in on the air from no apparent source. It sounded as though the walls and ceilings were filled by music, whose notes were softened and subdued with entrancing effect. At the conclusion of the gastronomical part of the night's entertainment, Gen. O. E. Madden, the president, arose and introduced the intellectual part. There were no set toasts, the president simply calling on different ones for remarks without reference to any particular subject. Brief remarks were made by Ex-president Henry C. Davis, G. P. Lowry, Gen'l E. S. Greeley, W. D. Sargent, Dr. Rossiter W. Raymond, A. H. Patterson, Hon. C. McLaren, ex-member British Parliament, C. Dutton, and several others. Mr. A. S. Hibbard, of the Long Distance Telephone, sang a college song, the entire company joining in the chorus. It was well rendered and received hearty applause. Mr. F. Z. Maguire read an original poem, in which humorous reference was made to the infancy of electricity, and what many prominent members of the club would do when they reached heaven. Gen'l O. E. Madden was pictured as just entering the heavenly gates, and as he stepped in, the first thing he did was to ask St. Peter to join the Electric Club.

Dr. R. W. Raymond read a poem which was well received, and the speechmaking was interspersed with some vocal music which was exceedingly well rendered. The post-prandial entertainment was entirely informal, and there was plenty of good humor.

It was not until after midnight that the festivities were brought to a close, and every one went home well pleased with his night's enjoyment.

At the foot of the stairs, in the hall, was a decoration which caught the eye of everyone, and which was greatly admired. It was a beautiful flower piece, designed by Dr. J. B. De Lery, manager of the Electric City Company, and presented by him as a token of his friendship for and kind feelings towards the club. The design represented the Eiffel tower, surmounting which was a floral arc lamp, decorated with red, white and blue ribbons, representing the American colors. At the base of the tower, conforming to the arches, were the words "Science," "Progress," "Art," and "Industry," composed of bright flowers, which formed a pleasing contrast with the green body of the tower. Dr. De Lery received many congratulations on the embodiment of his tender feelings for the club. Mr. Wm. W. Stadler, the steward of the club, felt proud over the success of the affair, over which he had full supervision. He has a wide reputation as a club manager, and it was well maintained on this occasion.

The club lectures will begin during the latter part of the month, and it is expected that the coming season will by far surpass all its predecessors for interest and good results.

The following is a complete list of the gentlemen who were present at the banquet:

Gen'l O. E. Madden, G. P. Lowry, A. H. Patterson, E. T. Gilliland, C. W. Price, C. H. Lord, Lieut. Veeder, J. C. Riley, L. Waldo, Mr. McCully, W. H. Fleming, Baron Blanc, D. L. Coles, F. T. Southwick, E. E. Bartlett, W. C. Peet, H. Ward Leonard. C. D. Shain, S. M. Hammill, A. G. Dewolfe, W. R. Brixey, G. B. Prescott, jr., Theo. Von der Luhe, L. H. Orr, F. P. Lowry, H. C. Adams, J. J. Wood, W. J. Morrison, A. B. McLean, T. P. Conant, C. O. Baker, jr., H. D. Stanley, H. C. Davis, C. McLaren, E. S. Greeley, A. V. Garratt, H. A. Reed, H. C. Foster, C. Dutton, P. H. Alexander, J. W. Welsh, T. Barr, Jos. Wetzler, Mr. Angell, Mr. Navarro, Mr. Dexter. C. E. Stump, Louis Bell, F. C. Mason, C. H. Barney, T. C. Martin, G. M. Phelps, F. R. Colvin, Mr. Holland. Mr. Stubbs, P. C. Ackerman, W. A. Stout, F. Z. Maguire, A. L. Salt, Mr. McCartney, A. P. Meany, A. P. Hovey, R. C. Crawford, Mr. Cole, Capt. Zalinski, G. T. Manson, A. T. Welles, E. S. Innett, H. L. Storke, J. J. Carty, Mr. Crandall, H. B. Thayer, Mr. Taintor, Mr Marsh, A. S. Hibbard, W. D. Sargent, A. Cameron, F. A. Pickernell, W. L. Candee, Geo. Worthington, H. L. Shippy, J. B. Wallace, M. Terry, G. B. Coggeshall, A. R. Foote, Thos. R. Taltavall, F. Jarvis Patten, J. B. De Lery, A. F. Moore, D. Pearson, J. W. Stover, C. A. Judson, J. A. Wetmore, W. T. Cullen, E. F. Gennert, J. W. Godfrey, E. F. Peck, Chas. F. Peck, A. J. De Camp, W. C. Bitting, W. F. Beidler, O. A. Moses, A. F. Stailey, J. A. Seeley. Senator P. B. Pumb was expected to be present, but sent his regrets.

ELECTRIC LIGHTING AND FIRE INSURANCE RULES.*

Every system of artificial illumination involves some risk from fire. Electric lighting, although it may be the safest of lights, is not exempt from this danger.

Until recent years, insurance companies have given their attention to framing regulations for checking the spread of fire when once it had originated, rather than devising means for preventing an outbreak.

The early inexperience and ignorance of many who undertook electric lighting, and consequent accidents, rendered some guidance and restrictions absolutely necessary for protection against fire. No authority existed. The Society of Telegraph Engineers proposed a few obvious regulations which were accepted by the majority of insurance companies as sufficient. Comparatively recently the Electrical Society have framed a much more elaborate, and an admirable set of suggestions. Meantime the Phœnix and many other fire offices have formulated conflicting rules of their own, which they more or less enforce.

Much is left to the conscience or ability of the contractor, which is unjust to those who abide by the best rules.

Large numbers of persons and millions worth of property are affected by these rules.

Such rules should be based on the deductions of experiment and the teaching of experience. They should give the utmost freedom of action and encourage progress. They should contain the minimum that is necessary, and this should be strictly enforced. Above all, these rules should be in accordance with the general principles which regulate all successful engineering constructions. For example, if we consider such familiar but different structures as a locomotive engine, a steamer, a bridge, we shall observe that there is no absolute safety in any one of them. Each has been perfected, not by directing the mind to a particular class of facts, but by a judicious compromise between many conflicting necessities, by giving neither more nor less than a just measure to each requirement, and in each case, all this has had to be done with due economy and limited means. In this spirit, all fire insurance regulations should be framed.

In regard to conductors, my first point is to show that any attempt on the part of the insurance companies to determine a fixed current density is useless, vexatious, and scientifically wrong.

For any electric light installation it is necessary to limit the fall of potential in the more distant lights. This can only be done by so limiting the current density that there is not the remotest chance of fire from over-heating of the wires. For example, suppose the fall of potential between the brightest and dullest lamps were limited to 4 per cent., and the most distant lamp was 75 yards from the dynamo, then the mean current density must not exceed 1,600 amperes per square inch. If the distance be 100 yards, 1,250 amperes per square inch; if 150 yards, 800 amperes, and so on. In any electrical installation in a large building, it is convenient to sub-divide the lights into groups, dependent upon their distance, and to adopt a table of wires and lamps on the several circuits corresponding to these mean distances, and thus secure comparatively uniform brightness. If, however, an arbitrary rule, such as 1,000 amperes per square inch be insisted upon, this rational principle of lighting cannot be adopted. It is, of course, necessary to adopt some limits of currents, but these depend upon the sizes of the wires, as it is easily shown by experiment and reasoning that the larger the cable the less must be the current density. *However small* the current, the smallness of the wires must be limited. For example, No. 20 S. W. G. is perhaps the smallest size that should be used, for fear of mechanical injury. In mansions, &c., where the first cost of wiring is of less consideration, and where the wires are placed out of sight, No. 16 S. W. G. may be the limit of smallness. Such details are best left to private judgment, but should be stated on the insurance policy.

That wires can be made red hot by electricity, and give rise to fires, was one of the most obvious facts thrust upon the notice of the insurance companies, and apparently almost the only one they could imagine or comprehend. This danger has been greatly magnified. It is, moreover, the danger most easy to absolutely abolish by judiciously arranged cut-outs.

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Experience has led me to regard good cut-outs, properly fixed and wired, with almost implicit confidence as protecting the wire.

In an experience extending over seven years, all the dangers of fire have proceeded from imperfect contacts (with two exceptions). In two cases the wires were cut in two by carpenters, not concerned with electric lighting. In one case a fire arose from the slackening of a binding screw through shrinkage of wood. The resistance of a well-scraped contact is considerable, but loose screwed contacts get hot with even 5 ampere currents. Broken wires with ends in contact are sure to set the insulation on fire through sparking. Insufficient area of contacts leads to heating. Cut-out wire requires specially good contacts to prevent melting at their ends from this cause.

Cut-outs are no protection against heating and sparking from imperfect or broken contacts.

* Abstract from paper read by Wilson Hartnell before section G, British Association, Leeds, September 8th.

ELECTRIC COAL-CUTTING MACHINERY.

BY ELMER A. SPERRY.

EDITOR ELECTRIC AGE:—In reading the paragraph "Electric Coal-Cutting Machinery" in the ELECTRIC AGE of September 13th, I was put in mind of some experiments that I tried two or three years ago, to ascertain the exact mathematics with reference to the recovery of power from electricity when the power was of a reciprocatory character. To do this I used large solenoids, one of which weighed 300 pounds. The cores were 2¼ inches in diameter in the case of double solenoids, one working upon each leg of a horseshoe shape, and one of 3 inches in diameter working within a single solenoid. After some expensive experiments in attempting to devise an electric mining machine on this principle I took the elements above specified and secured them upon a Fairbanks scale, loaded the platform and arranged the cores over them in such a manner as to measure the exact pulling power with various currents and with various positions of the core. The results of these experiments showed that the double solenoid was 22 per cent. more efficient than the single solenoid but worked on a shorter range. So much for the comparison of the two systems.

As to the economy attending their use I ascertained that the single solenoid could be made to give a return of about 9.9 per cent.; the double solenoid being made to give a return of about 12 per cent. The self induction of the coils seemed to retard the velocity of the moving cores, and when the circuit was ruptured in which these bobbins were placed the spark was from 2 to 10 inches in length, depending upon the density of current being used at the time. In the large single solenoid I put at one time as much as 4½-horse power for a short period of time. This seems to confirm the *Electrician's* statement that the "reciprocating action is the wrong way to produce motion on a large scale by electricity."

The writer, however, has extended his observations with reference to reciprocating action as compared with other motions as used for mining operations, and is free to state that in his opinion there is in the practical application of power, whether it be produced electrically or otherwise, when used for mine excavating machines, no comparison between the reciprocation which delivers a percussive, and a cutting tool which tends to scrape, cut or sever the material by a slow movement under pressure.

This latter action, especially with hard substances, is entirely out of the question, there being no known substance but the diamond that may be employed for the cutting tool. I have seen the best mushet steel knives of most approved pattern, and made with extreme care, require change so often, even in moderately soft substances, that the expense attending their use rendered this system of excavating machinery thoroughly impracticable.

USEFUL FORM OF VOLTA PILE.

At the recent meeting of the British Association at Leeds, Sir William Thomson exhibited a new form of volta pile.

Four hundred staples, constructed with one limb of copper and the other of zinc, were mounted in an ebonite frame, standing on four wooden legs. The adjacent staples were set at a distance less than $\frac{1}{20}$ in. apart, their ends pointing downwards. A copper tray, with handles, was placed below the frame, and contained water. On lifting the tray, so that the ends of the staples were immersed, and lowering it again, a drop of water was left hanging by capillary attraction between the zinc and the copper of the adjacent couples. The whole then formed a simple battery of four hundred cells. The battery was not made for giving a current, but was used with an electrometer, and saved a great deal of trouble and expense compared with the setting up of a number of ordinary batteries. It had been found to be particularly useful in measuring the capacity of cables. The volts were found to be very constant from element to element, and any number could be readily taken, or they could be divided into two or more sets by means of a plug, which was merely pressed in between any pairs.

MAGNETIC PROPERTIES OF STEEL.

In a paper read before the meeting of the British Association at Leeds, September 9th, on the subject of the effect of oxidation on the magnetic properties of manganese steel, Mr. L. T. O'Shea, the author, says:

When manganese steel drillings are oxidized they become magnetic. The development of magnetic properties being due to removal of manganese by oxidation, etc., to the magnetic properties of the oxide of iron (probably magnetic oxide) formed.

When the oxidized product is reduced in hydrogen the iron oxide is converted into metallic iron and the manganese remains as manganous oxide (Mn O.). The reduced steel is now powerfully magnetic in virtue of the magnetic properties of unalloyed metallic iron.

During the process of oxidation the proportion of manganese to iron oxidized in a given time is only very slightly in excess of the proportion of manganese to iron in the original steel. The excess of manganese oxidized is in all probability due partly to the greater susceptibility of manganese to oxidation, and partly to the heterogeneous structure of the steel.

A LAW.—President Harrison has affixed his signature to the act of Congress authorizing the Texas-Mexican Electric Light and Power Co. to erect wires across the Rio Grande at Eagle Pass, Texas.

TELEPHONE ALONG THE CONGO.—A steamer recently left Antwerp with the necessary apparatus for the equipment of a telephone line along the Congo railway in Africa.

THE ELECTRO MAGNET.*

Amongst the great inventions which have originated in the lecture room in which we are met are two of special interest to electricians—the application of gutta-percha to the purpose of sub-marine telegraph cables, and the electro-magnet. This latter invention was first publicly described from the very platform on which I stand, on May 23d, 1825, by William Sturgeon. For this invention we may rightfully claim the very highest place. Electrical engineering, the latest and most vigorous offshoot of applied science, embraces many branches. The dynamo for generating electric currents, the motor for transforming their energy back into work, the arc lamp, the electric bell, the telephone, the recent electro magnetic machinery for coal mining, for separation of ore, and many other electro-mechanical contrivances come within the purview of the electrical engineer In every one of these, and in many of the useful applications of electricity, the central organ is an electro-magnet. By means of this simple and familiar contrivance—an iron core surrounded by a copper wire coil—mechanical actions are produced at will, at a distance, under control, by the agency of electric currents. These mechanical actions are known to vary with the mass, form, and quality of the iron core, the quantity and disposition of the copper wire wound upon it, the quantity of the electric current circulating around it, the form, quality, and distance of the iron armature upon which it acts. But the laws which govern the mechanical action in relation to these various matters are by no means well-known, and, indeed, several of them have long been a matter of dispute. Gradually, however, that which has been vague and indeterminate becomes clear and precise. The laws of the steady circulation of electric currents, at one time altogether obscure, were cleared up by the discovery of the famous law of Ohm. There extension to the case of rapidly interrupted currents, such as are used in telegraphic working, was discovered by Helmholtz; whilst to Maxwell is due their further extension to alternating, or, as they are sometimes called, undulatory currents. All this was purely electric work. But the law of the electro-magnet was still undiscovered; the magnetic part of the problem was still buried in obscurity. The only exact reasoning about magnetism dealt with problems of another kind; it was couched in language of a misleading character; for the practical problems connected with the electro-magnet it was worse than useless. The doctrine of two magnetic fluids distributed over the end surfaces of magnets, which under the sanction of the great names of Coulomb, of Poisson, and of Laplace, has unfortunately become recognized as an accepted part of science, along with the law of inverse squares. How greatly the progress of electro-magnetic science has been impeded and retarded by the weight of these great names it is impossible now to gauge. We now know that for all purposes, save only those whose value lies in the domain of abstract mathematics, the doctrine of the two magnetic fluids is false and misleading. We know that magnetism, so far from residing on the end or surface of the magnet, is a property resident throughout the mass; that the internal not the external magnetization is the important fact to be considered; that the so-called free magnetism on the surface is, as it were, an accidental phenomenon; that the magnet is really most highly magnetized at those parts where there is least surface magnetization; finally that the doctrine of surface distribution of fluids is absolutely incompetent to afford a basis of calculation such as is required by the electrical engineer. He requires rules to enable him not only to predict the lifting power of a given electro-magnet, but also to guide him in designing and constructing electro-magnets of special forms suitable for the various cases that arise in his practice. He wants in one place a strong electro-magnet to hold on to its armature like a limpet to its native rock; in another case he desires a magnet having a very long range of attraction, and wants a rule to guide him to the best design; in another he wants a special form having the most rapid action attainable; in yet another he must sacrifice everything else to attain maximum action with minimum weight. Toward the solution of such practical problems as these the old theory of magnetism offered not the slighest aid. Its array of mathematical symbols was a mockery It was as though an engineer asking for rules to enable him to design the cylinder and piston of an engine were confronted with receipts how to estimate the cost of painting it.

Gradually, however, new light dawned. It became customary, in spite of the mathematicians, to regard the magnetism of a magnet as something that traverses or circulates round a definite path, flowing more freely through such substances as iron, than through other relatively non-magnetic materials. Analogies between the flow of electricity in an electrically-conducting circuit, and the passage of magnetic lines of force through circuits possessing magnetic conductivity, forced themselves upon the minds of experimenters, and compelled a mode of thought quite other than that previously accepted. So far back as 1821, Cumming experimented on magnetic conductivity. The idea of a magnetic current was more or less familiar to Ritchie, Sturgeon, Dove, Dub, and De La Rive, the last-named of whom explicitly uses the phrase, "a closed magnetic circuit." Joule found the maximum power of an electro-magnet to be proportional to "the least sectional area of the entire magnetic circuit," and he considered the resistance to induction as proportional to the length of the magnetic circuit. Indeed, there are to be found scattered in Joule's writings on the subject of magnetism, some five or six sentences, which, if collected together, constitute a full statement of the whole matter. Faraday considered that he had proved that each demagnetic line of force constitutes a closed curve; that the path of these closed curves depended on the magnetic conductivity of the masses disposed in proximity; that the lines of magnetic force were strictly analogous to the lines of electric flow in an electric circuit. He spoke of a magnet surrounded by air being like unto a voltaic battery immersed in water or other electrolyte. He even saw the existence of a power, analogous to that of electromotive force in electric circuits, though the name, "magnetomotive force," is of more recent origin. The notion of magnetic conductivity is to be found in Maxwell's great treatise (vol. ii., p. 51), but it is only briefly mentioned. Rowland in 1873, expressly adopted the reasoning and language of Faraday's method in the working out of some new results on magnetic permeability, and pointed out that the flow of magnetic lines of force through a bar could be subjected to exact calculation; the elementary law, he says, "is similar to the law of Ohm." According to Rowland, the "magnetizing force of helix" was to be divided by the "resistance to the lines of force," a calculation for magnetic circuits which every electrician will recognize as precisely as Ohm's law for electric circuits. He applied the calculations to determine the permeability of certain specimens of iron, steel, and nickel. In 1882, and again in 1883, Mr. R. H. M. Bosanquet brought out at greater length a similar argument, employing the extremely apt term, "Magnetomotive Force," to connote the force tending to drive the magnetic lines of induction through the "magnetic resistance," or, as it will be frequently called in these lectures, the magnetic "reluctance" of the circuit. In these papers the calculations are reduced to a system, and deal not only with the specific properties of iron, but with problems arising out of the shape of the iron. Bosanquet shows how to calculate the several resistance (or reluctances) of the separate parts of the circuit, and then add them together to obtain the total resistance (or reluctance) of the magnetic circuit.

Prior to this, however, the principle of the magnetic circuit had been seized upon by Lord Elphinstone and Mr. Vincent, who proposed to apply it in the construction of the dynamo-electric machines. On two occasions they communicated to the Royal Society the results of experiments to show that the same exciting current would evoke a larger amount of magnetism in a given iron structure, if that iron structure formed a closed magnetic circuit, than if it were otherwise disposed.

In recent years the notion of the magnetic circuit has been vigorously taken up by the designers of dynamo machines, who, indeed, base the calculation of their designs upon this all-important principle. Having this, they need no laws of inverse squares of distances, no magnetic moments, none of the elaborate expressions for surface distribution of magnetism, none of the ancient paraphernalia of the last century. The simple law of the magnetic circuit, and a knowledge of the properties of iron, are practically all they need. About four years ago, much was done by Mr. Gisbert Kapp, and by Drs. J. and E. Hopkinson, in the application of these considerations to the design of dynamo machines, which previously had been a matter of empirical practice. To this end the formulæ of Prof. Forbes for calculating magnetic leakage, and the researches of Profs. Aryton and Perry on magnetic shunts, contributed a not unimportant share. As the result of the advances made at that time, the subject of dynamo design was reduced to an exact science.

*Abstract of lecture by Prof. S. P. Thompson before the Society of Art, London.

THOMSON'S ELECTRIC METER.

The following are a few particulars from the London *Electrician*, of the new electric meter shown by Sir W. Thomson to Section G, British Association meeting at Leeds: The general principle may be described as that in which a specimen of the current is chosen at certain intervals and is measured on a counter train. The current is measured on the Weber dynamometer principle. A movable coil in a shunt circuit, having a non-inductive resistance in series with it, is carried at the top of a long vertical lever or double pendulum pivoted close to its centre of gravity. A "wheel-barrow integrator," consisting of a counter train, whose unit arbor is provided with a rolling disc, forms the counterpoise to the coil. A series coil, fixed to the back of the case, repels the shunt coil as in Sir William Thomson's balances. The lever thus constitutes an inspectional amperemeter. Beneath the counter revolves a large drum, or rather part of a drum or cylinder, the cylindrical surface being cut away in such a manner that the part which is left would, if developed, be the curve representing the movement of the shunt coil for different currents. This drum revolves once in six minutes. When a heavy current is passing, the wheelbarrow integrator is swung in towards the disc which carries the drum, and it rolls on the cylindrical surface for a considerable portion of one revolution. With a smaller current the integrating wheel will touch that part which has been more cut away. The principle and the method by which it is carried out resembles, therefore, the Frager meter, which is extensively used in France.

With regard to the fact that as the instrument stands at present it is in a rather expensive form, Sir William Thomson said that the reduction of expense is the life and soul of engineering. Economy must always be considered except in the building of ironclads, and the work of Section A. There work should be done regardless of expense. The construction of standardizing laboratories and of the instruments used in them should also be carried out without any attempt at economy. His endeavor was always first to make the most perfect instrument possible, and after it was completed economical considerations might be entertained.

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from an insulator specially designed for this class of work.

Wherever turnouts occur, frogs are used, the conductors being soldered to them in the same manner as when used for street-railway work. Connections from the mains to the overhead conductor are made at suitable intervals, and a portion of the current is utilized for lighting purposes, two 110-volt lamps being placed in series. There are fifty of these lamps—eight at the foot of the shaft, two in the pumping-room, four in the blacksmith shop and two in the slope-room; the remainder being distributed along the gangway.

The rails are used as conductors for the return-current, copper end connections effecting a complete metallic circuit. In adapting the tracks to the electric system it was found necessary to make a few changes to accommodate the increased output. The shaft sidings will accommodate seventy loaded cars and fifty empties, whereas, before, they had a capacity for but fifteen on each side.

The locomotive is of 3-foot gauge, and has a length over all of 9 feet 7 inches, a width of 5 feet 3 inches, and height of 5 feet 6 inches. The weight of the locomotive is 10,500 pounds, to which 1,800 pounds has been added to increase traction. The motor employed is of the type "G" railway motor of 40-horse power. The locomotive is run by one man who is assisted by a boy in making up the trains and turning the switches. It displaces seven mules and three drivers. During a period of eleven and a half days the average number of cars delivered at the shaft-bottom by the locomotive was 550.5, against 526.95 per day, delivered by mule haulage, much time being consumed by waiting at the bottom of the shaft for empty cars. Thus far the locomotive has shown that it will increase the daily output to 700 cars per day.

In the discussion which followed Vice-President E. B. Coxe, of the Lehigh Valley Coal Company, stated that an electric installation in a Lykens Valley mine had proved so satisfactory that the plant was to be doubled, and the engineer had advised him to introduce the system at Drifton.

James Douglass, of New York, thought that electric power transmission offered the possibility of utilizing the enormous heaps of waste fuel found about coal mines, to operate irrigating pumps for watering distant fields and reclaiming land now under water.

Dr. Raymond announced in closing, that the Thomson-Houston Company, of Boston, would organize an excursion to Boston and elsewhere, at the end of the Western trip, for the electrical instruction of the members of the Institute and their guests.

Of the accompanying illustrations, Fig. 1 represents a longitudinal vertical section of the perfected Monarch ore-separator, adapted for separating fine ore, and Fig. 2 the same, adapted for cobbing ore of the size of stove or chestnut coal. The two designs are identical in principle, and vary from each other in minor details only.

At Friday's session Prof. Elihu Thomson read a paper on "Electric Welding," which was listened to with great interest by the English delegates. Samples of large and small welds in iron and copper, and lead, and in all shapes, were exhibited. There was on the stage a small welding machine, and at the entrance to the hall a large one, both in practical operation, so that the members might see for themselves how electric welding was accomplished.

The Thomson welding apparatus has so often been described to electrical people that to do so now is needless.

Prof. Thomson, however, made some general remarks which will be read with interest at this time. He said, in part:

In this art, the foundation experiments were made about four years ago. The author had the pleasure of describing some of their results, particularly relative to electric welding, in a paper written in the latter part of the year 1886. The appearance of that paper aroused a considerable interest in the subject, which has continued from that time, and it is curious to note how it has caused the revival of early attempts to use the electric arc in metal welding or working, sometimes in conjunction with a magnet for displacing the arc and converting it into a blowpipe of great intensity, the latter being a procedure due, it is believed, to Werdermann, in the early days of the production of electric arcs from dynamo machines.

It is not my present purpose to deal with any of these arc methods of electric metal work. Their practicability is doubtful. So far as is known to the author, there are no existing instances of the use in practice of the electric arc for welding, though numerous attempts have been made, which have failed from one cause or another.

The operations with which this paper deals are those in which the heating effect of electric currents traversing a solid metal conductor gradually brings the metal to the working temperature. This temperature is, in the case of easily fusible metals, much below a red heat, and is hence unattended with luminous effects which, however, appear in the case of metals softened or fused with greater difficulty.

It is proper here to correct an impression which has gained some currency—namely, that it is the extra resistance caused by the break or limited contact between the meeting portions of metal which gives rise to the heating in electric welding. While this limitation of contact surface undoubtedly hastens the heating at the joint, it is nevertheless a fact that a solid bar, joining the clamps of an electric welding machine, will be heated between those clamps to welding temperature, and may be upset by the approach of the clamps one toward the other. Indeed, this process is actually employed to upset collars on shafts, or to set or fasten in place, by a sort of riveting action, collars which have been placed as rings, more or less closely fitting, upon a bar or shaft. The real cause of the concentration of the heating effect at the joint, or between the clamps, is the relatively greater conductivity of other portions of the welding circuit, which circuit is usually composed of massive copper conductors, kept cool, in the case of large work, by circulation of water.

By thus keeping the clamps cool, as well as the conductor in which the welding currents are generated, their conductivity is preserved from running down and there follows a greater accentuation of heating effect at the joint, with the added result of a considerable saving in the electrical energy required to do the work.

Prof. Thomson then described the apparatus in detail and its operation, and enumerated the uses to which the process can be applied. In closing, he said:

Reference may be had to the subject of economy in the work done, and to the power required. In the first place, the conditions vary so greatly that no general statement can be made; but when it is remembered that for making steam waste gases from operations requiring high temperatures are still hot enough, and that the nature of the electric current enables high temperature to be secured from power developed from steam at comparatively low temperatures, it is easily seen that in many cases of heavy metal working power for welding is already at hand, just as power for hammering in heavy forging is obtained in many cases, from the waste gases of forges. Again, by the electric process the large water powers can be turned to account in metal working, and places where fuel is dear and water plentiful may in the future take positions of importance with respect to certain varieties of such work.

Furthermore, where steam is generated for the express purpose of welding and working metals by electricity, the localization of the heat to the exact point required, as compared with heating a considerable length or mass in the fire, with the loss of heat involved in so doing, may offset the heavy losses in the generation of power from steam. It is readily seen that the economy of heating to high temperatures in the fire must fall as the temperature of the metal rises, the temperature-difference between that which gives heat and that which receives it becoming less and less. In the electric process the reverse is true, aside from increased loss by radiation and conduction as the temperature rises. During heating, the increasing temperature of the metal in most cases adds greatly to its resistance, and this in turn increases the electrical economy of the plant, or increases the proportion of the electrical energy converted into heat in the work itself.

Considered in relation to automatic character, range of adaptability, the convenience and cleanly nature of the work, the perfect control of temperature secured, and the uniformity of result, the electric welding and metal working processes are decided advances over the prior art, and seem destined to a wide application.

At the close of his paper, Prof. Thomson, extended an invitation to the delegates to visit the works of his company, at Lynn, Mass., on their return from the West.

NEW YORK NOTES.

The verdict of the jury in the case of lineman Kopp who was accidently killed by an electric shock on the night of September 15th, at the corner of Broadway and 35th street, was that death would not have occured had Kopp exercised proper care. The jury censures the Board of Electrical Control for taking no action when it was well-known that the insulation of the electric wires at that point was defective.

The supplement to the regular illustrated catalogue and price list of the goods dealt in by the McCreary Electrical Specialty Company, recently issued, covers many electric light fixtures and lamps of new and artistic design. Another catalogue including many specialties is now in print and will be issue in a few days.

The Police Board are considering the question of introducing a modern and reliable system of electric signals between police stations and patrolmen on duty. The present system is an antiquated and tedious one, being the old dial method of signalling which is the same as was used 35 years ago. There is an abundance of room for improvement in this direction, and while the Board is modernizing itself, it should not overlook the fact that the wires should go underground.

About six months ago the well-known leather belting firm of Chas. A. Schieren & Co., of this city, received an order from the Louisiana Electric Light Company for a double leather belt 160 feet long and 72 inches wide and one 550 feet long and 48 inches wide. These belts have just been finished, and the firm has received another order within the past few days from the same company for another 72-inch belt of the same length as the first named. These belts are said to be the largest and heaviest in the world, and duplication of an order for such an immense belt as the one referred to is unmistakable evidence that the goods manufactured by this firm are of excellent quality. R. J. G.

NOTICE OF REMOVAL.—Secretary Barney announce in the *News-Letter* of the National Telephone Exchange Association, just out, that his office is now at 20 Cortlandt street, ground floor of the Telephone building. His telephone number is "1139 Cortlandt street." In the same letter a sketch report is given of the proceedings of the annual meeting of the Association, at Detroit, Sept. 9th and 10th, last.

REMOVAL NOTICE.

Owing to the necessity for more room for the accommodation of our rapidly increasing business, we hereby give notice to our friends that the offices of the ELECTRIC AGE are now located in the new building of the New York *World*, at the corner of Park Row and Frankfort st. This building is the latest addition to the large number of elegant and massive structures for which New York is celebrated. It is by far the highest in this section of the country, and the view obtained from the top of the dome is well worth going many miles to see. Some idea of the height of the building may be obtained from the fact that the last story in the dome is the eighteenth from the street.

The offices of the ELECTRIC AGE are situated on the first floor, so that our friends will not have to tire themselves out in going up too far towards the clouds.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED SEPT. 30TH, 1890.

437,183. Electric Meter. Richard N. Dyer, East Orange, N. J. Filed Jan. 5, 1888.

437,203. Method of Adjusting Watches. Geo. E. Hunter and Frederick H. Corthell, Elgin, assignors to the Elgin National Watch Company, Chicago, Ill. Filed Sept. 23, 1889.

437,204. Method of Adjusting Watches. Geo. E. Hunter and Frederick H. Corthell, Elgin, assignors to the Elgin National Watch Company, Chicago, Ill. Filed Sept. 23, 1889.

437,205. Apparatus for Adjusting Watches. George E. Hunter and Frederick H. Corthell, Elgin, assignors to the Elgin National Watch Co., Chicago, Ill. Filed Feb. 13, 1890.

437,206. Apparatus for Adjusting Watches. George E. Hunter and Frederick H. Corthell, Elgin, assignors to the Elgin National Watch Company, Chicago, Ill. Filed Feb. 13, 1890.

437,210. Electric Street-Car. Luther H. Leber, Pittsburg, Pa., assignor of two-thirds to John L. Swear, same place, and David J. Richardson, Allegheny, Pa. Filed June 21, 1890.

437,226. Electric Illuminated Letter. James A. MacEntee, Chicago, Ill. Filed Apr. 4, 1890.

437,259. Electric-Motor Gearing. Joseph J. Sprague, Carthage, Mo. Filed July 19, 1890.

437,266. Machine for Covering Wire, Cord, &c. Kasimir Vogel, Chelsea, Mass., assignor to the Vogel Electric Insulating and Manufacturing Company, Portland, Me, Filed Apr. 14, 1890.

437,272. Distribution and Regulation of Electric Currents. Franz Wilking, Berlin, and Hermann Müller, Nuremberg, Germany. Filed Mar. 28, 1890. Patented in England, Italy and Belgium.

437,293. Coin-Operated Telephone Attachment. Herbert F. Dugan, San Francisco, Cal. Filed June 6, 1890.

437,307. Automatic Telegraphy. David Kunhardt, Aachen, Germany. Filed Mar. 20, 1890.

437,311. Artificial Ground and Compound Metallic Circuit System. Charles E. McCluer, Richmond, Va. Filed June 1, 1888.

437,324. Electric Cut-Out. Elmer E. Bailey, Everett, and George J. Galbraith, Boston, assignors of one-third to Thomas W. Lane, Boston, Mass. Filed May 27, 1890.

437,330. Electric Cable. David Brooks, jr., Philadelphia, Pa., assignor to the Electric Cable Construction and Maintenance Company, of Pennsylvania. Filed Dec. 29, 1888.

437,348. Apparatus for Operating Signals. Samuel L. Powell, Lewistown, assignor of one-half to Frederick D. Morrison, Baltimore Md. Filed June 20, 1890.

437,352. Electric Hand-Switch. Joseph W. Battershall, Attleborough, Mass. Filed Dec. 24, 1889.

437,358. Electric-Railway System. Charles K. Harding, Atlantic, Iowa. Filed June 9, 1890.

437,359. Electric Snap-Switch. Wm. Hochhausen, Brooklyn, N. Y. Filed Feb. 17, 1890.

437,360. Dynamo-Electric Machine. Wm. Hochhausen, Brooklyn, N. Y. Filed Feb. 17, 1890.

437,362. Electric Cut-Out. William J. Jenks, Nyack, N. Y. Filed June 16, 1890.

437,363. Lightning-Arrester. Harry M. Kalbach, Ashland, Pa. Filed Jan. 29. 1890.

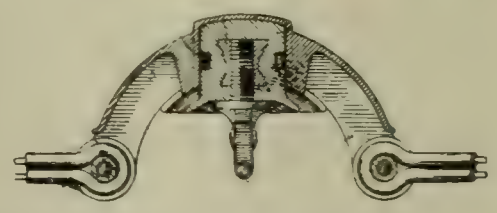
437,369. Electric Alarm. Arnold Tschira, Freiburg, Germany. Filed July 26, 1890. Patented in Germany.

437,387. Magnet-Winding Machine. James J. Wood, Brooklyn, N. Y. Filed July 29, 1890.

437,393. Galvanic Battery. Edward H. Crosby, Boston, Mass., assignor to the Crosby Electric Company, New York, N. Y. Filed Feb. 8, 1890.

437,397. Lightning-Arrester for Fire-Alarm Boxes. Robert Hudie, Allegheny, Pa. Filed June 11, 1890.

437,412. Rheostat or Rheotome. Marcel Deprez, Paris, France. Filed Feb. 24, 1888.



437,533.—SUPPORTER AND INSULATOR FOR SUSPENDED CONDUCTORS.

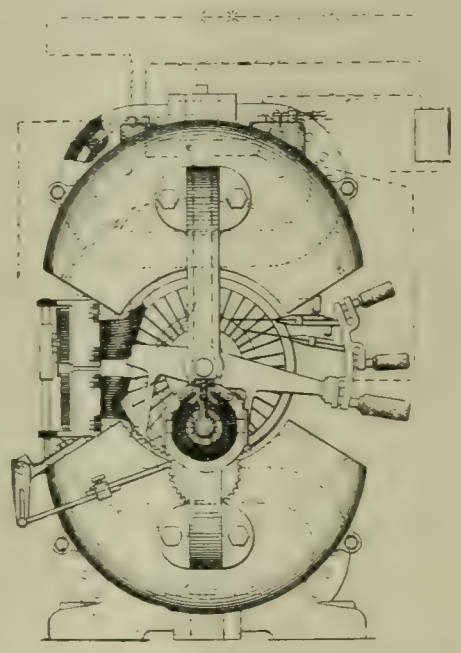
Patented in France, in England and in Belgium.

437,422. Telegraphy. Thomas A. Edison, Menlo Park, N. J. Filed Oct. 23, 1885.

437,423. Phonograph. Thomas A. Edison, Llewellyn Park, N. J. Filed July 17, 1888.

437,424. Phonograph. Thomas A. Edison, Llewellyn Park, N. J. Filed Oct. 17, 1888.

437,425. Phonograph-Recorder. Thomas A. Edison, Llewellyn Park, N. J. Filed Feb. 11, 1889.



NO. 437,360.—DYNAMO ELECTRIC MACHINE.

437,426. Phonograph. Thomas A. Edison, Llewellyn Park, N. J. Filed Aug. 10, 1890.

437,427. Method of Making Phonogram-Blanks. Thomas A. Edison, Orange, N. J. Filed Feb. 17, 1890.

437,428. Propelling Device for Electric Cars. Thomas A. Edison, Llewellyn Park, N. J. Filed May 5, 1890.

437,429. Phonograph Blank. Thomas A. Edison, Llewellyn Park, N. J. Original application field Feb. 17, 1890. Divided and this application field May 9, 1890.

437,445. Conduit for Underground Wires. Thomas M. Morton, Baltimore, Md. Filed June 24, 1890.

437,469. Galvanic Battery. Gustav A. Liebig and Charles Willms, Baltimore, Md. Filed June 25, 1890.

437,501. Electric Generator. William M. Mordey, Lambeth, England. Filed March 25, 1889. Patented in England, France, Belgium, Italy, Switzerland, and in Austria-Hungary.

437,502. Arc Lamp. John A. Mosher, Abilene, Kans., assignor of one fourth to Ann M. Mosher, same place. Filed Dec. 31, 1889.

437,510. Telegraph Key. Arthur F. Purdy, Lawrence, Cal. Filed Apr. 15, 1890.

437,512. System of Electrical Distribution. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed July 13, 1888.

437,513. Electrical Switch. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed Mar. 28, 1890.

437,516. Switch Board for Electric Lighting Systems. Robt. F. Sawyer, Chicago, Ill. Filed Dec. 11, 1889.

437,533. Support and Insulator for Suspended Conductors. Charles J. Van Depoele, Lynn, Mass. Filed Apr. 3, 1890.

437,534. Upward Pressure Contact Device for Electric Railways. Charles J. Van Depoele, Lynn, Mass. Filed Apr. 10, 1890.

437,535. Motor Truck for Electric Railway Cars. Charles J. Van Depoele, Lynn, Mass. Original application filed Dec. 4, 1889. Divided and this application field Apr. 10, 1890.

437,568. Electric Conductor. Edward Clark, Newburg, Orange County, N. Y.; Samuel V. Harron, administrator of said Edward Clark, deceased. Filed May 15, 1889.

437,570. Welding Metals Electrically. Charles L. Coffin, Detroit, Mich. Filed Nov. 22, 1889.

437,613. Switch for the Moving Contacts of Electric Railways. John W. Murray, Saginaw, Mich. Filed July 15, 1890.

437,624. Mechanical Telephone. James M. Russell, Anderson, Ind. Filed June 4, 1889.

437,632. Insulated Wire. Charles F. Splitdorf, New York, N. Y., assignor to himself and John M. Splitdorf, same place. Filed Mar. 13, 1890.

437,654. Electric Forging Apparatus. George Lauder and James H. Simpson, Pittsburg, Pa., assignors to the Carnegie, Phipps & Company, Limited, same place. Filed Jan. 16, 1890.

437,661. Motor Truck for Electrically Propelled Vehicles. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed June 13, 1889.

437,662. Automatic Switch for Stationery Motors. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed June 23, 1890.

437,663. Armature for Dynamo-Electric Machines and Motors. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed July 15, 1890.

437,667. Electrical Switch. Lucius T. Stanley, Brooklyn, N. Y., and Henry B. Cutter, Philadelphia, Pa.; said Stanley assignor to said Cutter. Filed July 5, 1890.

437,668. Fire Alarm Signal Box. John Young, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Mar. 26, 1887.

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BUSINESS NOTICES.

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Pat. Mar. 19, 1889. THE OLD STYLE.

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A NEW TYPEWRITER.

In the office of W. J. Barron, at No. 200 Broadway, may be seen the first Typewriter ever made with adjustable type-bars. It is one of the original Sholes and Glidden machines, and was made in Milwaukee by Mr. Barron in 1871, who introduced it to the officers of the Automatic Telegraph Company, of this city, by whom it was adopted. It was considered absolutely perfect, and so it was at that time. The name of the machine was shortly afterward changed to the Remington Typewriter, and is, with the Caligraph, now regarded as one of the most durable machines on the market. Through the inventive genius of Mr. Barron, however, there will shortly be introduced to the public a machine that beyond all question of doubt will far surpass anything of the kind ever constructed. Having been prominently identified with various typewriting companies since their inception Mr. Barron is enabled to overcome the defects appearing in the manufacture of each machine. That he has profited by his knowledge is abundantly shown in the beautiful model now in practical operation at his office. One of the features—of which there are several—is the ease and rapidity with which the carriage can be removed from the frame; the perfect alignment of characters and absolute freedom with which the ribbon is automatically reversed. To every purchaser of a machine two paper carriages will be furnished so that in the event of the operator, who, for instance, is engaged in writing a long article, wishes to write a letter, it will only be necessary to remove one carriage and substitute the other. This can be done, as has been proven, in the the space of two seconds. Having completed the letter the carriage containing the article previously referred to can be replaced and work thereon at once resumed.

Probably the most important feature of this machine is the accurate alignment of the type and the manner in which it is accomplished. The type-bar hangers are detachable, but not adjustable. They are so perfectly made that any one can take them off the machine and screw them on again without affecting the alignment. A typewriter taken from one machine and put on another will align perfectly without requiring any adjustment. The bearings of the hanger are susceptible of the finest adjustment—indeed the adjustment is so fine that one turn of the screw carries it forward but one twenty-thousandth of an inch. The connecting wire is not attached directly to the type-bar, but to an intermediate lever which is hung under it, and which throws it against the paper. This construction insures a perfectly even wear on both bearings of the bar, and prevents it from getting out of alignment. The connecting wire is made of one solid piece of steel, and will last as long as any portion of the machine.

So perfectly is the machine constructed that it is impossible under ordinary conditions to get out of order. Every part used in its construction is of the very best steel. Should by any possibility one of the pieces get out of order, another can be substituted at the shortest notice by apprising the agent. The same set of tools used to manufacture one particular character is utterly useless when applied to another—a fact which makes the machine as reliable as the best chronometer ever manufactured. The key-tops are made of a composition, white in color, which is subjected to a pressure of twenty tons. Unlike some of those on machines now in use, they are so firmly attached to the lever as to be immovable. The ribbon, which as previously stated, is by a very ingenious method reversed automatically, is no longer than the cylinder. It can be detached and if necessary another one of a wholly different color of ink substituted therefor almost instantly. The letters of the last words of a manuscript containing 20,000 words written by the aid of one piece of ribbon costing about two cents were as clear and legible as the first. The machine is easily cleaned, every portion of it being accessible to the operator. It not only weighs less by 10 pounds than any other machine, but in point of beauty and serviceability is surpassed by none.

The machine will be named the Densmore Typewriter, after Mr. Amos Densmore and Dr. Emmet Densmore, of this city, who with Mr. Barron were former owners of patents under which the Remington typewriter and the Caligraph are manufactured, and are now associated with him in placing it before the public. It will be ready for the market about the first of January.

ELECTRIC LIGHT IN HOMES.—The progress of the electric light in our homes, says a prominent English electrician, has been much more rapid in England than in any other country, but its employment for street-lighting, for shops and manufactories, has been infinitely more rapid and extensive in the United States than with us. In America the growth has been enormous. There are now 250,000 arc lamps illuminating the public streets and shops, and 3,000,000 glow lamps in dwellings, stores, and workshops.

IS IT COMING TO THIS.—One hundred years hence: Showman to Audience—This, ladies and gentlemen, is the skeleton of a horse, now an extinct animal. The horse up to the last century was a beast of burden, but since the electric motor has become the universal power the horse has rapidly died off for the want of something to do.

MR. WESTINGHOUSE BUYS A SILVER MINE.—Mr. George Westinghouse, jr., the head of the great electrical interest in Pittsburg, has bought a silver mine near Tucson, Arizona, and paid therefor $75,000. If reports are true he got it at a bargain, as, it is said, there are $2,000,000 in sight.

ELECTRIC LIGHT FLASHES.

Weldon, N. C., is to have an electric light plant.

In Reidsville, N. C., the municipality is to purchase the electric plant of the Danville Electric Light Company, and improvements will likely follow.

The tenders for the erection of an electric light plant in Fredonia, N. Y., have all been rejected on account of being too high. New specifications will be drawn and bids drawn thereon.

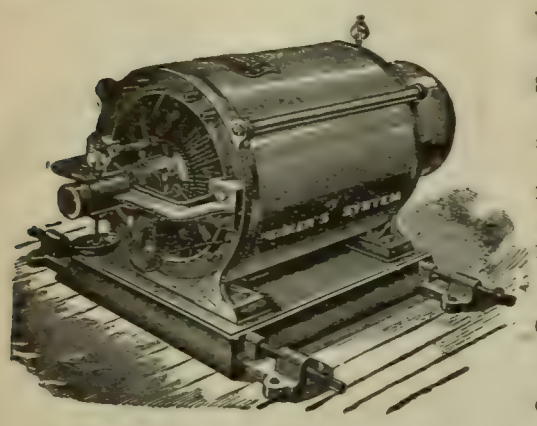
Thirty thousand dollars has been voted for the purpose of establishing an electric light plant in Jamestown, N. Y.

The city clerk of Seattle, Wash., has been ordered to advertise for street lights. The incandescent lights are to be of 16 and 30 candlepower, and the arcs 2,000 each.

Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889.

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INCANDESCENT ELECTRIC LIGHT SYSTEM.



Unequalled for Distribution over Wide Areas.

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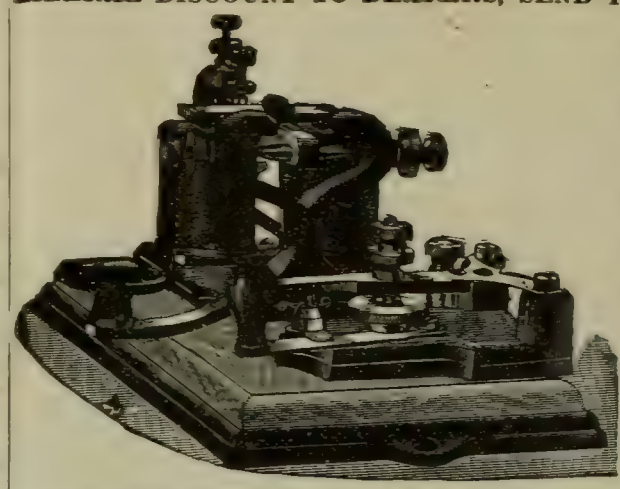
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The following list will illustrate the expense attending the purchase and use of small installations, and serve as guides when ordering plants for domestic purposes.

PLANT No. 1.		PLANT No. 2.		*PLANT No. 3.	
2 No. 9 Cells at $1.25	$2.50	4 No. 9 Cells at $1.25	$5.00	6 No. 9 Cells at $1.25	$7.50
1 1-C.P. Incandescent Lamp (large bulb)	.85	1 3-C.P. Incandescent Lamp (large bulb)	.85	1 6-C.P. Incandescent Lamp (large bulb)	.85
1 Key Socket	1.20	1 Key Socket	1.20	1 Key Socket	1.20
1 Shade and Holder	.50	1 Shade and Holder	.50	1 Shade and Holder	.50
50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.50
4 Charges of Depolarizer (will run 80 hours)	.40	2 Charges of Depolarizer (will run 40 hours)	.40	3 Charges of Depolarizer (will run 70 hours)	.90
	$5.95		$8.15		$11.45

*This plant will be found useful for lighting small rooms, dining tables, desks, and for reading purposes. It will also properly light two stalls in a stable.

NOTE.—Any number of 1-C.P. incandescent lamps can be employed, provided that not more than one is used at any one time.

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NOVELTY ELECTRIC COMPANY, 50-54 North Fourth Street, Philadelphia, Pa.
THE ELECTRIC GAS LIGHTING COMPANY, 195 Devonshire Street, Boston, Mass.

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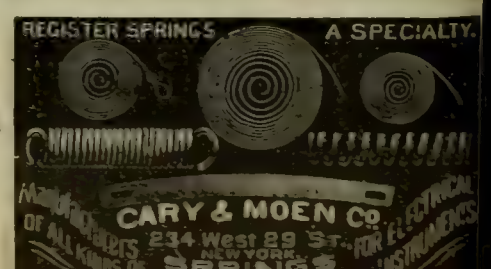
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R. J. GRAY, Manager, Advertising Dept.

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NEW YORK, OCTOBER 18, 1890.

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THE STREET RAILWAY ASSOCIATION MEETING.

The meeting of the National Street Railway Association in Buffalo, on October 15, 16 and 17 will be of unusual importance, on account of the consideration electricity will receive in the discussions. People are beginning to look upon horse cars as relics of the musty past, and when that mode of travel is compared with the new power it is not surprising that horse cars are looked upon with unkindly feelings. After traveling on electric cars then to go aboard of a horse car the latter dwindles into extreme insignificance. It makes no difference how elegantly a horse car may be fitted up there is the feeling that it is a horse car, whereas on an electric car one feels that there is power in reserve to go at a very rapid speed if occasion requires, and there are no hindrances.

It is an indisputable fact that the days of the horse car are numbered, and street railway managers are already appreciating that fact. The pressure is great in favor of electricity for the propulsion of street cars, and the street car managers are yielding to that pressure. Electricity is to be the universal power, and those who may make an effort to cry it down will surely get the worst of the encounter. It is something that will not down.

That street railroad managers are alive to the times is quite evident from the interest they are taking in electricity as applied to street railway work. It is a matter of business necessity, and they are making no mistake in opening the doors of their annual convention to electricity.

LIFE OF ELECTRIC CAR WHEELS.—According to statistics compiled in the office of one of the largest car builders in this country, the average life of a car wheel on an electric motor is four months.

THE NIAGARA TUNNEL.

An event of great importance took place in Niagara Falls, N. Y., on October 4th, in the commencement of the construction of the long-talked-of Niagara tunnel. Amid much enthusiasm and under auspicious circumstances, Mr. C. B. Gaskell, the president of the Niagara Power Company, with a nickel-plated shovel turned the first sod in what is to be a work of great magnitude, namely, the building of a tunnel for the purpose of utilizing a portion of the immense power of the great Falls of Niagara for industrial purposes.

The utilization of this great power, for the production of electricity, has been the dream of electrical engineers for years, and it seems to have at last reached the state of realization. A general invitation is extended to electrical engineers to devise the best and most economical method of utilizing the power that nature has so bountifully supplied at this locality. By transforming this power into electricity it is possible to re-transform it into power at any distant point, and here is just where the important part electricity may play in the scheme comes in. It would be out of the question to take existing plants in distant places to this source of power, hence there is but one thing to do and that is to transmit the power, through the agency of electricity, to where the plants are located. There is a good deal of enthusiasm manifested among the citizens of Niagara Falls over the prospect of their town becoming a large manufacturing centre, but they lose sight of the fact that existing plants cannot well be taken to the power—the power must be taken to the plants.

New plants may be established there, but on account of the geographical position of the place the industrial development of the town may not be as great and rapid as they anticipate. Electricity stands in the way of the realization of their hopes. The large manufacturing centre of Buffalo, and other adjacent places, will likely derive greater benefit from the new power than will the town of Niagara Falls. Of course it would be a great advantage to have plants located on the ground as near as possible to the source of power. Then the loss of power in transmission would be saved, but as the electric method of transmission is the most efficient of all known methods, and the only practical one for long distances, electricity will likely be the master of the situation.

INCREASING TRACTION BY ELECTRICITY.—In view of the assertion made by Prof. Thomson in his paper on electric welding read recently before the British Steel and Iron Institute at Chickering Hall, that electric welding was not due to the high electrical resistance of the imperfect joint of the metals when cold, the question naturally arises in this connection, what is the cause of the increased traction of locomotive engines when an electric current of proper proportions is passed between the driving wheels and the track? Last June at the Convention of Railway Telegraph Superintendents, at Niagara Falls, an exhibition was made of the method of increasing traction by this means, and it seemed to be then proved conclusively that the additional hold of the wheels on the track was due to an actual weld between the wheel and rail at the point of juncture. Prof. Thomson has shown that a solid and unbroken bar of metal can be raised to welding heat between the clamps of the welding machine, and that a partial and high resistance joint is not essential to the success of the operation. On the other hand, in the case of electric traction, the joint is necessarily a broken one, and the parts, *i. e.* the rail and wheel, seem to be actually welded together. These facts seem to prove that high resistance is a necessary condition in one case and not in the other, according to the effects to be produced.

SERMONS BY TELEPHONE.—In Birmingham, England, telephone transmitters are to be set up in Christ Church, so that subscribers to the telephone, if they desire, can hear the service and the sermon at their private residences. It will be remembered that two or three years ago an attempt was made in some parts of New Jersey to enforce what are commonly known as the Sunday "blue laws." These laws are so strict and narrow that a literal interpretation of the same rendered the citizens liable to arrest for even walking to church on Sunday. But by the plan above noted the unpleasant features of this law may be overcome by staying at home and enjoying the sermon. This method of attending church is not to be recommended, however, as it would naturally foster laziness, and if the fashion spread we would find our eloquent divines speaking and gesticulating to empty benches.

LIMITATION OF AMERICAN PATENTS.

Patent Commissioner Mitchell in his annual report, extracts of which will be found on another page, calls attention to the unfortunate language used in section 4887 of the Revised Statutes, in reference to the limitation of patents in the United States, when the same inventions are patented in foreign countries. This section provides that every patent granted for an invention that has previously been patented in a foreign country, shall be so limited as to expire at the same time with the foreign patent.

The intention of this enactment was probably to prevent foreign applicants from obtaining patents in the United States, of longer duration than the home patents previously taken out by them. Its practical effect, however, is to impose a penalty on American inventors who patent their inventions abroad before their domestic patents are granted.

Those competent to judge in this matter agree that the section should be modified so as to prevent a foreign patent previously obtained on an invention from affecting the life of an American patent on the same invention.

As the section now stands, it is exceedingly detrimental to American inventors, and is not in accordance with the American idea of encouraging invention.

The change proposed would result in benefit to the American inventor in another direction. He could then enjoy the benefit of the provisions of the International Union for the Protection of Industrial Property, of which the United States is a member.

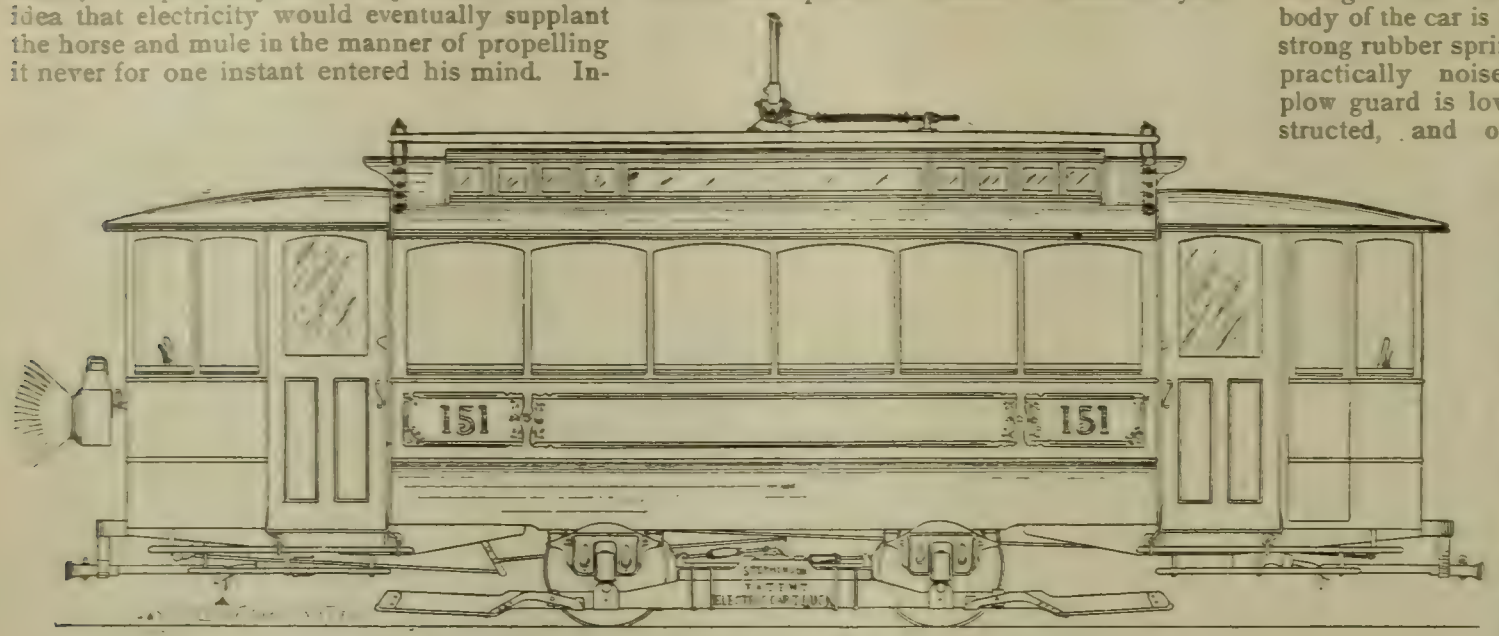
By the terms of the Union, persons who have made application for patents in one of the States constituting the union, may within a definite period apply for a patent for the same invention in the other countries belonging to the Union without being prejudiced by intermediate acts, such as the publication or use of the patented article. As a matter of fact, however, the American inventor can not avail of these benefits so long as section 4887 remains in its present form.

PROPOSED ELECTRICAL COMMISSION.—In a recent interview, State Senator Erwin stated that he intended to introduce a bill this winter in the New York State Senate, to create a commission who shall have charge of all the electrical plants in the State, regulate charges, supervise the method of lighting and stringing the wires. The commission is also to have the power to prescribe the manner in which this work shall be done.

ELECTRIC RAILWAYS.—The announcement that an electric railroad is to be built connecting Worcester with the busy manufacturing town of Spencer, says the Boston *Transcript*, is a reminder that the steam railroads must look out for the sharp competition of electric lines in the early future. The distance between the two points by the present routes is 20 miles. "Steam railroads," says the article, in conclusion, "will find themselves fighting to hold all the surburban business they have built up, though even after electrics are in competition there will be enough of this traffic left to be a big source of revenue for them."

MODERN ELECTRIC CARS.

When John Stephenson built the first car ever introduced on a street railway in the United States, it is perfectly safe to presume that the idea that electricity would eventually supplant the horse and mule in the manner of propelling it never for one instant entered his mind. Indeed his establishment was open for business and in fine running order in 1831—thirteen years before the first telegraph wire was strung between Baltimore and Washington.



STEPHENSON PATENT VESTIBULE CAR

FIG. 1.

That the John Stephenson Company is alive to the demands of the traveling public is abundantly shown in the vast number of improvements that have been made from time to time to add to the comfort of passengers.

This well-known firm which has a world-wide reputation for car building of the highest order, has just completed an elegant vestibule car (see fig. 1). The steps run from one end of the car to its body proper. To insure safe footing they are cover with corrugated rubber. Instead of the ordinary hand hold, the doors are ornamented with a horizontal bar, to which a passenger in alighting may cling without fear of falling. The same rule also applies to those who board the car. The metal used is of the very finest bronze. Its exterior is all that could be desired. It will attract attention anywhere. Everything in and about it savors of the luxuries of one of Pullman's or Wagner's vestibule cars. Its seating capacity is twenty-two, and should it be necessary fully as many could find accommodations on the platforms, and this too without their coming in direct contact with either the conductor or driver, both of whom can be isolated from the passengers through a series of sliding doors.

The interior of the car is reached through an alcove, and the ceiling is ventilated and permits a free vent for foul air. The advantages held out by this system are fully demonstrated by the fact that in cold weather the windows are invariably clear, while in cars unprovided with ventilated ceilings the window panes are covered with a thick coating of frost. Passengers of nervous temperament suffer no annoyance whatever from the rattling of the windows, as they are securely protected from contact with the woodwork by slices of rubber closely fitted to the sash. The channels are of the best bronze, and the pillars which are exceedingly narrow intercept very little light. Illuminated lettering is another feature worthy of mention. This enables passengers to see as readily at night as during the day the car they wish to take.

The car is lighted by three incandescent lamps in the center, and one at either end, each of 16-candle power. Another valuable adjunct is a headlight of such power as company making the purchase desires to introduce. Heretofore the most powerful electric cars turned out by the Stephenson Company have been fitted with two motors of 15-horse power each. In this instance, however, an exception has been made; the car in question having been supplied with two motors of 20-horse power each, of the Thomson-Houston system. The maximum speed which is calculated this motor, with two trailers, will attain is 15 miles per hour. The car is provided with every appliance known to science that will in any way prove conducive to the comfort and safety of passengers. It not only has a wheel brake but a truck brake as well, the latter of which is so extremely powerful as to raise, when fully applied, the wheels from the rails. To increase the traction, sand boxes have been introduced in each end of the car.

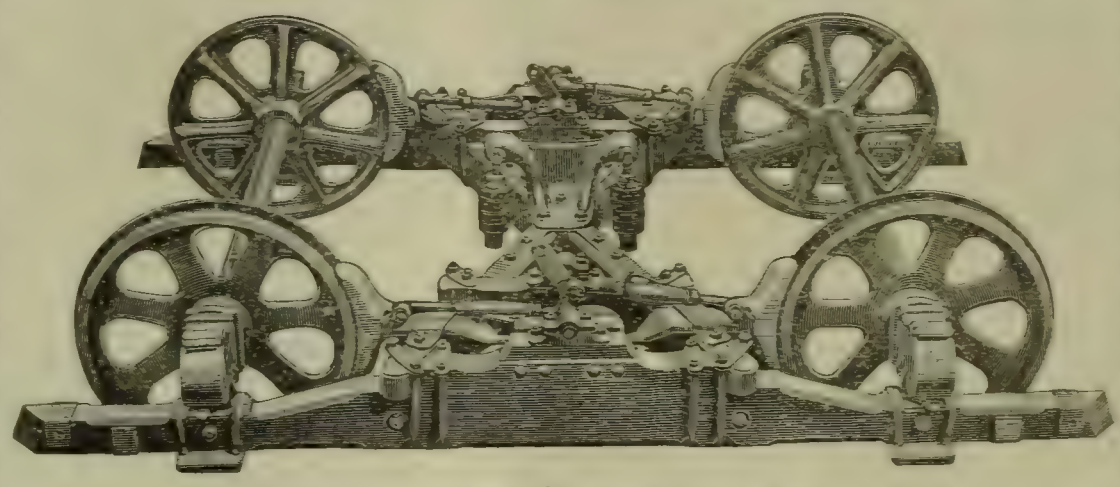
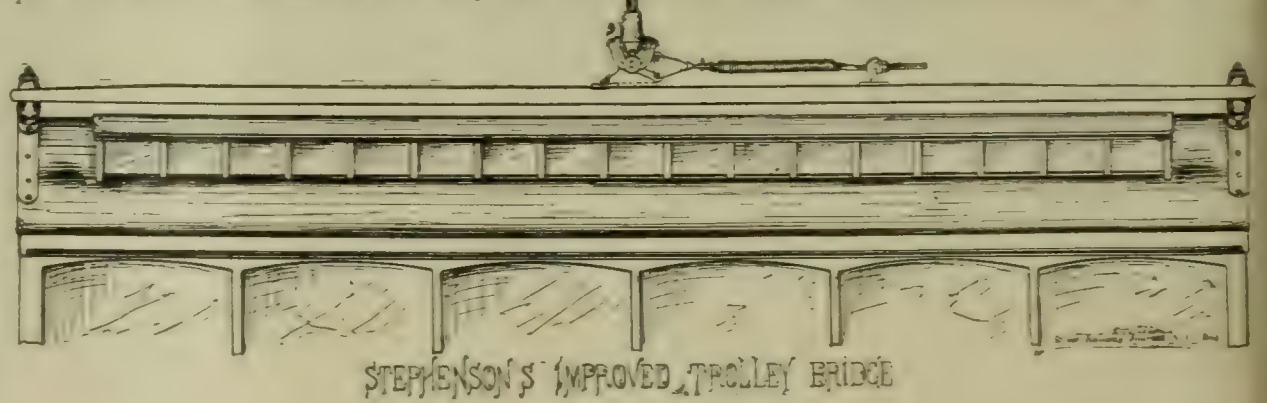


FIG. 2.—STEPHENSON'S ELECTRIC CAR TRUCK.

The motor frame is most substantially and compactly built and is located between the front and rear wheels. The wheels, by the way, are of cast iron and are in all probability the strongest ever made for a like purpose. The body of the car is separated from this frame by strong rubber springs. The motion of the car is practically noiseless in consequence. The plow guard is lower than any other ever constructed, and owing to its flexibility, by reason of its connection with a unique devise on its frame, will raise itself over a small cobblestone and yet sweeps from its path any large obstruction.

Figure 2 is an illustration of the electric car truck, made by the John Stephenson Company. This truck is preferably of wood and is unique in design and construction.

It is exceedingly simple, but four pieces being required for the truck frame which has within itself all needful bracing. It affords maximum room for machinery. While carrying motors and powerful brakes it is free from dependance on the car body, and it is not subject to looseness of joints or change of form. The truck frame is connected with the bottom of the axle by a hinge joint or stump which facilitates removal of the wheel and also affords slight elasticity. Each motor on its axle is held to the car by three bolts, viz: a hinge joint bolt in each of the two axle boxes and the nose bolt connecting that end of the motor with the goose neck at the truck, between rubber cushions. The removal of these three bolts and lifting of end of car body allows the easy withdrawal of the axle and wheels with the motor for replacement and repair. It is claimed for this truck that it affords in the highest degree quiet, ease and comfort to passengers, because the motor brakes and other machinery are detached from the car body and carried by the truck with insulators intervening between the car body and its bearings on the truck; and for the same reason jostling and concussions annoying to passengers are avoided. It also diminishes the wear of wheels and rails, passes curves and switches with ease, prolongs the life service of the car and its machinery and requires less electrical energy to propel the car.



STEPHENSON'S IMPROVED TROLLEY BRIDGE

FIG. 3.

The trolley bridge (figs. 3 and 4) is of sufficient weight to bear the trolley stand and arm, and is supported at the end walls of the car between rubber cushions, thus being insulated from contact with the car roof. The latter is thus protected from damage and the passengers are free from the annoying drumming noise which con-

tact causes. Both the truck and the trolley are insulated from the car. It would be difficult to form anything like a complete list of the number of electric cars manufactured by this firm for shipment to the various cities throughout the United States without consulting the books, but it might be interesting to our readers to note the following which have been taken at random :

Hamilton, Ohio, and Salt Lake, Utah, both of whom use the Edison system; Burlington,

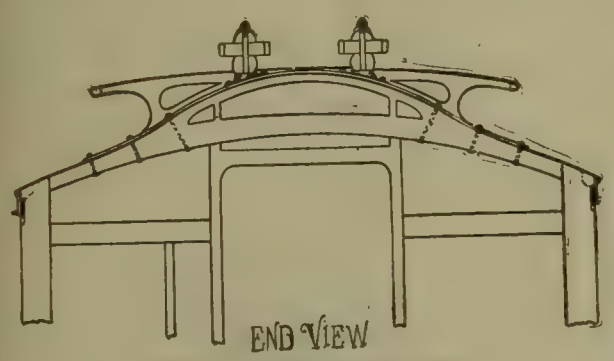


FIG. 4.—TROLLEY BRIDGE.

Iowa, the Westinghouse; Georgetown, D. C., and Sydney, New South Wales, the Thomson-Houston; Covington, Ky., the Short; Berlin, the Sprague, and East Reading and Northumberland, Pa., the Daft.

In conclusion it is well to remark that so far as our observations go the cars manufactured by this firm are built on scientific principles and represent the highest development in the art of car building.

STEVENS' POSITIVE GRAVITY SWITCH.

The accompanying illustrations show the new switch just put on the market by the Electric Merchandise Company, of Chicago. This switch has, after careful examination by several engineers in New York, Boston, Pittsburgh and Chicago, been christened the "Only" overhead switch, as it appears on the line.



FIG. 1.—GRAVITY SWITCH.

It will be noticed that the face of the switch where the trolley wheel runs is level with the trolley wire, having no depressions to wear the wheel which has been a serious objection to every other practical switch on the market.

Illustration No. 2 shows the openings through which the wheel passes. In whichever way the car is going the wheel itself opens a space wide enough to allow the wheel to pass through, which

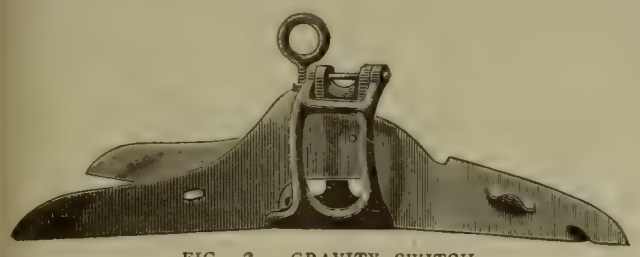


FIG. 2.—GRAVITY SWITCH.

space closes immediately the car passes and is ready for another car or for a car coming in an opposite direction. It matters not at what speed the car is going, it is an impossibility for the steel to leave the trolley wire. The switch is but 18 inches in length and is, therefore, the smallest overhead switch in the market, while being undoubtedly the most simple, practical and efficient. It is made for both right and left hand turnouts.

ELECTRIC LIGHTING FOR BEGINNERS.

BY THE EDITOR.

Part IX.—Alternating Current Dynamos.

175—What is an alternating current dynamo?

An alternating current dynamo is one which produces a current of alternating polarity in its armature coils.

176—Does the alternating current produced in the armature coils flow through the external circuit?

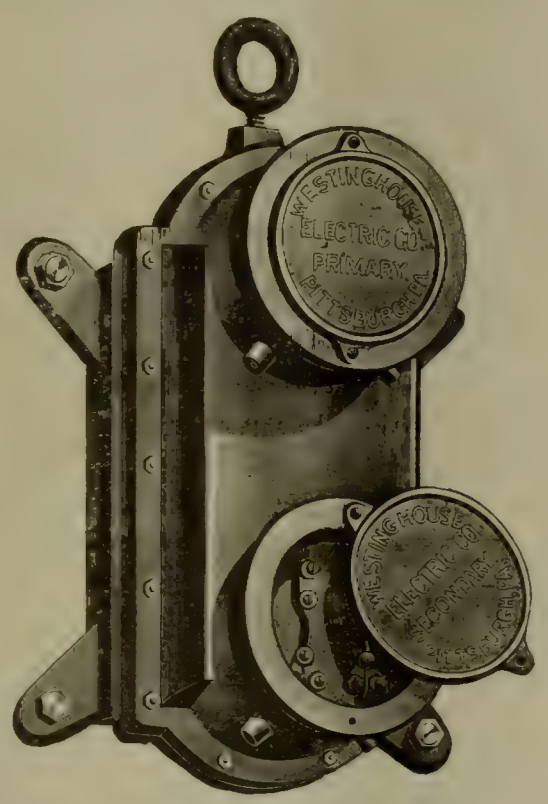
Yes; it is alternating inside and outside of the armature coils.

177—What is the character of an alternating current?

An alternating current is composed of successive impulses of current, the first impulse in one direction, the second in the opposite direction, the third in the same direction as the first, the fourth the same as the second, and so on, alternately. It is also usually of high potential and little volume.

178—How rapidly do the alternations of current succeed each other?

The rapidity of alternations varies greatly according to the make of the machine, and to



CONVERTER.

the work it is designed to perform. Some machines produce 10,000 or 12,000 alternations per minute.

179—What is the largest alternating current dynamo ever constructed?

Gordon's dynamo, an English machine, is said to have been the largest ever built.

180—Give some of its points.

Gordon's machine is capable of feeding 5,000 incandescent lamps of 20 candle-power each. The armature is stationary, while the field magnets revolve, and the number of current alternations per minute is 1,474,560.

181—What are the principal American alternating current dynamos?

The Westinghouse, the Thomson-Houston and the Slattery.

182—What are alternating currents used for?

For illumination.

183—What class of illumination; inside or outside?

Both inside and outside.

184—What class of lamps are used for illumination by alternating current systems?

Both arc and incandescent lamps.

185—What are the uses of arc and incandescent lamps?

Arc lamps are used for outdoor, or street lighting, and incandescent lamps for interior illumination.

186—Is the alternating current used in the same manner for indoor and outdoor lighting?

No; while the original current is the same in both cases, it is modified in one case before being transformed into light.

187—Explain the use of alternating current for street lighting.

In street lighting by the alternating current the current flows directly to the arc lamps.

188—For indoor lighting does the current go directly to the lamps?

No; it goes through a converter or transformer, and is modified. The lamps receive the modified current.

189—What is a converter, or transformer?

A converter, or transformer is a device by which an alternating current of high potential and small volume is converted or transformed into a current of much lower potential and much greater volume. The converter will be fully considered later on.

190—What advantage does the alternating current system of electric lighting possess over the direct current system?

The main advantage it possesses is that lamps may be operated at a greater distance from the dynamo than would be practicable with direct current machines.

191—What other advantages are there in the alternating system over the direct circuit system?

Another great advantage is the saving of copper in the wire, a comparatively small wire being used for the external circuits than could be used for direct currents.

192—Why is it possible to use smaller wire in the alternating system than in the direct current system?

Because the alternating current is of high electro-motive force, or pressure, and of little volume, and for this reason does not require as large a wire as is usually required for direct currents.

(*To be continued.*)

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AT THE BUFFALO CONVENTION THIS WEEK.

The Interior Conduit and Insulation Co., of New York, who have some 150 miles of their underground conduits in successful operation in Minneapolis, carrying the feeders of the overhead trolley system of the Minneapolis Street Railway, will have an excellent exhibit of their admirable system at the Convention of the National Street Railway Association, at Buffalo. The exhibit will consist of the one-half size model of their new man-hole, and will show their improved methods of entering the conduits into the same and other interesting details of the system.

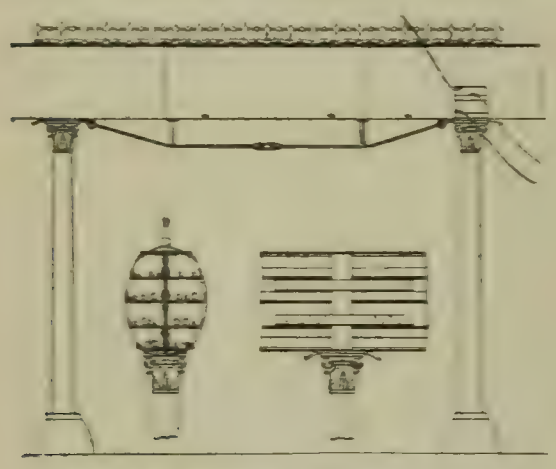
The Thomson-Houston Electric Company will have on exhibition an electric snow plow and an electric track sweeper.

WHO OWNS THE EARTH?—This is a question that is propounded by Prof. S. Kimball, of the Worcester Polytechnic Institute, in a recent address before the Worcester Club. "A new class of troubles is now coming to the front," said the professor. "Not many years ago a wire erected for any electric purpose had the whole field to itself. There were no neighboring currents to molest it, and the earth was universally used as the return of the circuit. Now when other companies begin to use the earth as a return, the delicate, sensitive instruments of the telephone company are affected. The question now comes, who owns the earth? Our civilization demands the electric light, the telephone, the telegraph and the electric motor. Every extension of the service will necessarily call for some readjustment of existing systems, and vexatious problems will arise which will require wise legislation to solve. It is very desirable that no false alarms be raised to obstruct the real question at issue."

AN OVERHEAD ELECTRIC CONDUIT.

We illustrate herewith an overhead conduit for electric wires invented by Mr. Adolphus A. Knudson, a well-known electrician and inventor, formerly of New York, but now of St. John, N. B.

The striking feature of this system is its artistic design and appearance. The idea is to provide means for carrying wires overhead but at the same time overcome the popular and justifiable objections to unsightly poles. Poles, however straight and well finished, soon become an eyesore, after linemen have ascended them a few times and they are all riddled with spur holes. This is not the only objection to poles. Some are tall and some are short; some are straight and many are crooked, and in whatever aspect one may look at a pole line it cannot be truthfully said that it is an ornament to a street. All of these objections are overcome in Mr. Knudson's plan of running



KNUDSON'S OVERHEAD ELECTRIC CONDUIT.

wires. While thay still remain overhead, they are laid away, out of sight, in a structure that is totally devoid of all the objections above enumerated. In the illustration a longitudinal view of a section of the conduit system is shown, also a cross sectional view, showing the sub-division of the interior of the conduit and the manner of laying the cables therein.

As will be seen in the illustration the columns supporting the overhead conduit are designedly ornamental, and the method of looping a wire for the purpose of connecting it with a lamp, etc., is also shown.

This system offers an economical method of placing electric conductors out of harm's way, and at the same time they are easily accessible. The dangers attending the use of subways and the unsightly pole lines are also entirely gotten rid of.

ELECTRIC WELDING.—In his paper read at the meeting of the British Iron and Steel Institute at Chickering Hall the other day, Prof. Elihu Thomson took occasion to correct an error which is quite a common one among electricians. The Professor stated that the understanding that in electric welding the heating of the parts to be welded was due to imperfect contact and resulting resistance was not correct. He had no doubt that limitation of the contact surface does hasten the heating at the joints, but it was nevertheless a fact that a solid bar of metal joining the clamps of a welding machine could be heated between the clamps to a welding temperature, and may be upset by the approach of the clamps toward each other. The fact that a solid, unbroken bar can thus be raised to welding temperature is incontrovertible proof that the heating is not due altogether to the poor conducting qualities of the cold joint. This fact is an interesting one, and Prof. Thomson did a wise thing to state it at the time he did. This was the first time many of his hearers had had welding machines explained to them, and it was far easier to state the fact correctly at the beginning than to correct any false notions later on. There are many who still know of no other theory than the erroneous one, and these will be glad to have this additional light thrown on the subject.

ABUSING THE TELEPHONE.

A great many users of the telephone labor under the belief that the telephone company is the incarnation and essence of everything that is contrary and exasperating. They never for a moment think that they themselves may be the first cause of their own troubles. Some of the things that the telephone company has to contend with are herewith appended. The article appears in an exchange under the head of "Instructions for the Use of the Telephone," and is as follows:

If you have a telephone in your office or store, ring up "Central" and then go and wait on a customer. Pay no attention to the bell when "Central" rings back, but go to the telephone in about fifteen minutes, ring up again, and make a kick if the operator is not there waiting for you.

Always speak in an undertone, in order to make "Central" ask you over what you said. If she does not hear you, tell her to "wake up," or "take the cotton out of her ears." She will then admire your originality, for she does not generally hear that advice more than forty times a day.

Put your "plug" in before a storm, and be sure not to take it out again, but go around to the central office and offer to lick the whole telephone company for neglect of duty.

Take your time in answering your bell, or, what is better, do not answer it at all, but in about half an hour ring up and ask who called you, and get mad if "Central" has forgotten who it was. She has nothing else to do but remember.

Always ask "Central" to transfer the message for you. She likes to do this, as it helps to kill time for her.

Allow everybody to use your telephone. Hang the receiver big end up, as in this way it gets full of dust, which makes another cause for complaint.

Bang on the transmitter with a lead pencil, as though you intended to knock it through the wall. This invariably makes it talk better. Refuse to pay toll messages, and if you are on a line with some one, always listen to their conversation, and be sure to want to use the line while they are doing so.

Whenever you see the manager, tell him that if he can not give you a better telephone or get that one fixed, you will throw the whole thing out of the window. When the inspector comes, deny that you have ever complained of the telephone, and that it works like a charm.

Lastly, kick against everything, and cause as much trouble for the company as you can. They are delighted to have you do so, otherwise business would be monotonous.

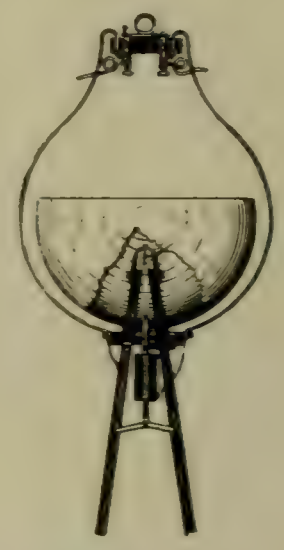
Paste this on your telephone for future reference.

EIGHT-WHEEL ELECTRIC CARS.—Newark, N. J., is rapidly coming to the front in the matter of electric roads. A few days ago the Springfield Avenue Electric Railroad began operations, using cars of unusual size and elegance. Each car has eight wheels, and has a carrying capacity of 60 passengers. To one axle of each truck is geared a twenty horse-power motor. The cars, it is said, surmounted the steep hills along the line without any difficulty. Another electric line is about to be opened in Newark, and the cars are models of elegance, being built by the Pullman Company, and upholstered in blue plush. The interior trimmings are of polished mahogany. Electricity is to be introduced generally on the Newark street railroads.

AN EXPLANTION.—In the article on page 2 of the last issue, headed "Improved Dry Battery," the location of the Crosby Electric Company was, by an error, made Boston. The headquarters of the company are in New York, not Boston.

ARC LAMP.

An arc lamp of novel form is illustrated herewith. It is the invention of Ralph H. Beach of St. Paul, Minn., and the peculiar arrangement of the carbons with reference to each other is the most striking feature of the lamp. The arrangement of the carbons resembles that feature of the Jablochkoff candle. They are movable one from the other and their holders, and to one of the holders is connected the core of a solenoid which is in the main lamp circuit. The motion of the core of the solenoid moves the carbon holder



BEACH'S ARC LAMP.

thus separating the carbons and establishing an arc. An elongated polepiece extends from the solenoid in the direction of the carbon points, and is made flaring at its outer end to repel the arc and maintain it near the tips of the carbon points.

Means are provided in this lamp for automatically advancing the carbons, and there is a short circuiting device arranged upon each of the carbon holders. This device is adapted to be operated by the movement of a follower to the carbons to close the circuit between the carbon holders.

STANDARD OHM.

The Committee on Electrical Standards, of the British Association, in its report read at the recent meeting at Leeds, says, with reference to the Mercurial Standard Ohm:

The question of the best value to adopt for the dimensions of a mercury column having a resistance of one ohm has been raised by some members of the Committee during the year. There is no doubt that the column of 106 centimetres adopted by the Paris Conference in 1884 is too short.

After a discussion of the results of the most recent observations, the following resolutions were adopted by the Committee:

(1) The Committee recommend for adoption as a standard of resistance sufficiently near to the absolute ohm for practical purposes the resistance of a column of mercury 106.3 c.m. in length, 1 square mm. in section at at emperature of 0° C.

(2) That for the purpose of issuing practical standards of resistance the number .9866 be adopted as the ratio of the B.A. unit to the ohm.

Thus the new unit may be obtained from the B.A. unit by increasing it in the ratio .9866 to unity, or, to put it differently, the specific resistance of mercury in B.A. units is taken as $.9535 \times 10^{-4}$, and the length of a column of mercury which has a resistance of one B.A. unit as 104.97 c.m. The specific resistance of mercury in ohms is $.9407 \times 10^{-4}$.

PERSONAL.—Mr. T. McCoubray formerly Secretary and Treasurer of the Crocker-Wheeler Motor Co., is now connected with the Okonite Company, in this city.

DIRECT READING PHOTOMETER.*

The object I had in view in designing this apparatus was to meet a want that has been felt by electrical engineers and others interested in the measurement of light, namely, a convenient form of apparatus as handy to manage as the usual set of measuring instruments which are provided, so as to take its position along with the voltmeter, the ammeter and the wattmeter.

Incandescent lamps are now made of such generally uniform construction that if we can, with facility, measure the light produced, we can readily deduce, for all practical purposes, the amount of current delivered, and thereby deter-

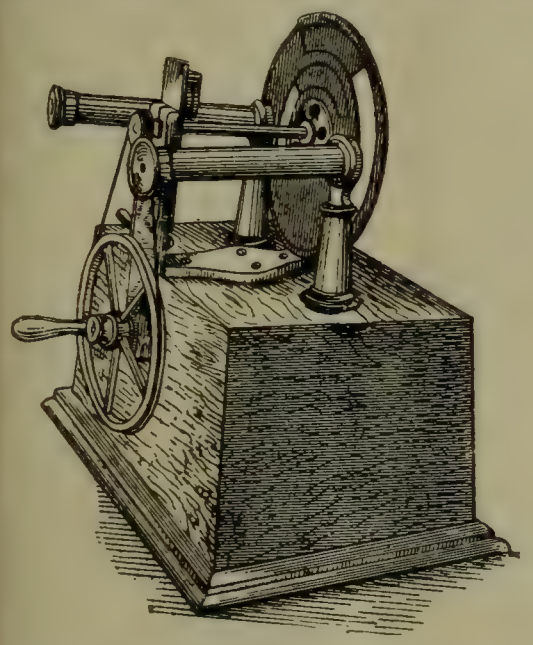


FIG. I.—PHOTOMETER.

mine the general efficient working of the installation. Or, conversely, if we know the current in watts passing through a glow lamp, we can determine the suitability of the filament for the purpose required, provided we can readily obtain photometric measurements. The conditions imposed are, that the instrument should be portable, have a range from one candle-power to that of the electric arc, that the light to be measured, and that of the standard, should be exactly at the same distance from the screen.

This instrument, Fig. 1, consists of two discs, each pierced by two semi-ring-shaped windows or apertures. These openings extend to the half circle (180); both are of the same width, one inch broad. The openings in the two discs are placed in reverse positions to one another, so that if one half ring is opened to its full extent (180), the other half-ring is entirely closed; or,



FIG. 2. FIG. 3. FIG. 4.

if the discs are shifted to an intermediated position, both apertures will be opened to an equal extent—namely, 90. See Figs. 2, 3 and 4.

If, in this position, the discs are rotated, it is obvious that an equal amount of light can pass through both rings, but if the light to be measured is 1 to 17 c. p., then the angular length of the two apertures must bear a proportionate ratio in order that the two shadows shall be of equal density; and accordingly, one aperture will be open to the extent of 10 for the brighter light, whilst that of the standard light is opened 170. Instead of dividing the circle into the conventional 360, I divide the half circle into 2,000 in round numbers. By still farther shifting the discs, this aperture may be entirely closed and read up to infinity. The divisions of the half circle are numbered from left to right and right to left, showing at once the fraction values of the angular extent of the opening or arc, and thereby giving the values of the light.

In order to make the discs turn one upon the other, I have devised a modification of the Fergusson paradox; that is to say, the discs are carried by independent shafts, one of which is hollow, to allow the central axis to turn within it; at the end farthest from the discs a cog wheel is fixed to each axis. By means of a sliding link the two wheels can be brought into gear with the axis also provided with cog wheels, each being the same diameter, but one is cut with 100 teeth, whilst the other has 99 teeth. Thus, upon rotating the discs, each revolution of the gearing wheels advances the discs, and so changes the proportion of the openings, one decreasing whilst the other increases, and *vice versa;* this we can do until the two shadows are of equal density, or approximately so, when the final adjustment can be given by hand. Behind the windows two hollow cones are placed which have their axes directed to a point common to both (Fig. 5), but at some distance in front of the discs where the two shadows fall upon the screen. A second or back screen is then placed at the mouth of these cones, over which it fits, and

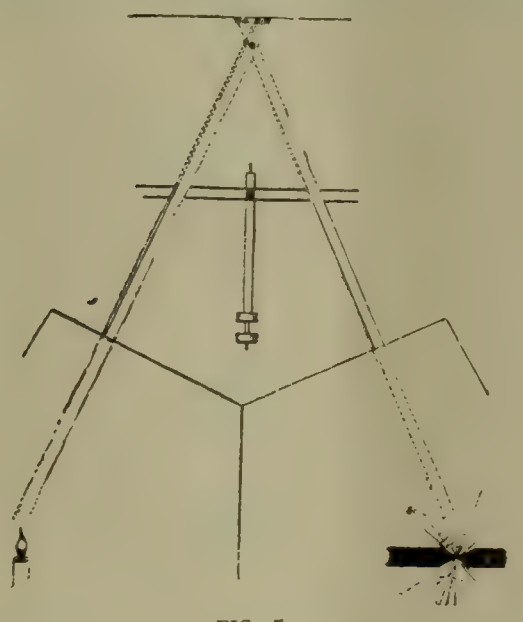


FIG. 5.

effectively cuts off one light from the other, so that on one side is, say, the electric light, and on the other the standard candle. The light from both passes through axes of their respective cones, and through the discs, and on to the screen upon which the shadow image is cast.

*Abstract of a paper by F. H. Varley, read before Section A, British Institute.

GAS COMPANIES AND ELECTRIC LIGHTING.

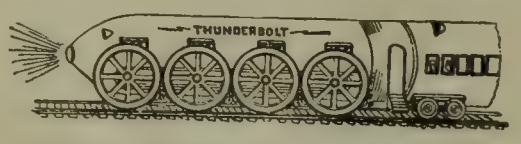
Mr. W. H. Preece, the English electrician, in a recent paper on electric lighting said:

It is surprising that gas administrations in England have not been more enterprising in developing electric lighting. In Vienna, Rome, and Stockholm, the gas companies have established central stations, and the progress of the industry in these cities is very great. The proper function of gas is to supply heat, not light, and as a source of power it has a future more brilliant than its past. If it could be supplied as fuel it would remove the troubles of coal transit and storage, of ash and dust removal, of smoke and of stoking. It has even been shown that it is cheaper to convert coal into gas on the spot, and to use the gas as the source of power, than to apply the coal direct for the production of steam in boilers. The waste of energy in the use of coal is enormous. The energy contained in one pound of coal if burnt in one hour is theoretically sufficient to supply 5.6 horse power for that hour. The best practical result yet obtained by the steam engine is scarcely one horse power.

The electric light is unquestionably the light of the future. Its use is advancing with leaps and bounds. Not only is it naturally the proper source of light, but economically it must eventually supplant its rivals. When electrical energy is generally distributed through our towns, and its supply is continuous, and properly controlled, so that it is always within the reach of all; and when means can be devised to wire up houses as cheaply as they are now fitted for gas, everyone will take it, not alone for its beauty, but because it is, above all, a source of health and comfort.

150 MILES AN HOUR.

It will be remembered that Wm. D. Marks, the well-known electrician of Philadelphia, recently made the statement that he could build an electric motor which could draw a train of cars from Philadelphia to New York in 36 minutes. He claims that on a well-constructed and straight roadbed he can attain a speed of 150 miles an hour. In this connection the accompanying illustration taken from a New York daily paper will be of interest, purporting to show the appearance of Mr. Marks' electric locomotive. The motor would be about 40 feet long, and about as high as the steam locomotive. The wheels would have insulated steel tires which would conduct the current from the rails through the brushes at the top of the wheels to the motors.



MARKS' ELECTRIC LOCOMOTIVE.

The railroad between the two cities would be divided into blocks, each being supplied with an independent current. The paper from which we culled this information states that an ingenious feature of the use of electricity as a motive power, is that in case of accident or emergency the supply can be shut off from the track, and the motor brought to a standstill. We apprehend, however, that in case of accident to a train going at a speed of 150 miles an hour, there would not be sufficient time between life and death to shut off the current.

THE TELEPHONE.

There are, in round numbers, 475,000 telephone subscribers in the United States. In Germany the telephone subscribers are estimated to number 31,325; in France, 9,487; in Great Britain, 20,426; in Russia, 7,585; in Italy, 9,183; in Austro-Hungary, 4,200; in Spain, 2,218; in Portugal, 890; in Switzerland, 6,570; in Belgium, 4,674; in the Netherlands, 2,872; in Denmark, 1,837; in Sweden, 12,864; in Norway, 8,390.

An effort was made at Washington recently to secure a reduction in telephone charges to the government, and to attain this end an amendment was added by the Senate to the General Deficiency bill proposing to reduce the government rate to $30 per annum, and provided that if the telephone company should decline to accept that rate, the privilege of using the streets, alleys and reservations in Washington for the laying of wires should be denied it. The fight on the company was begun in the Senate by Senator Morgan, who presented the amendment providing for a reduction in the rates, and he was assisted in his opposition by Senator Plumb, who thought it an outrage that the government and the public should be compelled to pay $60 a year for the use of an instrument which he said, does not cost more than $3 or $4 to make. Hearings were given the officers of the telephone company by the House Committee, and they had ample opportunity to show the expense of maintaining the service and give their reasons why the proposed reduction should not be made. The House thereupon non-concurred in the amendment of the Senate, and the conferees endorsed their action. The lowest annual charge for telephones in the District is $60 per annum.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Oct. 11, 1890.

C. E. Bibber, of the Holtzer-Cabot Electric Co., has gone west on a two months' trip.

The chair shops of J. A. Dunn at Gardiner, are to be lighted by electricity.

Mr. H. L. Pierce, of the firm of Pierce Bros., Leominster, Mass., will exhibit the trolley wire fixtures of their make at the Buffalo convention.

An order that the Belt Line Street Railway Co. be authorized to extend the location of its tracks was laid upon the table at a meeting of the Lynn Aldermen, this past week.

The overhead bridge for Factory K of the Thomson-Houston Company, Lynn, is being built by the Morgan Engineer Company to extend the length of the building.

The New England Printing Telegraph Company are rapidly nearing Boston with their New York line. The line now extends from Walpole, Mass. to Donelenville, Conn.

The Consolidated Electric Manufacturing Co. are working night and day yet cannot manufacture the famous "H. G." socket fast enough to fill their orders.

The first number of "Bubier's Popular Electrician" a monthly scientific journal for the amateur and the public at large has made its appearance. It is to be published monthly.

A new movement is on foot to establish an electric railway in Hyde Park. Capital has already been guaranteed in Dedham, Hyde Park and Boston.

The Pittsfield Electric Street Railway Company, has just been incorporated with a capital of $40,000. The directors are Joseph Tucker, W. R. Plunkett, Alexander Kennedy, C. E. Merrill and J. W. Hull.

Mr. G. H. Buckminster of the Eastern Electrical Supply and Construction Co. was in New York the past week making extensive purchases of electrical goods for this company who are doing a rushing business.

L. F. Jordan, of the Jordan Train Lighting Company, will attend the street railway convention, at Buffalo, and exhibit their system together with the "Best" trolley hanger, which is controlled by this company.

Beverly will probably be the next town in which the Naumkeag Street Railway will petition for right to erect poles and string wires for their electric system. The petition will meet with considerable opposition but it is generally believed that the company will grant the petition.

Upwards of 400 of the best and most skilled employés of the Thomson-Houston Electric Works, representing every department, have organized. The organization was made under the auspices of the Lynn Central Labor Union. The organization has not yet received its name.

The Malden Electric Company are now running an all-night service for incandescent lighting instead of until 12 o'clock as heretofore. They have orders for the wiring of houses enough to keep their present corps of employés steadily at work for the next six months.

C. J. Van Depoele, of the Thomson-Houston Company, has patented a support and insulator for suspended conductors, the claim covering a support for suspended bare electric conductors, comprising a support sustained above the conductor and a thin metal clip formed with sloping edges and extending under the conductor and secured to said support. Also an under-pressure contact device for electric railways. It covers a contact-arm for electric railways, consisting of a wooden trolley-pole forming a strut and a metal tie-rod therefor, the tie-rod being connected at its extremities with the extremities of the wooden pole and one or more intermediate braces connecting the tie with the strut. Also a motor truck for electric-railway cars. The combination, with a spring-supported truck-frames and its axles, of a support or secondary frame secured to the truck-frame and extending between the axles, an electric motor carried wholly by the spring sustained support or frame, and flexible connectors between the motor and one or both of the axles.

The storage battery cars that have been experimented with for some months on the street railway of the Union Railway Company, in Providence, have proved a failure, and they have been returned to New York. "The reason is," said one of the officials, "the storage cars are in a crude form, and they are not perfected yet for rapid transit."

The question of moving the tracks, electric wires and poles of the West End Railway Co. at the lower end of Brookline street, in Cambridge, was given a hearing before the Board of Aldermen this week. Remonstrance against removal was made by a large number of prominent people and a petition in opposition, extensively signed, was presented to the Board. The matter, after a heated and amusing discussion, was referred to the committee on bridges.

Mr. G. F. Curtiss, of the Thomson-Houston works has gone to San Francisco to superintend the installation of the great electrical plant in the Mare Island Navy Yard. Two thousand incandescent lights are to be put in the shops and some thirty arc lights will be put in. The contract calls for the completion of the work in six months from October 1. W. J. P.

ELECTRICAL DISPLAY AT THE AMERICAN INSTITUTE FAIR.

The electrical display at the American Institute Fair now being held in this city, is not as extensive as in former years. What there is, however, attracts considerable attention. The Crosby Electric Company, of this city, have a large booth in which is found an assortment of the various styles of their batteries now in use, together with a novelty in the shape of an electrical cigar lighter. Mr. Harry Randall represents the company and explains the merits of his goods to those desiring information.

Mr. James H. Mason, the well known manufacturer of the Mason Primary Battery, has an attractive and extensive exhibit consisting of cut outs, lamps and batteries, for light, power and cautery purposes. A number of his improved cells are on exhibition, and his display is the subject of considerable inquiry by visitors to the fair. Mr. Mason is represented by Mr. C. D. Seabridge, who is very successful in explaining the valuable features of the battery to all who seek information.

The Tucker Electrical Construction Company, of this city, installed the Mather plant to furnish the exhibition with incandescent lights. The work is not only thoroughly done, but artistic taste is displayed. The work reflects credit on both the Tucker Company, as well as the Mather system.

The large number of arc lights distributed throughout the building are supplied by a Schuyler dynamo, which is situated at the rear of the building and attracts considerable attention from the passing crowds.

The Metropolitan Signal Company, of 45 Broadway, New York, has quite an extensive display of its various modes of signalling and communication between different parts of buildings.

Of course the Edison phonograph attracts widespread attention. There are quite a large number of them in position to be heard by those who desire to listen to the music, speeches, etc., which the cylinders contain.

The Clark Electric Company, of 192 Broadway, shows one of its arc lamps on a Mather incandescent circuit, which attracts considerable attention. This company's well known safety devices are also exhibited and described to all who desire to understand their use. The ornamental art fixtures for interior lighting is also a feature of this exhibit. Mr. F. L. Haviland represents the Clark Electric Company, at the Fair.

SANITARY ASPECTS OF ELECTRIC LIGHTING.*

Light, however it be produced artificially, is simply the equivalent of work that has been done elsewhere. Whether it be by the combustion of tallow or oil, by the burning of coal or of gas, by the glowing of a fine wire, or the formation of the brilliant arc, energy has been expended somewhere, to be transferred and reproduced in some other place in the form of light. The great principle of the conservation of energy teaches us that the amount of energy in the universe is a fixed quantity, that it can be neither created nor destroyed, that it can only be transferred, and that any expenditure of energy —work done —anywhere is the equivalent of energy utilized somewhere else. The rate at which this energy is expended is called *power*, and the amount of power which we foolishly call a *horse-power*, and which we roughly imagine to be equivalent to the power exerted by a horse in drawing a load along a road, is competent to produce an amount of light which is very simply measured. Our standard of light is the light given by a No. 6 sperm candle, burning 120 grains per hour. Now the energy of one horse-power constantly expended will give by the aid of

Tallow	the light of	6	candles
Sperm	"	8.7	"
Oil	"	9	"
Gas	"	13	"
Electric current—Glow	"	248	"
" Arc	"	1,492	"

The results to the air of these different modes of producing artificial illumination are well shown by the following table :—

Products of Combustion in developing 100 candles per hour.

Illuminant.	Quantity Consumed.	Carbonic Acid produced.	Water Vapor.	Heat.
	lbs.	cub. ft.	lbs.	Calories.
Tallow	2.2	51.2	2.3	9,700
Sperm	1.7	41.3	2.0	7,960
Oil	1.3	33.6	1.8	7,200
Gas	56 cub. ft.	40.3	2.5	12,150
Electricity .. (Coal)	2.2 lbs.	0	0	257

Thus we see how very much more efficient electricity is than any other agent for the production of light.

The great hygienic advantage of the electric light when illumining our dwellings and our workshops, is not that it purifies the air, but that it prevents the air from being vitiated by the introduction into it of the products of combustion, such as carbonic acid, carbonic oxide, sulphurous oxide, &c. ; it prevents the air from being weakened by the abstraction of oxygen, and it prevents it from having its temperature raised by undue radiation, and by throwing into it heated gases.

ELECTRIC CARS IN LEEDS.—The Thomson-Houston Company has offered to equip a section of line in Leeds with electric cars, and pay a nominal rent of 100 guineas a year. If, on the expiration of two years, the Corporation decides to adopt electricity as the motive power upon the tramways, it will be able to take over the concern from the American company at a valuation. This will be no doubt favorably considered by the Highways Committee.—London *Electrical Review*.

* Abstract of paper read by W. H. Preece, before the Sanitary Institute at Brighton, England.

OPENING OF A NEW SUPPLY HOUSE.

On Monday, October 6th, the new electrical supply house of Alexander, Barney and Chapin, No. 20 Cortlandt street, this city, was formally opened. Invitations had been sent out several days previously to the friends of the firm, individually and collectively, to be present at the opening, at which a hearty reception would be accorded to all. The entire day, of course, was given up to social intercourse, and business was laid aside for the day. Hundreds of well-known electrical people called to extend congratulations to the firm and wish them abundant prosperity. In the rear of the spacious store an elegant collation was served to callers. The menu, which, for originality, surpasses anything we have ever seen, was as follows:

MENU.

OYSTERS.
Neutral Points.

SOUPS.
Crowfoot Zinc. Carbon. Blue Vitriol.

FISH.
Pikes. Poles. Nippers.

ALEXITE—BEST VINTAGE.

ENTRÉES.
Monkey-Wrench. Pony Magnetos. Turtle Gong.

ROASTS.
Joints, Insulated. Spring Jack. Buzzer.

EXTRA DRY BATTERY.

DESSERT.
Automatic Drops. Cones. Maple Balls.

COFFEE.
Porous Cups—no grounds.

CIGARS.
Electric Club.

How the articles mentioned can be cooked so as to completely disguise their real nature, and be made so palatable, is indeed a triumph of culinary art. Monkey-wrenches and pike poles went down hundreds of throats without encountering any resistance whatever, and if there was any tendency to over-heating, the parts were liberally lubricated with Alexite and an extra dry battery or two. One person thought he had a hair in his mouth from the butter but it turned out to be nothing more than a coil of Okonite wire, the end of which had got caught in his teeth.

The lunch was artistically gotten up by Mr. Stadler, the steward of the Electric Club. On the front of the card of invitation was the very appropriate quotation from the *Merchant of Venice*, "Sir, you are very welcome to our house," and the sentiment was literally true in its modern adaptation. All comers were, indeed, truly and heartily welcomed by the members of the firm, and felt at home and among friends as soon as the threshold was crossed. As each one entered he was invited to register his name and address in a book which the firm intends to keep as a permanent feature of the business.

Their establishment will be an electrical headquarters and exchange, and all electrical people from out-of-town will be welcome to make this place their headquarters. The register will be constantly kept open for the record of the names of visitors. It is similar to a hotel register, and if any one desires to know whether Mr. So and So is in town, all he has to do is to consult the "A. B. C." register.

Having thus discussed the social feature of the opening we will now consider it from a business standpoint.

While a great many goods remained unpacked, the shelves and cases were well filled. All the goods were displayed in a very effective manner, which fact was favorably commented on. The firm evidently believe that artistic display of their goods will create a good impression. And so it does, for it indicates order and business.

The firm carries an extensive line of Queen and Co.'s goods, which have a great reputation for accuracy and fine workmanship. One of the first orders received by the firm on opening day was for Queen & Co.'s instruments, to the value of $350. Such an order as this is a strong testimonial of confidence in the firm and in Queen & Co.'s instruments.

To enumerate the goods the new firm will handle would require a volume. Everything intimately or remotely connected with electricity may be found at their place, and the house will carry a complete line of central station supplies, including oils, packings and engine supplies.

The show windows were very attractive with the artistic arrangement of the goods therein, and within the store the general effect was most pleasing. Each member of the firm, Alexander, Barney and Chapin, was present all day receiving callers and congratulations, and made things as pleasant as possible for their guests. Mr A. B. Smith, the well-known electrical expert, has charge of the electric light department of the new firm, and this branch of the business is certainly in good hands.

The location of the store is a very advantageous one, being in the heart of the business section of the city and convenient to all of the railroad ferries. The store is handsomely finished in ash, and altogether is one of the finest situations that could be found anywhere for such a business.

The firm has a great many friends and they all join in congratulations and wishes for a prosperous career.

PATENTS.

Commissioner of Patents, C. E. Mitchell, recently submitted his report for the fiscal year 1889–1890 to the Secretary of the Interior. The most important part of the Commissioner's report is that portion in reference to the limitation of patents. He says:

It is provided by section 4887 of the Revised Statutes that every patent granted for an invention that has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or if there be more than one, at the same time with the one having the shortest term. It is believed that this section was intended to prevent foreign applicants from obtaining patents in the United States, of longer duration than the home patents previously taken out by them. Owing, however, to the unfortunate language employed in the statute, the courts have not been able to limit its construction to its intended scope and purpose. Its practical effect at the present time is to impose a penalty upon American inventors who patent their inventions abroad before their domestic patents are granted. There can be no sound reason for thus discriminating against the American inventor who patents his invention abroad. All persons competent to judge in the matter agree in the conclusion that section 4887 of the Revised Statutes should be modified so as to prevent a foreign patent previously obtained from affecting the duration of the American grant to the same inventor for the same invention. It should be added that by no method can the Patent Office always satisfy itself whether a foreign patent has been obtained or not. An application, for instance, may be pending in the British Patent Office six months and may become a patent two days in advance of the date of the American grant to the same inventor for the same invention. In such a case the American patent should, according to the provisions of the statute referred to, expire at the end of fourteen years from the date of the foreign application, that being the date on which the foreign patent would expire. But this Office can have no legal evidence that such a patent has been granted, nor can it ordinarily obtain any information, hearsay or otherwise, upon the subject. Indeed, the foreign patent may be granted after the American patent has been printed and before its signature, and even in that case the American grant is limited by the duration of the foreign term.

Again, the change proposed should be made, in order that the American inventors may have the benefit of the provisions of the International Union for the Protection of Industrial Property, of which union the United States is a member. By the terms of that Union, persons who have made applications for patents in one of the States constituting the union may within a definite period apply for a patent upon the same invention in the other countries belonging to the union without being prejuiced by intermediate acts, such as the publication or use of the patented article. The period now fixed for that purpose is six months, an additional month being allowed to countries beyond the sea, thus giving the citizens of the United States seven months from the filing date of their domestic applications within which to apply abroad without the loss of any rights existing at the date of the American application; but it is by no means an unusual thing for the American application to be much more than seven months in maturing into a patent. In a great many cases interference proceedings arise with other applications or prior patents. Sometimes several parties are involved in a contest for priority and a complicated trial results, extending over an unfortunately long period of time. In all such cases the American inventor must be deprived of the benefits designed to result from the Union for the Protection of Industrial Property, or he must apply for a foreign patent within the treaty period of seven months. In case he elects to accept the latter alternative, his foreign application is likely to mature into a patent before the obstacles to the granting of the American patent are removed, in which case section 4887 applies and limits the duration of the American patent, besides making it almost impossible to tell when the shortened term will expire.

In referring to the clerical force in the Patent Office, the Commissioner says:

The present force of the Patent Office is inadequate. I have no reason to believe that the great increase in the amount of work done during the past year has been accompanied by any deterioration in its quality. On the contrary, I believe that such is not the fact. At the same time it must be admitted that the pace kept up in the Patent Office now, as during all recent years, is inconsistent with that high degree of care in conducting examinations which the patent system calls for. The Government undertakes on behalf of the inventor not only to give him a patent if his improvement is new and useful, but to conduct a painstaking examination in order to ascertain what the fact is in that regard.

* * * * * * *

There can be no excuse, excepting inadequacy of force, for failure to make the examinations thorough and exhaustive, and inadequacy of force, though it may excuse the Patent Office, is no excuse for the Government.

* * * * * * *

Because, then, of the large increase in the number of applications for patents, and because of the necessity of more deliberate and exhaustive examination, and because of the fact that American inventors are already paying the necessary expenses, I recommend a substantial increase in the examining corps of the Patent Office.

CORRECTION.—In the article headed "Primary Batteries," on page 12 of our issue of October 4th, the name "Masuris" was a misprint for Mason. It should have read "the celebrated James H. Mason Primary Batteries," etc. These batteries are first-class ones, and Mr. Mason and not Mr. "Masuris" is entitled to all the credit for producing a primary battery that has many valuable features and no objectionable ones.

BELT DRIVING.

The following hints on belt driving are given by a prominent firm in Glasgow, Scotland, who are makers of belts. They will be found valuable to electric light station engineers, as satisfactory lighting depends largely upon the true running of the dynamo belt.

Before starting any new belt-driving arrangement, a thorough examination of the shafting and pulleys should be made. All ought to come under the test of the measuring-rod, the plumb, the level and square, because the best engineering is sometimes disarranged by the subsiding of the mason-work. We have found in our experience that the pulleys are so hung on the shafting as so remove the periphery from the centre of the pulley to one of the sides, with the result that when a start is made the belt seeks the highest point, and will travel off the pulley. We have also found that shafts which are not perfectly parallel have the same effect on the pulleys and belt. The very smallest departure from truth upon a shaft will make a considerable change upon the face of a pulley of large diameter hung upon that shaft.

All ordinary pulleys up to twelve inches broad should have a round or curve of not less than one-eighth of an inch; others, ranging up to twenty-four inches broad, should have a curve of not less than five-thirty-seconds of an inch; while the curve for such as are over twenty-four inches broad should not be less than one fourth inch. For pulleys twelve inches in diameter and under, running at very high speeds, the curve ought not to be less than double the foregoing.

Main driving belts save expensive breakdowns, the rumbling noise of gears, costly foundations, and the continual application of wheel grease.

Belting is a soft and most elastic transmitter of engine power. It is also the most economical and satisfactory driver.

A main driving belt transmits power in giant form, and without loss.

Textile ropes waste engine power. Each rope pulls for itself. As a body, such ropes work with unequal strain and traveling speed.

Every inch in width of good double leather belting, traveling at 500 feet per minute, will transmit one-horse power.

Every inch in width of good single leather belting, traveling at 800 feet per minute, will transmit one-horse power.

A comfortable working strain for a single belt is about fifty pounds for every inch of breadth, and for a double belt eighty pounds.

One or more belts running independently on the top of another will add much to the transmission of power.

A belt running with the flesh side next the pulley will wear longest, because it is working according to the natural growth of the hide.

A smooth and elastic driving face can be put on the flesh side of the belt by painting it over several times with a preparation made for the purpose.

If the slack side of a main driving belt runs in wave form, it is certain that the engine is getting more steam on one side of the piston than on the other.

A badly balanced pulley, running at a high speed, will impart an unsteady motion to the belt running on it. The machine so driven makes bad work.

Flanged pulleys destroy many good belts. A proper rounded pulley will retain the belt on the centre. A belt ought only to have contact with the pulley face.

A heated bearing will throw ropes out of the grooves or cause belts to leave the pulleys, sometimes leading to an expensive breakdown.

When a pulley has the appearance of polished silver, then be sure the belt is slipping. An application of belt grease is needed to cure this.

The driving side of a belt should be kept clammy. The belt will then run back without slip.

A belt slips only when it gets too heavy a load to drive, or when it gets dry and out of condition.

When a belt gets saturated with waste oil, an application of ground chalk will soon absorb the oil and make the belt workable.

Belting having joints cemented only is quite as good as if the belt were formed of solid leather from end to end. It lasts much longer and drives better than when cut up with sewing.

Belts running over pulleys of small diameter at high speeds ought to be as thin and as wide as possible. Orange-tan leather of uniform thickness answers remarkably well.

Thin belts, as wide as possible, give by far the best results working vertically. A thick vertical belt will not long hug the pulleys.

Orange-tan belting, either double or single, works much steadier than any other class for long-distance driving.

Orange-tan leather makes the best belt for running at high speeds, being light, tough and almost without stretch.

For machinery requiring the continuous shifting of the belt, single ox-hide or orange-tan leather is too thin; but double ox-hide is highly recommended.

Giraffe-hide belting, made of oak or orange-tan leather, is from three-eighths of an inch to five-eighths of an inch thick, very strong, and suitable to belts that have to be often shifted, such as driving self-acting mules, circular saws, iron planers, etc.

A cross belt should not be put on the pulleys in such a way as to cause the ends of the splice to meet at the place of crossing. If so, the joints will soon tear up.

The cushion of air retained between the pulley and a flat belt prevents perfect grip. By using leather-link belting there is no slip, as the air escapes between the links.

Leather chain belting, cut from the butt, when made to suit the round of the pulley, will transmit from twenty-five to thirty per cent. more power than a flat belt.

Chain belting, made of orange-tan butt leather, is very suitable for all sorts of drives. For running electric-lighting plant, engineers' tools and wood-cutting machinery, it beats all others.

Pulleys on which leather-link chain belting is working very soon assume a dull lead color, indicating that there is no loss from slip.

For quarter twisting driving, and working on tapered cones, the patent thick-sided leather chain belt is proving a very great success.

Orange-tan leather rope, one inch square, running at 3,000 feet per minute, on pulleys not less than four feet in diameter, will transmit 40-horse power.

Long-staple cotton belting works very satisfactorily in warm climates, paper mills, wet spinning-mills and dyeworks, and for outside driving in all weathers. It is almost without stretch.

Llama-hair belting is the strongest hair belt made, and is most suitable for warm climates wet atmospheres. It is non-extensible.

For outside driving, Llama-hair and cotton belting require no other covering than a coating of boiled oil painted over them now and again.

A circular saw belt ought not to be narrower than one-fourth of the diameter of the saw. The spindle pulley should be as great in diameter as the width of the belt.

Do not grudge an extra inch of belt where there is pulley width.

Belts should have pulleys of as large diameter as possible to work upon.

A good machine is most valuable when driven by a proper belt.

An overworked belt gives much vexing trouble, and wastes more money than can readily be counted.

An underworked belt never ruffles the temper of its owner. The volume of its work is constant and steady.

Good belting keeps the machine fully employed.

Cheap belting, so called, is as unsatisfactory for heavy work as cheap boots are for heavy weather.

Never allow dust to cake upon the pulley or belt. The lumps so formed prevent the belt from having proper pulley contact.

When a belt breaks from fair strain, bursts nearly straight across at the weakest part When a belt is broken diagonally across the solid leather, then be sure it is torn by something else than fair strain.

ELECTRIC LIGHTING IN ENGLAND.

The progress of electric lighting in England has been very much checked by inordinate speculation, and by terrible failures in some of the earlier work done. There is something very captivating in the practical applications of electricity, and something romantic in its mystery. The neophyte has rushed into it with remarkable fervor, and the lessons of failure have in consequence been very severe. The users of the light have also been paying heavily for the education and experience of amateur tradesmen and inexperienced contractors, and have neglected to avail themselves of the professional services of the experienced electrical engi eer. People who would not build houses without the architect, nor construct bridges without the engineer, nor make their wills without the lawyer, rush wildly into the use of electricity without any professional assistance, where above all things, experience and knowledge are essential to prevent disaster and disappointment. Large installations have been completed without specifications to guide the contractor, and without inspection to see that the work has been properly done. The user has paid violently for his temerity, and fires and accidents have been the result. The heavy price of wiring a rented house, and the expensive character of the fittings proposed, have deterred many from adopting the light, even when it is within their reach. Highly insulated wire is unfortunately expensive. All cheap wires are nasty and dangerous. There is nothing that becomes the electric light better than simplicity, and its effect is frequently marred by elaborate brass work. It possesses also most active and widespread opponents, both in oil and gas—opponents who have benefitted by its introduction, and who are not slow to profit by its advance. The improvements in gas and oil lamps are as marked as the advancements in electric light, and as means of artificial illumination alone—that is as far as light giving power is concerned—there is little choice between the three, but oil and gas cannot lose those elements of discomfort and ill-health which differentiate them from the cool and pure glow lamp.—*London Electrical Review.*

WATER POWER FOR ELECTRIC LIGHT PLANT.—At Innsbruck, Austria, there is in course of construction a central station to be run by water power. The following facts in connection with this installation will be of interest: There is a waterfall at Muehlau, near Innsbruck, capable of furnishing a maximum of 600 H.P. The fall is 117 metres, giving a pressure upon the turbines of about 11.5 atmospheres. The water is led through pipes, 350 millimetres in diameter, to a pair of vertical turbines of 160 H.P. each. These turbines run at 250 revolutions per minute, and are coupled, direct, to two alternators, each capable of producing 40 amperes with 2,000 volts. There are two exciters running at 700 revolutions per minute, giving 60 amperes and 110 volts. The present capacity is 2,000 lamps of 16 C.P. each. The high tension current is carried on overhead conductors (eight mm. diameter) to a distance of about four kilometres till it reaches the outskirts of the town of Innsbruck: from there the current is distributed through a concentric main 5.86 kilometres in length.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Oct. 11, 1890.

Mr. W. P. Adams, general manager of the Western Power Construction Company, left town Wednesday for a week's trip to New York and Boston.

The Western Power Construction Company have closed a contract with the Chicago Edison Company for the placing of another 200-horse power engine in their station. This will make the seventh engine of this capacity installed for the Edison Company by the Western Power Construction Company.

The McIntosh Battery and Optical Company have a large and attractive exhibit at the Inter-State Exposition in this city. A prominent feature of their exhibit is a handsome electro-medical cabinet. Other electrical features are electro-static induction machines, medical batteries, testing instruments, etc.

The Chicago Electric Transit Company has been formed with a capital stock of $12,000,000. Incorporators: J. M. Hannahs, W. H. Powell and G. W. Stanford. This company proposes the building of an extended elevated electric railway from the Chicago River over the northern portion of the city, and also extending its operations to the district south of the river. Mr. Hannahs, the promoter of the enterprise, says that as soon as a franchise has been secured from the council, plenty of money will be forthcoming to make the road a reality.

The Central Electric Company are decorating their handsome store with a fine line of high class electroliers and single brackets. This department of their immense business is becoming a very important one and the most fastidious taste in this line can be satisfied by examining their stock of these goods. The Central Electric Company have made advantageous arrangements to furnish telegraph, telephone and electric light poles at the lowest market rates, having established, here in Chicago, a yard where they will keep on hand a full stock at all times.

When the Central Electric Company moved into its present quarters, 116 and 118 Franklin street, last January, it was thought that the immense floor space would be sufficient for a healthy increase of the business for five years, at least, but in less than six months they have been crowded for storage room and have had to go outside to obtain relief. This is evidence of the immense growth in the electrical business generally, but it is particularly expressive of the success of the Central Electric Company. It is not hard to account for this success, as a glance through the establishment will show any one at all familiar with the technique of the business that the Central have gathered to themselves a list of high class specialties that are in constant demand and could not help making any concern of healthy business methods grow. The personnel are men of tried merit and experience in the business and attend closely to the needs of their patrons and deserve success. The orders received for Okonite wire by the Central Electric Company, within the past week, have been greater than ever before in the history of the business, and this speaks volumes for this excellent and unsurpassed wire, as there have sprung up many competitors that have attempted to challenge Okonite, but Okonite still maintains its lead and high prestige. F. M. I.

ELECTRICITY ON ELEVATED RAILROADS.—In a recent interview with Jay Gould on the subject of rapid transit, that gentleman very significantly remarked that "experiments with electricity as a motive power are progressing and it seems a question of comparatively short time when it will be adopted on the elevated railroads."

NEW YORK NOTES.

The John Stephenson Company will be most ably represented at the convention by two of its enterprising salesmen.

The new electrical supply firm of Alexander, Barney and Chapin, at 20 Cortlandt street, are engaged in the preparation of a catalogue of their goods, which will be ready for distribution soon.

Dr. S. S. Wheeler delivered an interesting lecture on "Every Day Uses of Electricity," before the Harlem branch of the Young Men's Christian Association, on Saturday night, October 11th.

James Collier, ex-manager of the Union Square Theatre in this city, has patented an electrical device, of which, it is said, Mr. Edison has given his approval. The invention is a sort of continuous magic lantern, and when in operation projects pictures one after another on a properly arranged screen.

Mr. James F. Kelly, general manager of the wire department of the Edison General Electric Company has a large reputation for whole-souled activity in business, and is one of the most successful managers that can be found anywhere in active life. When he assumed charge of the wire business the sales for the first year aggregated $40,000; since then he has been multiplying the figures in an astonishing manner. Last month alone he effected sales to the amount of $100,000.

James A. Trimble, manufacturer of railroad car wood work, No. 218 East Twenty-eighth street, is doing a rushing business. He is enlarging his plant and will, in about a month, begin the construction of a large number of cars for which he has already contracted. Specimens of his work are to be seen in Savannah, Ga., Jersey City, N. J., Washington, Chicago and several other cities. Unless something unexpected transpires he will be in attendance at the convention in Buffalo, on the 15th inst., to laud the praises of his wares to such of the trades as do not already appreciate them.

Mr. James H. Mason, the well-known manufacturer of the Mason Primary Battery, has just enlarged his factory in Brooklyn, in order to accommodate his rapidly increasing business. The new building is of brick, two stories high and covers an area of 20x55 feet. It is connected with the old one by a passage way 10 feet wide by 18 long. When Mr. Mason erected the old factory he miscalculated the proportions of the business that he would have in the near future, and it is gratifying to note that the merits of his battery have and are being honestly recognized. Mr. Mason's enlarged factory is at 118 and 120 Park avenue, Brooklyn.

One night last week a messenger boy, who is old enough to have known better, amused himself in the office of one of the morning papers by cutting with a knife the wires of one of the incandescent light circuits, "for the purpose," as he said afterwards, "of finding out whether he could get a shock." His curiosity was of course satisfied. The lights went out with a bang, and before the astonished experimenter had time to recover his equilibrium he was fallen upon by the 200-pound religious editor, who, owing to the darkness, had not seen him. While the good man expounded a sermon that would never look well in cold type the boy made good his escape. The blade was burned completely in two, and had the boy's hand come in direct contact with the metal his obituary would in all probability have taken the place of this article.

Many of the members of the British Iron and Steel Institute, which society held its meeting recently in Chickering Hall, made a tour of some of the electrical establishments in this city, under the guidance of Dr. S. S. Wheeler, expert of the Board of electrical control. They inspected the Telephone Exchange at No. 18 Cortlandt st., the Western Union Company's headquarters, the Brush Electric Light Company's works in Elizabeth street, the Edison Station in Twenty-eighth street and several of the downtown electric lighting plants. The subway system and its workings were explained to the scientists by Expert Wheeler, and an inspection of the interior of the Broadway subway, as far as practicable, was made. Several of the subway manholes along the route were raised and examined. R. J. G.

COMBINATION ELECTRIC CAR.

An exhibit that will attract attention at the convention at Buffalo will be that of the Pullman and other companies who have combined to equip a very handsome car for the occasion. The car is a combination car, about one-fourth of the forward end being divided off for smoking compartment. In the centre of this compartment is a space for the driver, the seats being placed about this space and facing outward. The front of the car consists of curved glass, and the compartment is finished in oak and furnished with cushions covered with stamped leather. The passenger compartment is finished in mahogany. The seats are placed back to back so as to face outward and are covered with blue and gold tapestry. The ceiling in both compartments is of white wood decorated. The car will be lighted with one oil lamp and twenty incandescent lamps on the inside, and will have five lights and an electric headlight on the outside. The outside of the car will be white, the one word which it will bear and the decorations being gold. The car is 34 feet in length and 8 feet in width. Bronze rods support the hood both in front and rear, and the dashboards are of figured perforated bronze. The steps are the Stanwood steel insulated steps. Other features of the car are after the pattern of the palace sleeping cars made by the Pullman Company. Various companies have united in furnishing the other portions of the car. The electric equipment is that of the Westinghouse Company and will afford an opportunity to the many interested visitors at the convention to examine this system which has found so much favor in the short time it has been placed on the market. The trucks are furnished by the Maguire Manufacturing Co., and are what are known as the Hubbard Truck. The wheels were made by the Allen Paper Car Wheel Company, are 30 inches in diameter and are steel tired. The Session's Air Brake is used on the car. This car, which has been prepared with every attention to detail and to elegance, will be operated either on the local line or on a line constructed especially for the purpose during the entire continuance of the convention.

THE BROOKLYN INSTITUTE.

On October 10th, A. C. Robbins read a paper before the electrical department of the Brooklyn Institute, entitled "Some of the Engineering Problems connected with the re-establishment of the Western Union Telegraph Company, after its recent fire in New York City."

The paper, for the most part, is the story of the fire, the difficulties encountered in the re-establishment of telegraphic communication with the outside world, and the final triumph of skill and energy over what seemed insurmountable difficulties. The story is told in an interesting way, and the facts given therein are reliable.

"For the quadruplex proportional resistances," says the lecturer, "incandescent lamps were used until the proper resistance coils could be obtained. While the lamps, as a makeshift answered fairly well, I cannot say that I consider them a decided success, as they are too sensitive to changes of temperature."

A serious difficulty experienced was the want of a battery room. No room was available for

this purpose, except some shelves in the halls, and boxes under the desks. This was overcome by using the Edison-Lalande caustic soda battery, which, while of low pressure, furnishes quantity sufficient for from 8 to 10 circuits from one battery. There are five local circuits on each set of quadruplex instruments, these circuits ordinarily require 10 cells of gravity battery; four cells of the caustic soda battery has been found ample to work the local circuits of two sets of quadruplex, a saving of 16 cells, or 80 per cent. in battery room. The same percentage was secured in saving of battery room for the local batteries of the multiplex city loops, several loops being supplied from one battery.

The 20,000 cells of battery used previous to the fire have been replaced by 1,750 cells.

For several years past the dynamo has provided current for the main circuits from New York. A potential of 70 volts, regulated by a system of joint resistance, multiple supply, has been applied for supplying the loop locals. For intermediate batteries special apparatus is required for each battery. A one-eighth horse-power motor is by current from the building incandescent lamp circuit, run at a speed of about 2,200 revolutions per minute. This motor in its turn operates a generator of equal size and at about the same rate of speed, from which is obtained a current potential of about 100 volts sufficient for all intermediate battery purposes. The saving in room is 40 square feet for each intermediate battery. About 50 intermediate batteries were formerly used, but the number will probably be reduced somewhat.

ELECTRIC WELDING.—It will be of interest to note that the welding performed in connection with Prof. Elihu Thomson's paper read before the meeting of the Iron and Steel Institute in this city recently, was by C. E. Harthan, foreman of the Welding department at the factory in Lynn, Mass. Mr. Harthan has the title of champion welder of the world. The welding plant was in charge of Mr. W. H. Doughty, construction expert of the Thomson Electric Welding Company. The development of Electric Welding has produced many experts in this important industry. Among these are P. J. Reily, W. D. Hills, G. Wilmarth, Geo. De Lacy and F. E. Hatch, all of whom are in the employ of the company.

FRANKLIN INSTITUTE LECTURES.—Among the lectures to be delivered before the Franklin Institute, Philadelphia, during the season 1890–91, are the following: Dec. 15, 1890, "Two and a Half Miles a Minute," by Prof. W. D. Marks; Jan. 9, 1891, "Electricity as the Rival of Steam," by Dr. Louis Bell; Jan. 26, 1891, "Inductions of Electric Currents and Induction Coils," by Prof. Elihu Thomson.

ELECTRIC RAILWAYS.—A contract has just been closed by the Detroit Electrical Works, for the full electrical equipment of a street railway in Nashville, Tenn. The Rae system will be used. The same company equipped the Calumet Electric Street Railway, of Chicago, throughout with the Rae system. This road was successfully opened to the public, on Saturday, October 4th, and is Chicago's first electric railroad. It has been received with so much favor that extensions are already being arranged for.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED OCTOBER 7TH, 1890.

437,673. Electric Valve Controller. Louis Bell and Frank H. Root, Chicago, Ill. Filed June 18, 1890.

437,682. Electric Safe-Lock. George L. Damon, Boston, Mass. Filed Dec. 13, 1889.

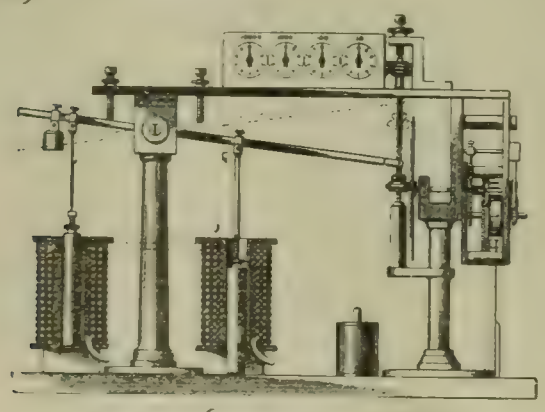
437,685. Insulator. Thomas F. Gaynor, Louisville, Ky., assignor to the Gaynor Electric Company, same place. Filed Jan. 24, 1888.

437,704. Regulator for Electric Generators and Motors. Robert Lundell, New York, N. Y. Filed Nov. 23, 1889.

437,720. Conduit Electric Railway. Ernest M. Reed, Wichita, Kans. Filed Mar. 10, 1890.

437,754. Electric Meter. Jacob Einstein and Sebastian Kornprobst, Munich, Germany. Filed Jan. 14, 1890.

437,763. Electric Meter. Anthony Reckenzaum, Clapham, England, assignor by direct and mesne assignments, of part to A. J. De Camp, Charles D. Norton, Charles M. Blanchard, S. M. Buckman, James A. Pentz, Charles Schaffer, Lincoln Godfrey, George W. Hewitt, Erwin Agnew, and L. Webster Fox. Filed Aug. 3, 1889.



NO. 437,763. ELECTRIC METER.

437,767. Arc Lamp. Ralph H. Beach, St. Paul, Minn., assignor to the Acme Electric Company, of Minnesota. Filed Jan. 25, 1890.

437,771. Electric Steam Generator and Water Heater, Henry R. Butterfield, Waterville, Me. Filed Sept. 12, 1889. Renewed May 15, 1890.

437,772. Burglar-Alarm. Crawford R. Canterbury, Brownwood, Tex. Filed May 15, 1890.

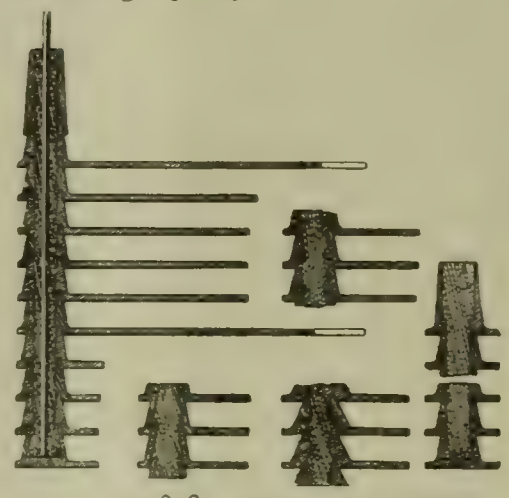
437,789. Electric Ceiling Block. Albert E. Nicholas, Leeds, England. Filed Mar. 25, 1890.

437,798. Electric Guest-Call. George F. Ransom, Minneapolis, Minn., assignor of one-half to George L. Hilt, same place. Filed Mar. 21, 1890.

437,832. Electric Motor. Julius Emmner, Jr., Washington, D. C. Filed Aug. 13, 1889. Renewed Sept. 11, 1890.

437,835. Electric Motor. George Little and George Judge Little, Passaic, N. J.; said George Judge Little, assignor to George Little. Filed Jan. 16, 1886. Renewed May 8, 1888. Again renewed Apr. 19, 1890.

437,844. Commutator. Harry H. Blades, Detroit, Mich., assignor to the Detroit Motor Company, same place. Filed Nov. 12, 1888. Renewed Aug. 13, 1890.



NO. 437,848. SECONDARY BATTERY.

437,848. Secondary Battery. Henry Lampert, Jr., Chicago, Ill. Filed Jan. 31, 1889.

437,851. Electric Light Fixture. James E. Brown, Brooklyn, N. Y., assignor to the Archer & Pancoast Manufacturing Company, of New York. Filed June 21, 1890.

437,859. Electrical Transmitter and Indicator. Dennis Kelley and Melville C. Parkhurst, Somerville, Mass. Filed Jan. 24, 1890.

437,868. Galvanometer Andrew M. Ritchie, Brookline, Mass. Filed Feb 18, 1890.

437,883. Pulley Attachment for Electric Lamps. Thos. H. Brady, New Britain, Conn. Filed Mar. 19, 1890.

437,901. Electric-Arc Lamp. Charles W. Hazeltine, St. Louis, Mo., assignor to himself and the Parker-Russell Mining and Manufacturing Company, same place. Filed July 9, 1890.

437,905. Electric Advertising Clock. Moritz Levi, New York, N. Y., assignor of one-half to Rasmus Forsholn, same place. Filed June 26, 1890.

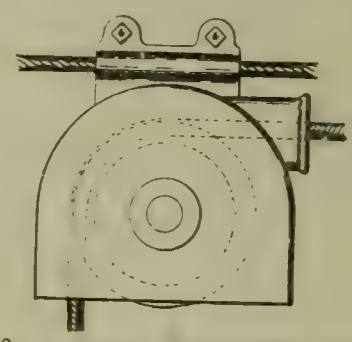
437,913. Covering for Electric Wire. David Brooks, Jr., Philadelphia, Pa, assignor to the Electric Cable Construction and Maintenance Company, of Pennsylvania. Filed Nov. 7, 1889.

437,926. Galvanometer. Thomas Harris, Detroit, Mich., assignor of three-fourths to Nathan T. Thurber, Alfred Lucking, and Henry F. De B. Cameron, same place. Filed Jan. 24, 1890.

437,927. Telephone-Support. Fred. C. Hughes, Detroit, Mich. Filed May 19, 1890.

437,930. Receiving Instrument for Telegraphy. Willard M. Miner, Plainfield, assignor to James M. Seymour, Brick Church, N. J. Filed May 28, 1890.

437,946. Brush-Holder for Electric Motors. Edgar A. Sweet, Milford, Mass., assignor of one-half to Charles W. Shippee, same place. Filed May 31, 1890.



NO. 437,883. PULLEY ATTACHMENT FOR ELECTRIC LAMPS.

437,953. Conduit and Electric Conducting-Rail Therefor. Joseph H. Wehrle, Newark, N. J. Filed Jan. 27, 1890.

437,961. Trolley. Isaac F. Baker, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Nov. 18, 1889.

437,986. Telephone System. Alfred Graham, London, England, assignor to the Consolidated Telephone Construction and Maintenance Company, Limited, same place. Filed Dec. 27, 1889. Patented in England.

438,003. Aerial Conduit for Electric Conductors. Adolphus A. Knudson, Brooklyn, N. Y. Filed Aug. 16, 1890.

438,036. Pole for Electric Wires, &c. Edmond Verstraete, St. Louis. Mo., assignor of one-half to Peter M. Kling and George J. Kobush, same place. Filed Dec. 27, 1889.

438,037. Rheostat. Joseph C. Vetter, New York, N. Y. Filed Nov. 5, 1889.

438,041. Metal and Circuit Detector. Robert L. Watkins, New York, N. Y. Filed May 10, 1890.

ELECTRICAL ENGINEERING AT CORNELL UNIVERSITY.

The mechanical and electrical engineering department began the year with increased facilities, and increased number of students. During the summer just past, extensive improvements have been made in all branches of these departments.

Franklin Hall is now given up entirely to the electricians, the chemical department having been removed to the new building. This building is 60x200 feet, and four stories high. It furnishes laboratory accommodations for 1,000 students. A new dynamo room has been fitted up for the electrical department. It covers a floor, space 60x100 and contains the following machines:—six small Westinghouse dynamos, three Weston, six Edison, one Stanley alternator, three Thomson-Houston, one Waterhouse, one Ball, one Mather, one Siemens-Halske, one Gramme; one Brush motor, one Tesla motor, two Sprague motors and a half dozen or more dynamos and motors constructed at the University. Power is furnished by two engines, Ide 40 horse-power and Straight Line 30 horse-power, and also by a 75 horse power turbine. In one side of the room is placed the switch-board, 200 terminals, recently designed by Prof. Moler.

The new engine testing room and electric lighting station adjoins the dynamo room. This room contains six engines and a number of dynamos as follows:—two Straight Lines, 30 h. p. each, one Payne engine, 25 h. p.; one 75 h. p. Westinghouse compound, a 20 h. p. Westinghouse and a 60 h. p. engine built by the Lansing Engine Works, Lansing, Mich. For lighting the University buildings and Campus, the following dynamos are used: one 600 light Edison incandescent, one Westinghouse alternating arc, also Westinghouse incandescent, and a large United States arc dynamo.

Prof. Snow of the electrical department is studying in Europe this year.

Geo. Shepardson, R. G. '89, has been made an instructor in electrical engineering here.

J. S. Loomis, E. E. '90, and S. B. Fortenbough, E. E. '90 are connected with the Brush Electric Works, in Cleveland, Ohio.

J. E. Greenwalt, '90, W. H. Powell, '90, and W. W. Churchill, R. G. '90 are with the Westinghouse Company.

L. B. Marks, R. G. '90 is manager of the Washington Carbon Works, at Washington, Pa.

ELECTRICITY ON THE FARM.—A farmer in Westchester County, New York, has been making some experiments with electricity as applied to germination of seeds, says an exchange. His method was to give his vegetables a shock from a battery, and the result was, so the story goes, his crop was a month in advance of his neighbor's. His cabbages flourished marvellously under the influence of the electric shock.

PULLMAN CARS FOR ELECTRIC RAIL WAYS.

Among orders recently received by the Pullman Palace Car Co., for electric street railway equipment, are the following:

One closed car, Elmer A. Sperry Co., Chicago, Ill.

Seven closed cars, Colorado Springs Rapid Transit Railway Company, Colorado Springs, Colorado.

Forty closed cars, Pittsburgh, Allegheny and Manchester Traction Company, Pittsburg, Pa.

Twenty-five closed cars. West End Street Railway Company, Boston, Mass.

Fifteen closed cars, Toledo Consolidated Street Railway Company, Toledo, Ohio.

One open and two closed cars, E. E. Chase, for service in Fort Worth, Texas.

Twenty-four combination open and closed cars, Tacoma Railway and Motor Company, Tacoma, Washington.

The Pullman Palace Car Company is to operate an electric road themselves at Pullman, Ill., where they have their works, and among the equipment to be placed in service on this road is a double deck car.

NICKEL-IN-THE-SLOT FOR EVERYTHING.—The nickle-in-the-slot machines are to have a new application says an exchange. The gas companies are making arrangements to use them in connection with gas metres in the dwellings of the poor. You want a light for an evening. You drop a penny in the slot, turn on the gas and light it. It burns just as long as a penny's worth will last, and then goes out. To get more light, you drop another penny in the slot. In Paris they already have machines which, when fed with a small coin, will hand out a cup of hot coffee and a roll. On railway cars at night you drop a few centimes in a slot and get an electric light at your elbow to read by. The Yankee nation must look to its laurels for ingenuity.

NEW ELECTRIC CAR.—Mr. Elmer A. Sperry, of this city, has recently perfected an electric street car, which has made several successful runs on the experimental line at Pullman, Ill. The car is a double truck (eight wheel) one, and the motor is elastically suspended under the centre of the car. From the motor elastic driving connections are made to all the axles, so that the power is applied alike to each wheel of the car. The new electric brake devised by Mr. Sperry, mention of tests with which was made in this column some weeks ago, is applied to this car. This car has been favorably commented upon by prominent street railway engineers, and it is not unlikely it will prove a factor in the railway field of the near future.

ELECTRIC LIGHT IN FLORIDA.—Mr. H. C. Sloan of Lakeland, Fla., proposes to erect an electric light plant in that city very shortly.

BROOKLYN INSTITUTE.—At the annual meeting of the department of electricity of the Brooklyn Institute, held October 10th, the following officers were elected:

President—James Hamblet.
First Vice-President—Prof. Samuel Sheldon.
Second Vice-President—J. P. Wintringham.
Secretary—W. H. Randall.
Treasurer—R. W. Bayrass.

Professor S. S. Wheeler will deliver a lecture before the institute on October 24th.

AMERICAN STREET RAILWAY ASSOCIATION.—Ninth annual meeting held at Hotel Iroquois, Buffalo, New York, Oct. 15, 16, and 17, 1890. Officers for 1890: President, Thomas Lowry, Minneapolis, Minn.; First Vice-President, C. Densmore Wyman, New York, N. Y.; Second Vice-President, John C. Shaffer, Indianapolis, Ind.; Third Vice-President, Robert McCulloch, St. Louis, Mo.; Secretary and Treasurer, William J. Richardson, Brooklyn, N. Y. Executive Committee: President Vice-Presidents and George B. Kerper, George W. Kiely, Frank H. Monks, Raphael Semmes, Francis M. Eppley.

The Accumulator Company of New York has closed a contract with the Dubuque Street Railway Company for six Edco cars operated by the accumulator system. Mr. J. A. Rohmberg, president of the Dubuque Street Railway Company, after having tested the system for three months with satisfaction, placed this first order with the intention of equipping the whole system with the Edco outfit. Mr. D. H. Bates, the president of the Accumulator Company will be present at Buffalo.

ENGRAVING ON GLASS BY ELECTRICITY.—Mr. Plantés new process of engraving on glass and crystal by electricity is found capable of producing results of marvellous delicacy. The plate to be engraved is covered with a concentrated solution of nitrate of potash and put in connection with one of the poles of the battery, the design being traced out with a fine platinum point connected to the other pole.

The Central Electric Company have furnished the Davenport Street Railway Company with their entire supply equipment, consisting of 110,000 pounds copper wire, and 50,000 pounds improved Candee wire. Candee wire has had quite a success in railway work, and it has proved equal to the severity of the tests placed upon it.

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1 Key Socket	1.20
1 Shade and Holder	.50
50 Feet of Insulated Electric Wire	.50
2 Charges of Depolarizer (will run 40 hours)	.40
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***PLANT NO. 3.**

6 No. 9 Cells at $1.25	$7.50
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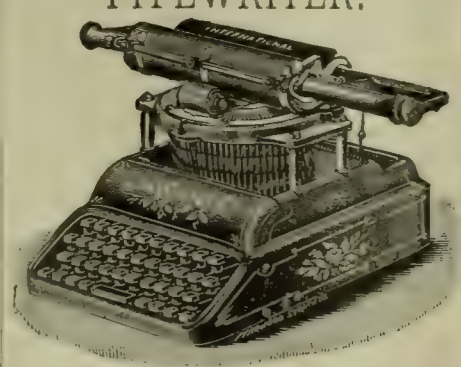
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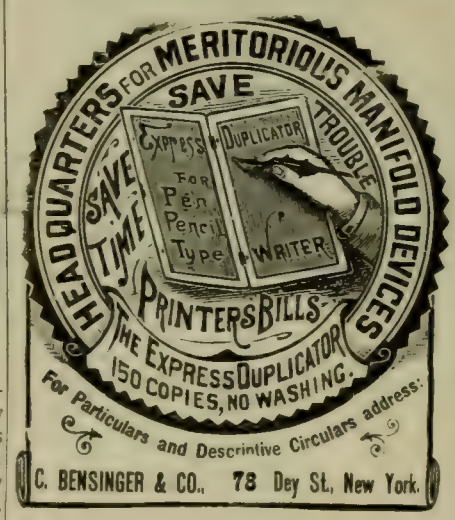
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THE STREET RAILWAY CONVENTION.

Street railway men, from all parts of the country, met in Buffalo last week and were made acquainted with electricity as applied to street railway uses. The many builders of electric cars had beautiful specimens of their goods on exhibition, and manufacturers and dealers in everything that is used in the equipment of electric railways took advantage of the opportunity to bring their goods to the notice of the assembled street railway managers.

The electric cars on exhibition were indeed works of art, and were a revelation to a great many who never had had the opportunity of seeing a modern electric car.

We venture to assert that the outcome of this convention will be a tremendous boom for the electric railway, and that the builders and furnishers of this class of roads realized the great importance of being in attendance is shown in the fact that they were there in full force with elegant specimens of their wares.

The railroad companies themselves, too, will receive a goodly share of the boom. Popular favor is strong for the electric railway. It is the ideal method of suburban travel, and the people like it because it offers many important advantages over the horse car. The latter is now looked upon as an anachronism, and justly so, for when the slow going horse car is considered in connection with the advanced position we occupy in actual life by reason of the use of electricity, it, indeed, does seem strange that we still should have with us that ancient vehicle.

There is abundant evidence, however, that its decadence is drawing to a close, and before long it will be a thing of the past. It will be looked upon just as we now look upon the stage coach of the past as compared with the steam locomotive of to-day. It was in the order of things, however, that we should have horse cars. We have had them, and they have outlived their day. Now comes the term of the electric railway and it seems to have a brilliant future before it.

The general interest taken in electricity, as a means of street car propulsion, by street railway managers, is a sure indication that the leaven is doing its work, and they realize the necessity of falling in line with public sentiment. Street car managers, as a rule, are a wide-awake set of men, and they seem at all times ready and willing to adopt the best of everything in their line that comes along, although they are occasionally made the target of criticism on the part of the press and individuals. But on the whole they do the best they can, and the interest they show in the new power is unquestionable evidence that they are watching out for the public interest as well as their own.

The more they please the public the better it will be for them. The public are like individuals; they have what may be called notions, or hobbies. The electric railway is the hobby at present. It is a hobby that is worth encouraging, however.

ELECTRIC RAILWAYS TO THE SUBURBS.—On account of the geographical limitations of New York city thousands of its business people seek homes outside of the city. Within the area described by a circle of a radius of thirty miles from the City Hall there are scores of beautiful towns which are considered the suburbs of the city and which are in the main inhabited by New York business men. Some of these segregated communities are large cities in themselves, notably the Oranges, Montclair, and Morristown in New Jersey, and Yonkers, N. Y., and are, in one sense part of the great city, although separated from it by many miles. The carrying of these people to and from the city, daily, is a tax upon the various railroads centering in New York that is almost overwhelming, and the suburban traffic is constantly increasing. Many of the railroads are now running trains as frequently as safety will permit, and yet the facilities are quite inadequate. It would seem that the electric railway could step in here and get a good share of this most profitable traffic. Electric railways running from New York, Jersey City and Hoboken, and Brooklyn, in different directions, taking in the near-by towns, would, we think, yield a handsome profit to the investor in such properties. Many people living in near-by places would prefer the clean and unobjectionable electric cars to the trains hauled by soft coal burning locomotive engines. We think that this field offers an excellent opportunity for the highest development of the electric railway. Many of the suburban places already have electric cars in operation within their corporate limits, and the extension of these from town to town would not meet with half of the engineering and other difficulties that have to be overcome in the building of an electric road in a thickly settled community.

THE TELEPHONE AS A RIVAL TO THE TELEGRAPH.—There is already talk about another increase in the capital of the American Bell Telephone Company, which is preparing to extend the long-distance system rapidly, so that in 1892, when its Western Union contracts and some of its fundamental patents expire, it will be in a position to supplant the telegraph in many places and the same time improve its service, so that the expired patents will be of less importance to thenew rivals that may spring up.

INSULATION FORMULA.—In a recent issue of *La Lumière Electrique*, M. Jacquin gives the following formula for the insulation resistance of cables carrying high-pressure currents:—$M = p\frac{1}{E}$, in which p is the total insulation resistance, 1 the total length in kilometres, and E the pressure in volts. The coefficient M is 400,000 ohms per volt per kilometre of cable used; and M. Jacquin considers a cable to have become unsafe if M has decreased to 10,000 ohms per volt per kilometre.

THE OVERHEAD WIRE SYSTEM OF ELECTRIC RAILWAYS.

If Dr. Allen, of Davenport, Iowa, represents the sentiment of the Street Railway Association, the overhead wire system of electric railways, that system is strongly fortified against the attacks of its opponents. "Are we not all personally believers in the overhead system of transmission?" he asks in his paper read before the convention at Buffalo last week. "What can there be more simple, cheap, more durable and more convenient." he continues.

He is right in asserting that the overhead system is simple. It is extremely so, and that is one reason why it is growing more and more popular—because the people can understand it.

The imaginary terrors that the overhead electric railway wires have for some misguided people are dying out, as they learn that there is no just foundation for any fears in that direction.

The system is cheap, and that is a very good reason why it should appeal to the street railroad manager. It is possible, of course, that a thing may be cheap and devoid of any other desirable quality. But here is something that is cheap, and really possesses many other valuable points. Besides being cheap, it is simple, durable and convenient—all most desirable features in a street railway equipment. Street railway managers that are luke warm on the subject of electricity should keep those qualities enumerated prominently before them. The claims can be abundantly substantiated, and we have yet to hear of the first case where any dissatisfaction resulted or exists through the change from horse-power to electrical power. On the contrary, the reports invariably show that the people are better pleased with the service and the operating companies are more prosperous.

HORSES AND MULES *vs.* ELECTRICITY.—Mules and horses are unfortunate in not being intelligent animals, or they might have at the Buffalo Convention offered a vigorous protest and kick against the tendency, on the part of street-railroad men, to supplant them with electricity. The future for the horse and mule really begins to look serious. When all classes of vehicles, from the junk cart to the fashionable carriage, are propelled by electricity, what shall be done with those useful, (or useless, animals?) They might be used to furnish the power to the dynamos for the purpose of charging the accumulators. In this case they would supply the propelling power for the vehicles just as they did before, only in another way. We offer this suggestion for the consideration of promoters of electrical enterprises.

ELECTRO MAGNETS.—It requires considerable courage to stand up before the world of science and say that all of the text books in any one branch of science are wrong in their statement of supposed facts, but this is precisely what Prof. Silvanus P. Thompson has done. All text books in electricity state, for instance, that the attraction of an electro-magnet for its armature varies inversely as the square of its distance from the poles. Prof. Thompson now comes forward and says that this is wrong, although he does not state how it actually does vary. On another page will be found enumerated several facts and fallacies concerning electro-magnets, which Prof. Thompson gives at the close of a recent lecture in London on the electro-magnet. They will be read with much interest, because they upset some of our previously acquired notions concerning that important instrument.

THE INFANT ELECTRICITY.—We very often hear it said that electricity is yet in its infancy. What it will be when it grows up to manhood no one is rash enough to predict. As an infant, however, it is the richest infant in existence. In this country alone it represents a value of six hundred millions of dollars, and in its employ there are no less than 250,000 persons. Electricity is, in more than one sense, a great power in the land.

THE FEIGEL CARS.

We present herewith engravings of two elegant street cars, which are now attracting general attention in the street car world. These are of the manufacture of the Feigel Car Company, 108 Wall street, New York. One of the cars is 26 feet long, and the other 33 feet. They are trimmed in mahogany, with spring seats and backs and are covered with the best Brussels carpet. Two elegant centre lamps are placed



FIG. 1.—FEIGEL CAR, 33 FEET.

on the curled oak veneered ceiling, which is decorated in gold. The stoves are placed under the seats, where are also four sand boxes. The trimmings are of bronze. Many of this style of cars have recently been placed on the two Newark, N. J., roads, where the double trucks on the larger cars are attracting general attention.

IMPROVED CABLE INSULATION.

Mr. David Brooks, jr., of Philadelphia, has recently invented and patented a valuable improvement in protective coverings for electric wires and cables. The principal feature of the invention is the possibility of bending cables or wires on short curves without impairing the insulation. Ordinarily short bends cannot be made with insulated wires or cables without straining the insulation on one side while it is compressed on



IMPROVED CABLE INSULATION.

the other, according to the bend. By Mr. Brooks' method of insulating conductors this objection is entirely obviated.

The insulation is built up in the following manner:

After the insulated conductors have been bunched together they are saturated with a molten or liquid insulating compound and then wrapped with tin-foil or thin metallic tape, with over-lapping edges, as shown in illustration. After this the wrapping is coated with a hot liquid compound of an adhesive nature, such as rosin and rosin oil, or asphaltum and oil. The nature of this compound is such that while preventing the separation or parting of the layers it will permit them to move or slide upon each other. A second wrapping of tin-foil is then applied on the compound, over the first layer, in the same manner, and pressed so that the two layers will adhere. A covering of any fibrous material, such as tape, also saturated in the adhesive compound, is then wrapped around the tin-foil, and around this is wrapped another double layer of tin-foil, and finally a second wrapping of tape. The whole is then dipped in the liquid compound, and a protective covering of a superior order is thus obtained.

In bending the cable in short turns, the inner layer may break, but the outer one will move upon itself, thus preserving the joints and insulation intact.

PATENT APPEALS.

In his annual report, recently submitted, Commissioner of Patents Mitchell says, with reference to patent appeals from the Board of Examiners-in-Chief: "I am satisfied that no appeals should come to the Commissioner from the Examiners-in Chief, and that his judicial jurisdiction over that body should go no farther than to grant new trials and rehearings in proper cases, according to the principles regulating such proceedings. I therefore recommend that proper steps be taken so secure an amendment to the law, having the effect to cut off all appeals from the Board of Examiners in-Chief to the Commissioner, and at the same time affording the Commissioner the power to grant new trials or rehearings. The appeal which now lies in *ex parte* cases from the Commissioner to the Supreme Court of the District of Columbia should be made to lie direct from the Board of Examiners-in-Chief to that court. Such a change in the organization of the Patent Office would relieve the Commissioner of a portion of that burden which is now too great to be properly discharged. It would save litigants the expense, annoyance, and delay of two appeals, where one should be sufficient, and it would secure that uniformity in decisions which the original act contemplated.

ELECTRICALLY PROPELLED BATH CHAIR.

In view of the general interest in recent experiments with a view to making an electrically propelled bicycle a practical thing, the following account of some recent trials, in England, of an electrically propelled Bath chair will be of interest. This electrically propelled chair was devised by Mr. J. Vaughan Sherrin, the inventor of a motor and battery suited for this class of work, and its performances gave much satisfaction.

The Bath chair, which weighs two hundred pounds, is of wicker-work, and the usual shape, and is mounted on wheels of the tricycle type. The primary cells, eighteen in number, and weighing eighty pounds, are placed on a large tray suspended between the wheels behind the chair. The motor, a modified two-pole Gramme machine, with laminated field magnets, weighs thirty-eight pounds and has a normal output of about one-quarter horse power. The gearing down is effected by chains. The eighteen cells contain one and a half gallons of depolarizing solution, costing about 6d. a gallon. With this charge the battery is capable of propelling the vehicle along ordinary roads for nine hours, at the rate of about six miles an hour; the zincs and solution then requiring to be renewed. During the runs in question, the Bath chair was very easily steered and stopped, and it surmounted, without much difficulty, a steep and muddy incline.

A small boat was also equipped with Sherrin motor and battery and it was propelled in a very satisfactory manner.

THE TELEPHONE.

During the convention of the National Broker's Association, at Saratoga, last September, one evening the delegates were entertained by music over the long distance telephone, over which the music of Strauss' orchestra was transmitted from



FIG. 2.—FEIGEL CAR, 26 FEET.

the Madison Square Garden, New York. At the same time a loop was connected with the house of Mr. A. S. Hibbard, the general manager of the Long Distance Telephone, who lives in Morristown, N. J., and a large party danced there during the evening to the music played in New York. The Long Distance Telephone Co. now operates 42,000 miles of copper wire. The lines include Boston, Providence, Worcester, Springfield, Albany, Syracuse, Rochester, Buffalo, Elmira, Wilkesbarre, New York, Philadelphia, Baltimore and Washington.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part X.—Alternating Current Dynamos (continued).

193—What are the main points of difference between alternating current dynamos and those of the direct current class?

Alternating current dynamos differ from direct current machines in the number and arrangement of the field magnets, armature winding and in the absence of commutator.

194—How many field magnets do alternating current dynamos have usually?

The number varies with the make of the machine and the use for which it is designed. Westinghouse alternators have 16 field magnets, while the Gordon machine, of English make, had 64 field magnets.

195—What is the object of having so many field magnets?

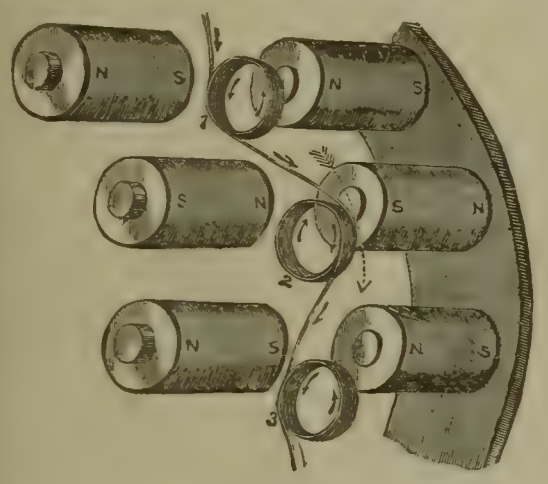


FIG. 1.—ALTERNATOR MAGNETS.

The greater the number of field magnets the greater will be the number of alternations in a given time, other things being equal.

196—How is the wire of the field magnets of an alternator wound?

The wire on each magnet is wound in the opposite direction to that of the ones on each side. Thus every other magnet is wound in one direction and every alternate magnet in the opposite direction.

197—How are the field magnets of an alternator arranged with reference to the armature?

In some machines the field magnets are arranged as shown in fig. 1; that is, with two sets of magnets facing each other, and in others

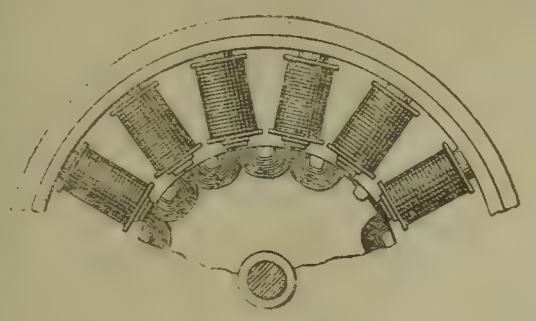


FIG. 2.—MAGNETS ARRANGED RADIALLY.

the magnets are arranged radially on the inside of a circular frame as shown in figure 2.

198—Name some of the principal machines with their field magnets arranged in each manner described?

Kapp and Siemens alternators (both of English make) are examples of the class represented in figure 1, and the Westinghouse alternator (American) is an example of the second class, which is represented in figure 2.

199—How are the field magnets of an alternator energized?

By an electric current, usually generated by an independent dynamo.

200—Is the current from this independent machine alternating or direct?

Direct.

*Copyrighted.

201—Is it absolutely necessary that the field magnets of an alternator should be energized by a direct current—if so, why?

Yes; only a direct current can be used for this purpose in order to maintain an unchanging polarity in the field magnets.

202—What is the object in winding adjacent field magnets of the alternators in opposite directions, as described in answer to question 196?

In order to reverse the polarity of the magnetic fields. This will be understood by reference to figure 1. The same result is obtained in the arrangement shown in figure 2.

203—What is the method of winding the armature coils in alternators?

The armature coils are wound in opposite directions, each from the other, as shown in figure 3.

204—What is the position of the armature coils with reference to the field magnets?

In some machines the armature coils pass through a space between two sets of magnets, as shown in figure 1, while in others they revolve in front of the poles of the field magnets, as illustrated by figure 2.

205—Explain the circulation of currents in the armature coils of alternators?

By reference to figure 1 it will be noticed that the current generated in coil 1 flows in the direction indicated by the arrows. In coil 2, which is wound in the reverse direction to coil 1, the current generated will flow in the same general direction. In coil 3, which is wound the same as coil 1, the current will flow as indicated by the arrows. This same arrangement is carried out all the way around the armature, every other coil being wound one way and the alternate coils wound the other. Now, by a little study

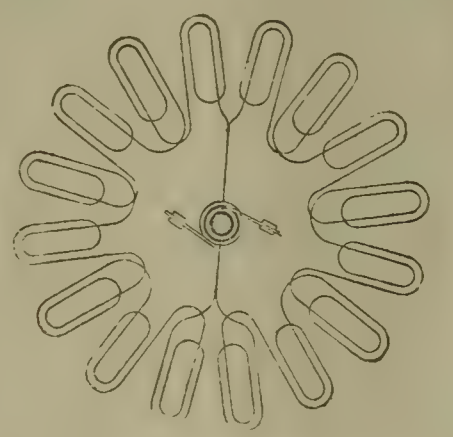


FIG. 3—WINDING OF ARMATURE COILS.

it will be understood that as the coils recede from one set of magnets and advance towards the next set, the currents generated therein will be in the opposite direction to those preceding. By these rapid changes in the position of the armature coils, with reference to the field magnets, the rapidly alternating currents are produced and led to the external circuit through the collecting brushes.

206—In one revolution of the armature how many reversals of current will take place?

The current will be reversed as many times as there are field magnets.

207—How are the alternations of current computed in practice?

By multiplying the number of field magnets by the number of revolutions of the armature per minute. The product will give the alternations per minute.

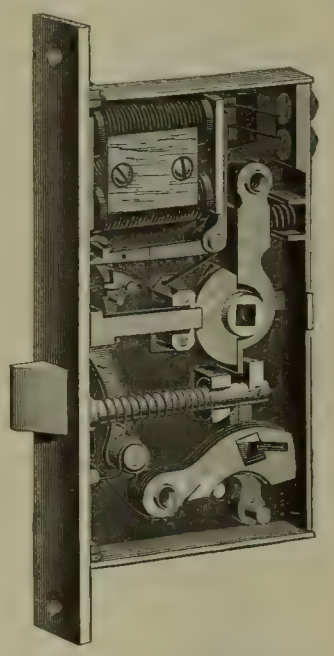
(To be continued.)

PORTELECTRIC CO.—Prof. A. E. Dolbear, as electrician for the New England Portelectric Company, has recently reported progress to the president and directors of the company. He concludes his report as follows: "Its [the experimental line and equipment] perfomances reinforces the judgment formerly expressed, that the Portelectric System will attain great commercial importance."

THE THAXTER ELECTRIC LOCK.

Scarcely a day passes but what we hear of some new application of electric force for the benefit of mankind. Man is depending more and more upon electricity to aid him in the perfomance of work, and it is getting to be so that we can do almost anything by simply touching a button, which lets loose the wonderful force upon which so much depends these days. The newest thing in this part of the country is an electric lock known as the Thaxter Electric Lock, of which we give herewith an illustration.

Heretofore the Thaxter Electric Lock has been but little known to the trade outside of Boston and vicinity; the inventor, as is too often the case, having been compelled to fight infringers in the U. S. Courts, or sacrifice his fundamental rights. Since the Court sustained the patent, infringements have ceased, and the lock has been improved and perfected until it is in every respect a first-class instrument, and is said to be the only strictly Electric Lock in the market.



THAXTER ELECTRIC LOCK.

This lock, while it can be used in place of an ordinary lock anywhere, is peculiarly adapted to entrance doors of private residences, apartment houses, offices, banks, etc. By the simple pressure of a button located at any convenient point closes the circuit, and the current passing through the magnet inside the lock (shown in figure) releases a lever. The spring then throws back the bolt from the tumbler, when the outside knob can be turned and the door opened. Not until the electrical apparatus has been actuated can the door be opened hence the value of such a device is at once apparent.

The Thaxter lock is both a front door lock and an electric door lock combined, and its cost is about that of any first-class front door lock of the usual makes. The catch of the lock can only be released by the electric push button inside the house, or by the use of the pocket key.

In fitting the Thaxter Electric Locks no cutting of the door jambs is necessary, as is the case where the Electric Door Opener is used. This is an important advantage. The door locks itself when it closes. In apartment houses the button (one for each suite) is located near the speaking tube which runs to the outside door.

The Electric Gas Lighting Company, 195 Devonshire st., Boston, Mass., are the wholesale selling agents for this valuable device, which we understand is giving great satisfaction wherever used.

ELECTRIC TRACTION.—Experiments with an accumulator car undertaken by Messrs. Hostmann and Company, of Hanover, in conjunction with the Oerlikon Company, on the line of railway, 20 miles long, connecting Hildburghausen, Heldberg, and Friedrichshall, have been satisfactory.

ANNUAL MEETING OF THE AMERICAN STREET RAILWAY ASSOCIATION.

The Iroquois Hotel, Buffalo, was, on October 15th, the centre of great activity and bustle. The occasion was the ninth annual convention of the American Street Railway Association, and the attendance of members and others interested in street car railways, directly and indirectly, was unprecedented. The feature of the meeting, and the one that brought the large crowd together, more than any thing else, was the part electricity was to take in the meeting.

The meeting was called to order at 10:45 A. M. by President Thomas Lowry, of Minneapolis, and Secretary Wm. J. Richardson called the roll. Nearly 200 members responded to their names as they were called.

President Lowry then made his annual address. He said that the United States Government thought street railway traffic of so much importance that in the new census a special report was made of street railways in cities of over 50,000 inhabitants. He referred to the fact that a paper on the street-car horse was to be read, and said electricity was making such rapid strides that he did not believe that at any subsequent convention the street-car horse would be considered. (Applause).

In the census report, he said, 56 cities are included, and out of 3,150 miles of track in these cities 2,351 miles are operated by horses, 260 by electricity, 255 by cable, 221 by steam, the balance, about 60 miles, being the New York and Brooklyn elevated roads. In smaller cities and outside the enumeration, there are about 1,600 miles of electric street railways in operation.

He advocated liberal franchises for street railway improvements, stating that the growth of a city depended largely on street railway extensions.

He closed his address with some remarks on the labor question as affecting street railroads. A paper was read on "a Perfect Street Railway Horse," which was full of interest to horse railroad men.

The first paper involving electricity was that of Dr. W. L. Allen of Davenport, Ia. The title of the paper was: "Electric Motive Power Technically Considered." Dr. Allen said it was a rare thing to have trolley wires break except at the curves. He said there is little to be asked for in the way of improvement of what we now have for overhead material. He advised that rails on both sides of the tracks should be connected with bands. Concerning the overhead wires he said: "Actual experience has proven that there need be so little trouble or danger from the station and overhead line that we cannot concede the need of either conduit or storage battery, so far as *we* are concerned. Every one of the street railway men present will uphold the statement that the only problem before us and the one about which we are always anxious, is 'What can we do to keep our motors out of the repair shops?' We don't worry about our station or overhead wires; we scarcely have time to think of them; we are constantly at work upon and perpetually annoyed by our motors."

The balance of the report was purely technical, including a statement of the many difficulties met with by street car electricians, and also an exhaustive statement on the unexpected expenses met with in running electric cars. He did not make a statement of the actual cost of running the cars, but deduced that a car ought to run 100 days without electric repairs.

The afternoon was devoted to a trip to Cold Springs where the merits of various street-car inventions were more or less satisfactorily demonstrated comprising an exhibition of the snow-plow and snow-sweeper of the Thomson-Houston system, the running of the Westinghouse-Pullman trolley car and the Edco storage-battery car.

At Thursday morning's session, after the reading of a paper on "Public and State Treatment of Corporations," by Geo. H. Scribner, of New York, and one by Benjamin J. Owen, President of the Reading, Pa., City Passenger Railway Co., on "Novel Schemes for the Development of Street Railways," the session was placed in the hands of the delegates for discussion of the merits of the various systems represented. D. H. Bates opened for the storage battery car, in which he referred to the street car horse and the cost of maintaining it, a comparison of propulsion, and the rate of speed, how storage battery cars differ from those in use on the overhead system. Every good word that can be said of the trolley can be applied with equal favor to the accumulator car, which, however, has many advantages peculiar to itself. One or two can be introduced at a time; can be run on a trolley or cable line, or on any route where an ordinary street car can be run; or in case of a serious break down or epidemic among horses. Mr. Bates now gave a great many figures, including first cost of plant and equipment and cost of maintenance and operation. This discussion ended with an appeal to the delegates asking that the Edco car be given a fair trial and it would depend on its merits for adoption.

The overhead system was next represented by A. H. Chadbourne, who explained in detail the working and method of construction of the Wenstrom generator, which is different from the regular trolley generator though similar in purpose. A long description of the field magnets and the style of armature was given, with the manner of wire connection, which cannot solder or melt. The gear of the generator is absolutely noiseless, and is fitted throughout with cogged wheels having interchangeable wooden teeth.

Mr. Wheeles of Washington was then given an opportunity to speak upon the underground system of conduits, which also has overhead wires. Switch boxes are placed along the line at regular intervals which cut the circuit automatically, only charging that section of the overhead wire between the boxes on which the car is running at that time, therefore there is no danger whatever from the trolley wire, the greater proportion being continually dead. This was a new feature of electrical street railway construction, and Mr. Wheeles's talk was listened to with much interest.

The United Electric Traction Company was represented by Mr. Neftel, who spoke of the Brush and Julien patents controlled by his company and shown on the cars of the Madison Avenue line in New York. At present the Tompson-Houston motors are used in this system, but a slow-speed motor has been specially designed and will be introduced as rapidly as possible. This ended the morning session, and the convention was adjourned until 2:30 P. M.

At the afternoon session the following officers were elected for the ensuing year: president, H. M. Watson, Buffalo; vice-president, W. A. Smith, Omaha; second vice-president, Charles Odell, Newburyport, Mass; third vice-president, A. D. Ryan, Columbus; executive committee, Thomas Lowry, Minneapolis; D. H. Henry, Pittsburg; Albert E. Thornton, Atlanta; H. M. Littell, Cincinnati; Thomas C. Keefer, Ottawa; secretary and treasurer, William J. Richardson, Brooklyn. It was decided to hold the next meeting in Pittsburg. The date set was the third Wednesday in October.

Following this, three different gentlemen were asked to address the convention in exposition of the various electric systems which they represented.

Mr. Higgins, of the Edison General Electric Company, was first heard. "It lays with you, gentlemen," said Mr. Higgins "whether electric cars succeed or not. Much depends upon the care given them, the condition of the armatures and brushes. They need not any less attention at the hands of the driver than does a locomotive at the hands of its engineer." Mr. Higgins described the various characteristics of the Edison electric car as compared with those of other makers.

Edward H. Johnson, of the Interior Conduit and Insulation Company of New York, spoke next upon the underground system of conduits. He argued that all feeders, mains and submains should be placed underground. Can they be put there at a reasonable expense and will the efficiency of the line remain unimpaired? Mr. Johnson said his company would answer yes to both those questions, and was prepared to back the assertion besides guaranteeing perfect insulation and thorough workmanship in every detail.

The products of the Thomson-Houston Company were now taken up and Mr. Mansfield of Boston ably expounded their merits. The Thomson-Houston system is the one in most extensive use, therefore is most favorably known. All the accessories and details which enter into the construction of these cars have been planned on correct principles. In closing, an appeal was made to the representatives to give on their lines an impartial trial to these cars—the company asked nothing further.

Mr. Potter appeared for the Brush and Short Electrical companies, and dwelt at length on the good principles made use of in these cars. The system of repairs had now reached a high degree of perfection, yet were inexpensive. The construction of the armatures and motors was fully described.

Mr. W. J. Carruthers Wain of London, Eng., and president of the Tramways Institute of Great Britain and Ireland was the next speaker, and a most engaging speaker he was, too. He talked in an off-hand way, with the assistance of but a few notes, on his general experience as a tramway director, and particularly of the recent experiments in Birmingham in the storage-battery system of traction. The general tenor of his remarks showed that he deemed American street-railroad owners far more favored individuals than those of England. As he spoke, here and there through his speech, of the restrictions placed on the street railroad business by English local authorities, one could not but believe that the American street-railroad magnates were not such downtrodden persons as might have been supposed after hearing Mr. Scribner's paper in the morning.

In tracing the growth of the storage-battery system in Birmingham, the speaker said: "Local authorities in England are much opposed to the overhead wires, so we finally concluded to take up the storage-battery system." He told how the Electric Construction Corporation had been formed and how the contracting company agreed to furnish motor power at the rate of nine cents a mile. He told of the severe tests that the storage-battery car had been subjected to during the preliminary experiments. It weighed nine tons, and when hitched to a steam engine it pulled it along, notwithstanding the latter had a full head of steam on. So far the system had been in use three months without a hitch or break. The company owns twelve cars, though but five are run now. The local authorities had fixed the limit of speed at eight miles per hour and at certain places the cars were not allowed to run faster than two miles per hour. At every sreet crossing the cars had to come to a dead stop. In that way a round trip of six miles was made in only 55 minutes.

In answer to various queries, he said that his company did not care to run cars more than 30 miles on one charge. The cells were charged principally at night, and practically took the same length of time to charge as to discharge them.

An elegant banquet was given at the Iroquois Hotel on the evening, at which 250 persons were present, including many ladies. Among the toasts given after the dinner, was one on "Electricity."

Friday was spent in sight seeing, and the programme included a trip to Niagara Falls on a special train. The party returned to the city at 5:30 in the afternoon and scattered for their respective homes.

THE MARÈS ENERGY METER.

The following particulars are given by *Le Génie Civil* of the Marès watt-hour meter, which might be briefly described as a combination of a Snelgrove electric balance, and a Thomson current weigher, will be of interest to our readers:

The watt-hour meter of M. E. Marès may be placed in the category of intermittent integrating meters since it adds up at regular intervals of time (4 minutes) the number of watts expended at the instant in the circuit. Fig. 1 explains the principle of the apparatus. G is a thick wire coil in series with the lamps, and inside it is the movable fine wire shunt coil. The latter is suspended from the end A of the lever A B, oscillating about the knife-edge *b*.

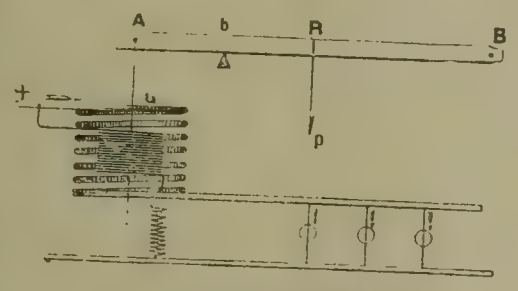


FIG. 1—MARÈS METER COILS.

The electro dynamic action between the coils is equal to a force, f (E C), and this may be balanced by a weight, p, acting, say, at the point R. Hence we have,

$$f\,(\mathrm{E\,C}) \times \mathrm{A}\,b = p \times b\,\mathrm{R},$$

or,

$$f\,(\mathrm{E\,C}) = b\,\mathrm{R} \times \text{a constant}.$$

That is to say, E C at any instant is equal to b R multiplied by a constant. What we have to do, therefore, in order to measure E C is to move a weight, p, along A B, and to measure off the value of b R. This result is attained in the following manner.

The moving weight p consists of a rack D (Fig. 2), which rolls along the arm A B, and which carries a small hollow metal cylinder g. The apparatus is adjusted by varying the load

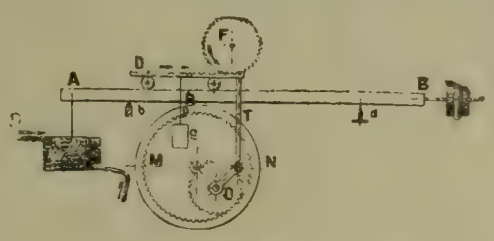


FIG. 2—MARÈS METER GEARING.

carried by g, and by moving the screw nut e. The rack D is actuated by the Lahire gearing M O N, and in virtue of the motion of the inner toothed wheel the rod T moves to and fro, carrying with it the rack D.

The integation is effected every four minutes as stated above. In that space of time, therefore, the rack D has to effect a complete to and fro movement. The Lahire gearing is worked by clockwork, which is wound up electro-magnetically. The rectilinear motion of the rack D causes the toothed wheel F to rotate, and this in turn gives motion to a train of wheels actuating a registering apparatus. In order that the rotations of F may be proportional to E C, it is necessary that the rack D should cease to come in contact with it the moment the beam is balanced, and the rack D should not again be engaged with the wheel F until it again commences a forward movement. This is effected in the following manner: When the weight p passes the point of equilibrium the beam tilts downwards on to the stop d, and the wheel F is disengaged. In order to prevent D from engaging with F on its return journey, the current, which continues to pass through the shunt coil during the whole of the forward movement of the rack is cut off during the second half revolution of M N The beam thus maintaining such a position during the return journey of the rack as enables it to clear the wheel F. If the series coil of the meter is not traversed by any current, the beam tilts over as soon as the rack begins to move forward and nothing is therefore measured.

The current is shut off from the shunt coil during half of each revolution of M N by means of an appropriate commutator. During the half revolution when the current is diverted from the shunt coil, it is made to wind up the clockwork. One complete revolution of M N causes the

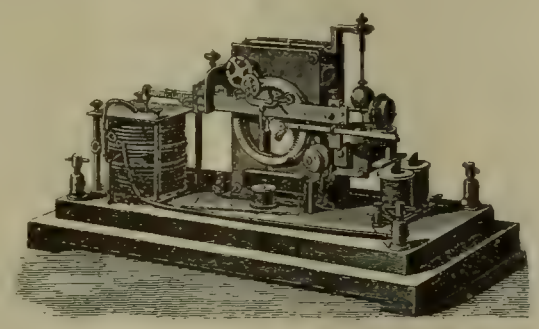


FIG. 3—MARÈS METER.

scape-wheel of the clockwork to run down by five teeth. One half of the commutator is, therefore, provided with five studs, and as these come into contact with the spring conveying the current five impulses are transmitted to an electromagnet, which by giving five pulls to its armature, winds up the scape-wheel by the amount it has run down.

The Marès meter, which is made by M. Dejardin, of Paris, has been used with satisfactory results on the circuits of the Montpellier central lighting station. A perspective view of the meter is given in Fig. 3.

ELECTRICITY IN JAPAN.

We are in receipt of a letter from S. N. Katogi, of Tokio, Japan, containing some electrical news from that far-off land. Mr. Katogi, it will be remembered, spent some time in this country during the early part of this year in the study of electricity, to prepare himself for the practice of that profession in his native land.

The telephone exchange in Tokio was opened during the beginning of October. Tokio and Yokohama are connected by trunk lines, the distance being 18 miles. There are several hundred subscribers in the two cities. No. 17 hard drawn copper wire is used, and the lines are all overhead. The Gower-Bell transmitter has been adopted.

The Sprague Electric Railway exhibit at the exposition at Tokio attracted a great deal of attention, and was very successful.

There is considerable activity in electric lighting in Tokio city. Four companies are in the field, two in practical operation and two in course of preparation for work. In Yokohama the Yokohama Electric Light Company began operations on September 15th.

Mr. Katogi states that financial matters in Japan are not in good condition and electrical enterprises suffer in consequence.

Mr. Katogi is now connected with an electrical concern in Tokio, called Miyoshi Works.

On the 18th of September last Mr. Katogi delivered an address before the Tokio Electrical Society on the subject of American Electrical Industries, and it was received in a manner highly complimentary to that gentleman.

AIR CONDENSERS.

The following is a description of the air condensers of the British Association:

The condensers consist of 24 concentric tubes; the outer tube is about 2ft. 9in. high and 6 in. in diameter. Each succeeding tube diminishes in diameter by half an inch; the tubes are about $\frac{1}{32}$nd of an inch in thickness, and the air space between the inside of one tube and the outside of the next is about $\frac{3}{32}$nd in., but it was found impossible to get all the tubes of exactly the same thickness, so that in some cases the distance between the tubes is less than the above. These tubes are carried by two conical brass castings; the outside surface of each casting forms a series of twelve steps, over which the successive tubes fit. Each tube is held in position by screws. The upper one is supported by the outside casing of the condenser, and twelve of the tubes hang vertically from it. The lower cone is carried by three ebonite pillars, about 3in. in height; the twelve tubes which are attached to it come respectively between



AIR CONDENSER.

those which are suspended from the upper cone. Thus the insulation depends on the ebonite pillars, assuming there is no leakage across the air from the edges of the tubes. There is an opening in the outer casing, closed by a door, by means of which the ebonite can be cleaned; the whole is dried by placing inside a small vessel of sulphuric acid. In the centre of the upper cone there is a hole through which a rod passes. The rod is connected with the lower cone and forms the electrode for the insulated cylinders. An ebonite plug, fitting tightly round the rod, can be pushed down so as to close the hole and prevent the ingress of dust when the condensers are not in use; when they are being used the plug is removed.

A NEW ELECTRIC CAR.—A Springfield, Mass., paper says: The battery for the storage of electricity in portable form, patented about a year ago by Sidney H. Barret, of this city, and described at that time, is proving its efficiency in comparison with other storage batteries. A passenger train on the Connecticut River railroad, running between Springfield and Northampton, has been for some six months lighted with this battery to the satisfaction of the railroad company, and those interested in this battery are supported by expert opinion in their claim to have "the best." Orders have been received sufficient to occupy several months in filling them.

The Barret company have recently begun the construction of an electric motor car, or noiseless locomotive. This car is to be about ten feet long and is to be attached to the cars now in use, simply taking the place of the horses. The car will be furnished with 300 cells and two 20-horse-power motors, which will give 100 horse power, sufficient for an entire day's work. The mechanism is so arranged that the car can be propelled by either the overhead system or storage batteries.

AMERICAN MACHINE TELEGRAPH SYSTEM.

This is a system of telegraphy in which greatly improved results are obtained by devices and arrangements extremely simple, both electrically and mechanically.

The promoter of this system, Mr. D. H. Craig, of New York City, and the inventor Mr. Frank Anderson, of Peekskill, N. Y., both have been intimately connected with the more or less successful improvements in this direction for a great many years, and this system is the outcome of much and varied practical experience.

This system is of the class—the only one in which very high speed is attainable—in which the Morse code of signals is transmitted by means of perforations in a strip of paper, and received either by chemical decomposition or ink writers.

The rapid preparation of accurate perforations is therefore a fundamental necessity. Recognizing that this is the weak point in all systems of this class, the effort has been made, with marked success, to reduce to the simplest form possible the functions of the perforations, to the end that they, and thereby the means for producing them, might be simplified.

In the new system the full effect which is designed to be produced at the receiving end by *double current* transmission, is produced, indirectly, by *single current* transmission, and therefore admits of much simpler perforations and a modification of the transmission by which the holes, instead of representing the dots and dashes, represent the intervals between them. still further reduces the number of perforations, so that a set of six punches, five for the letters and one for the space (see diagram), are capable of producing as many different transmitted characters, as ninteen punches, including the feeding row, of the Wheatstone, or twenty of the "American Rapid" systems.

Two classes of perforators are provided—the regular office perforator, designed for speed, which is limited only by the speed at which the operator can touch and depress the keys, and a smaller and cheaper one capable of working up to 20 or 30 words per minute, and designed to be used in small offices, and by individuals who may choose to do their own perforating. This smaller perforator has an attachment which prints, automatically, on a separate fillet of paper, as the messages are perforated. a copy of this perforated letter or message, in Roman print, which may be filed for subsequent reference.

There is connected with both perforators a simple and very complete device for forming an unlimited number of absolutely secret ciphers, so that letters or commercial messages may be perforated and telegraphed with absolute secrecy, except to the sender and receiver.

The transmitting and receiving instruments are combined in one piece of mechanism, run by very small electric motors, governed, and capable of adjustment to any required speed.

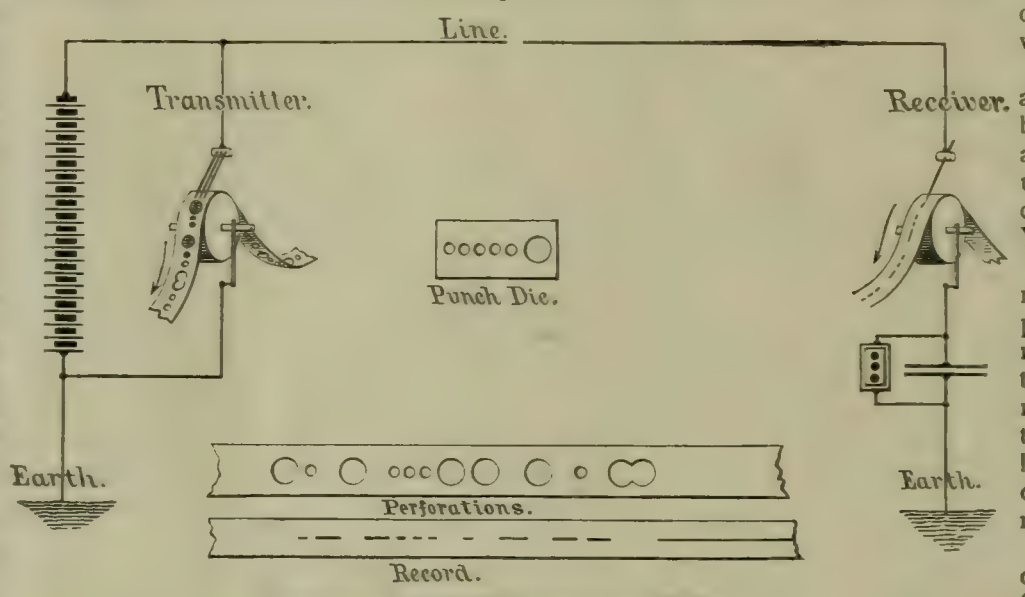
As will be see by the diagram, the transmitter is not placed between the battery and the line, as is usual, but in a shunt from line to earth—the battery being normally connected to the line. The office of the preforations in the fillet is to close this shunt, thereby short-circuiting the battery and interrupting the flow of current to the line, so that signals on the line correspond to the intervals between the perforations, as shown in the diagram.

The "sparking" is very slight, even with very heavy batteries, for the change is not from an open to a closed short circuit, but from the line circuit, in which there are no coils or magnets, to the closed circuit, and therefor there is a barely visible tendency to "spark."

The greatest advantage of this arrangement, in rapid transmission, is that the line is connected to earth through a path of no appreciable resistance between each signal, and in the nature of the operation the cessation of the signal and the grounding are necessarily absolutely simultaneous, and therefore much more effectual in discharging the line than any other method of shifting line from battery to earth; consequently much the largest portion of the static charge, the great obstacle to rapid signalling, escapes at the sending end, leaving a minor portion only to be contended with at the receiving end.

Another great advantage is, that even at the highest possible speed, the entire strength of the battery is thrown upon the line at each signal, because the current does not have to pass through "contacts" in its course—the only part depending on the "contacts" being the shunt-circuit, which, owing to its little resistance, is much more easily worked through contacts than the line circuit.

The receiving instrument may be either an ink writer or chemical recorder, the latter being preferred because of its simpler nature as to mechanism and because it dispenses with coils or magnets in the line circuit. After passing through the recorder, the circuit passes to one side of a condenser, the other side of which is connected to earth—the operation of the condenser being controlled by the usual arrangement of adjustable resistance in a shunt (see diagram), through moderate circuits can be worked without the shunt.



AMERICAN MACHINE TELEGRAPH SYSTEM.

The electrical signal, after leaving its record on the damp paper, enters and charges the condenser to a degree more or less approaching its own potential. The moment the signal impulse begins to weaken, the static charge of that part of the line near the receiving end (the other part finding an easier path back to sending end) tends to follow and prolong the record but is met by the counter charge of the condenser and neutralized, or most probably forced backward toward the sending end, for the grounding of the line there makes that the path of least resistance for the condenser discharge, as the resistance in the condenser shunt is kept four to six times that of the line.

Herein is shown also a further advantage of the perfect grounding of the line at sending end—namely, the more complete discharge of the condenser between each signal, it affords; for if the usual arrangement of transmission by direct open and close contact of line and battery be substituted, the condenser becomes so completely charged, after the first two or three signals, that no further record can be obtained unless the resistance in the condenser shunt is so far reduced as to impair the effect of the condenser on the record.

Of course, sufficient artifical leakage in the line before the recording pen would allow the condenser to discharge back through the pen, but such leakage would be subtracted from the signal current to its detriment. The well-known action of an electro-magnet in a shunt about the pen can be utilized also in this system, but the action of all such devices depends on a division of the signal current before it is recorded and therefore weakens the record.

The previously described arrangement, however, insures the perfect action of the condenser without any loss whatever, except that due to necessarily imperfect insulation of lines. Hence it is found that while most automatic systems work best in rainy weather, owing to the lessened static charge, this machine system works just as well in the dryest and coldest weather, when the insulation is most perfect, as in wet, leaky weather, and it would work just as well, or better, if the insulation were perfect, as artifical circuits have shown.

It has been found that for an actual circuit of about 2,500 ohms resistance 1,000 miles long, a current of 200 or 250 volts and condenser of 4 M. F. shunted by resistance of 10,000 ohms, gave unvaryingly good results at a speed of 500 to 600 words per minute (a working speed 300 words under the limit possible) through all kinds of weather without any change whatever in the above adjustments.

The record obtained is remarkably clean and sharp, and has been produced perfectly readable at a speed of 3,000 words per minute, over a low wire resistance circuit of 351 miles between New York city and Washington.

There is connected with each receiver and transmitter a telephonic indicator, by which information is conveyed, automatically, to both the receiving and transmitting operators whilst transmitting or receiving, the instant the least derangement of the line wire occurs, and, generally, the exact nature of it.

There are also some other details of patented and valuable devices for facilitating the effective use of the line wires, but the above embrace the essential improvements of the machine system of rapid telegraphing, which are all covered by recent American and European patents.

WARNING OF STORMS BY TELEPHONE.—Scientific authorities in Paris have been interrogated respecting the proposed application of the telephone to meteorology. M. Faye, a leading authority of the French Academy of Sciences, is of opinion that the telephone is capable of transmitting storm sounds and of predicting a tempest at least 12 hours before it bursts. The microphone has likewise transmitted the lightest sounds from a distance, and there is no reason why the telephone should not be utilized in a similar manner.

M. Faye meanwhile does not see how the adjuncts to the telephone proposed by the inventor of the plan for predicting storms in advance can be made to work efficiently. These adjuncts consist of two bars of iron placed at a distance of eight or ten yards one from the other, and brought into communication on one side with an insulated bronze wire, and on the other with a telephone.

If the whole of the apparatus were placed at an altitude on the seacoast, it might, in the opinion of the scientist, carry out the object intended by its inventor. The same sounds, however, could as well be transmitted from a height near the sea, or even from a captive balloon, by the microphone which has been used recently in Italy, not for aerial, but for subterranean sounds, such as precede shocks of earthquake or eruptions of volcanoes.

THE MARTIN BI-METALLIC WIRE.—The Telegraph Administration of Greece and Sweden have adopted the Martin bi-metallic wire for telegraph and telephone purposes.

THE EXHIBITS AT THE BUFFALO CONVENTION.

The exhibits of electrical appliances pertaining to street railways were of an elaborate and extensive nature. Almost the entire space in corridors, aisles and large parlors was taken up with street car appliances, that of electricity standing out most prominently among them. The space along the sidewalks in front and on the other side of the hotel was entirely taken up with street cars, car motors and trucks and other paraphernalia. The large hall known as the arcade, close at hand, was also occupied by exhibits of a general advertising character.

The Electric Merchandise Co., of Chicago, had a beautiful exhibit consisting of electric street railway supplies. A full line of raw hide pinions attracted considerable attention together with a line of track brooms and line material for overhead work; also. elegant fixtures for cars and stations were on exhibit. The representatives were W. R. Mason, the general manager of the company, assisted by J. S. Gustin.

F. A. Magee represented the E. S. Greeley & Co.

The J. G. Brill Company, of Philadelphia, was represented by John A. Brill, Payson K. Andrews, J. A. Hanna, and their exhibit consisted of one improved motor truck, No. 7, and No. 11 maximum traction pivotal truck and several model trucks. A vestibuled end of a car, of the Brill make, with sliding doors, also attracted attention at the exhibition in the arcade.

A. L. Daniels was on hand with samples of the goods manufactured by the Eureka Tempered Copper Company of North East, Pa.

Chadbourne, Hazelton & Co., of Philadelphia, the general selling agents for the United States, of the Westrom Consolidated Dynamo and Motor Company, was represented by A. H. Chadbourne and William Hazelton. Mr. E. L. Tunis, the president, and ex-governor J. B. Groome, vice-president of the Westrom Consolidated Dynamo and Motor Company, were also on hand. The exhibit was an extensive and elaborate one.

The Peckham Street Car Wheel and Axle Co., 45 Broadway, New York, was represented by E. Peckham and M. D. Peckham. The exhibit consisted of improved No. 1 and No. 2 cantilever trucks and patent interchangeable motor wheel and patent motor axle. Life guard, track brakes. Special pendulum motor hangers are also specialties of the Peckham system.

The Short Electric Railway Company, of Cleveland, was represented by Mr. S. H. Short, J. Potter, John Ridall, C. C Curtiss, H. R. Kinzelbach, Sam'l Fortenbaugh, E. Brown, T. C. Frenger, Jno. C. Lincoln, E. H. Morrison and E. W. Tisdall. The exhibit occupied the reception room, and consisted of a motor in operation besides various parts of car equipment; also a vestibule car complete with elec trical appliances—Brill truck and Short motor. The car body was manufactured by the Gilbert Company, of Troy.

The Lewis & Fowler Manufacturing Co., and Lewis & Fowler Girder Rail Co., of Brooklyn, were represented by John W. Fowler, H. C. Simpson, W. H. Delany, Geo. W. Meyers, Louis E. Robert and John England. The exhibit consists of bronze car trimmings, car heaters, registers, electric car sand boxes, girder rails and other appliances.

The Okonite Company was represented by Captain W. L. Candee and T. M. McCoubray, and their exhibit occupied a prominent space in the Arcade. Samples of the various wires, including braided wires and various lamp cords and underground and sub-marine armored cables were shown.

The North American Construction Company, of Pittsburgh, Pa., was represented by Mr. W. L. Adams, of the Buffalo office. The exhibit consisted of central station apparatus, theatre and ordinary store lighting transformers, meters, stage regulators, switches, cut-outs, sockets, lamps, etc.; also one of the new type of United States dynamo. A sample of the Westinghouse cigar lighter was also shown, as well as one of the new alternating arc lamps with flat carbon which needs trimming only once in a week.

The Edison General Electric Co., occupied parlor H, where miniature street cars were on exhibition. The company also had an extensive exhibit at the Arcade, and was represented by John Muir, Chas. D. Shain, J. H. Vail, F. R. Chinnock, E. E. Higgins, Chas. T. Hughes, Prof. White, A. D. Paige. The display includes a new Gilbert electric spring truck equipped with two Edison motors; all the latest devices and improvements in the Edison system; a skeleton car showing the manner of wiring a car; station, car, and line equipments, E. M. W. wire; the Edison underground system for feed wire service; a new street car armature; two dynamos, etc. In the Hotel Iroquois this company has a parlor on the second floor, the front being adorned with a novel sign, the words "Edison General Electric Company" of small incandescent lamps. They show two models of complete cars, maps, etc. At Cold Spring this concern has four Edison cars, which will be practically tested on the Park trolley line.

The Russell Street Carette Co., of Chicago, was represented by Mr. A. W. Brickwood, who had charge of their regular sized two-horse carette, having a capacity for twenty-three persons. The carette was drawn around town which proved its usefulness and easy riding qualities. Many of the street railway people look upon the carette as a valuable adjunct to their system as feeders. The carette, as its name implies, is a small car, and is similar to any ordinary street car, with the exception of size and not running on a track. Another feature is a platform similar to that of a street car.

The John A. Roebling's Sons Co., of Trenton, N. J., was represented by Mr. Geo. C. Bailey, of Chicago and Mr. F. A. C. Perrine, of Trenton, N. J. The exhibit was made up of the various wires made by the company, including silicon bronze trolley, hard copper trolley, soft copper, lead encased weatherproof, lead encased braided and copper strand, and all such as is in use on an electric street railway.

The Interior Conduit and Insulation Co. was represented by Mr. E. H. Johnson, E. W. Little and Clift. Wise, the chief engineer. The exhibit consisted of a half-size manhole and interior conduits.

The Accumulator Co., 44 Broadway, New York, was represented by D. H. Bates, vice-president.

The Electro Dynamic Company, of Philadelphia, was represented by W. W. Griscom, president, and E. A. Scott, superintendent. The exhibit consisted of a complete car run by accumulators of which there are 88. The car has already run over 10,000 miles in Philadelphia on the Darby road, one of the lines of the Traction Company in regular service. The car made several trips around the city. The motors and gearing are of the manufacture of Electro Dynamic Co. The car is known as the "Edco." The Electro Dynamic Co. was first in the field to install electric light, motor and storage battery plants, and it is the oldest electric motor company in the world. As each cell of battery has an electromotive force of two volts, the highest voltage used on the car is 176 volts when all the cells are in series. The car runs at several different speeds. When starting, the cells are in four parallels, with an E. M. F. of only 44 volts. The speed is doubled by turning the switch so as to place the cells in two parallels, and is again doubled by putting them all in series. This speed can again be doubled by putting the motors in parallel and double the last rate of speed; about 25 to 30 miles an hour can be attained by a device of the Electro Dynamic Company, but this speed would be too great for ordinary street railroads. The motors can be run either separately or together, and also in series or in parallel, according to the requirements of power or speed. The least voltage of an overhead line is 500 volts.

While the voltage of the accumulator system is much too low to endanger life under any circumstances. There is in fact, no possibility of a person securing a shock as the circuit is entirely underneath the car. The great advantages claimed for the storage system, are that streets are not obstructed by unsightly poles or wires, second, that there can be no danger to persons or property from the current used on the cars, and third that the economy is much greater than animal traction, and it is believed to be greater than that of any overhead system. Much less power is required as the maximum at the charging station, and the power plant is at all times run at its maximum capacity, which is its most economical load. The cost of maintenance of the power plant is much less than by the overhead system or by cable traction, because there is no variation in the load on engine or dynamo. The cost of maintenance of motors on the cars is also much less than by any other system on account of the low voltage. There is also no danger of a shut-down of plant by the burning out of the central station dynamos by lightning, as has occurred in more than one instance in the overhead systems. The car starts and runs very smoothly, and can be stopped very quickly by an elastic electric brake.

The Thomson-Houston Electric Co., of Boston, was represented by Mr. H. L. Carger, W. Coffin, Norman Carty, Wm. B. Ferguson, W. J. Clark, W. F. Stebbins, Geo. W. Mansfield, Lieut. Cahoun, C. S. Healey, Mr. Morey, and their exhibits of a snow plow and a sweeper attracted general attention.

The Pickford and Francis Belting Co., of Buffalo, exhibited several rolls of dynamo belting.

A model pole for electric railways, devised by William Serrell, a civil engineer, of New York, attracted a great deal of attention.

Emmet Bros., of New York, exhibited a full line of overhead supplies, gears, etc., for electric railways. They also showed many new devices.

The exhibit of the Hathaway Electric and Cable Transfer Tables, by Hathaway and Robinson, of Cleveland, was very attractive.

The Connecticut Motor Company, of Plantsville, Conn., exhibited electric motors, power generators and incandescent dynamos. This company was represented by Mr. F. C. Rusling.

Messrs. Chas. A. Schieren and Co., of New York, made a fine display of their well-known belting.

The Standard Underground Cable Co., of New York, Chicago and Pittsburgh, was represented by Mr. Geo. L. Wiley, of New York. The exhibit consisted of samples of their underground electric wires and cables, including samples of twenty miles of the 0000 cables, now being laid underground in the city of Buffalo by the Field Engineering Company, of New York, for the Buffalo Street Railway Company.

The Westinghouse Electric and Manufacturing Company, of Pittsburgh, Pa., was represented by Mr. H. McL. Harding, J. L. Barclay, H. W. Grannis, B. F. Stewart, W. G. Osgood, J. M. Atkinson, W. R. Rutherford, W. G. Rose, Mr. Schaffler. A Pullman street car, with eight wheels, elegantly furnished, costing $6,000 for the body alone, having two 15-horse power Westinghouse motors, was shown in actual operation. The weight of the car is 16,000 pounds. The car carried one trailer and worked satifactorily.

Mr. Charles L. Pullman represented the Pull- Company and made many friends for his system.

The Detroit Electrical Works, of Detroit, was represented by Paul W. Bossart, F. B. Rae, C. A. Benton, and W. A. Jackson, who had on the parlor floor an excellent working model of the Rae system. The apparatus was mounted on a Sheffield truck, and attracted merited praise.

Mr. C. S. Van Nuis, of New York, had a fine display of his well-known "Ajax" switches.

Continued on page 9.

LIGHTING OF A MODERN MAN-OF-WAR.

In an article on the electric lighting of a modern man-of-war, in the London *Electrician*, some very interesting information is given on this important subject.

In reference to cut-outs the article says:

We must constantly keep before us the contingency of any compartment in the ship being flooded either through collision or a submarine explosion in war time, when the whole circuit in that compartment would be short-circuited, and it is impossible to over-estimate the fuel that would be added to the tendency to panic and confusion resulting from the "hurling" explosion of a torpedo or the crash of a collision, if they were followed by an extinction of light. Men can probably be trained to stand at their stations after the shock of some unknown accident; but to the listing ship and rush of water add darkness, the result can well be imagined. It is useless to talk of having the fighting candles always lit. These undoubtedly would be useful some ten minutes or so after the electric light had gone out; but shining through their small bulls-eyes after the glare of the electric light they would relatively produce but sufficient light to make the darkness visible. It is for reasons such as these that a proper method of connecting sub-mains in water-tight compartments should be strongly insisted on, so that as far as possible the extinction of light may be confined to that one compartment. To do the first, the mains should be run the whole length of the compartments to be lighted, a submain being forked into each; secondly, a water-tight cut-out box should be fitted near the fork in the submain, and all leads to that compartment taken away from the further side of this box. Such an arrangement would act as a disconnecter, and insulate the mains from the flooded area around. Of course, it is quite possible only one cut-out would go, in which case the other wire would put the dynamo to earth, which, for many reasons, is objectionable; but should it be thought necessary to arrange for the fusing of both, methods will occur to any mechanic or electrician of causing both cut-outs to go on the fusion of one. One more practical point in connection with this subject. Any person accustomed to cut-outs knows that often it is impossible to predict which of several cut-outs in series will go first; sometimes a short-circuit in a branch may cause the main cut-out to go, another time a sub-main, and perhaps a third time both—it is entirely a question of additional heating and of contact in the cut-outs. To save main cut-outs as much as possible, the mains should be large for the current they carry, their cut-outs as large as possible consistent with their fusing before the mains heat dangerously, and their contacts kept scrupulously clean; more than this cannot be done.

In placing cut outs much of their efficiency depends on the positions chosen for them. Of course, in all circuits so liable to earth as those on board ship, cut-out wires should be in the lead, and return wires of mains, sub-mains, branches, and in leads for single lamps as near the place of branching as possible. A single cut-out cannot guard against an earth leak in the opposite wire; it is therefore very necessary to have one in each. Cut-out blocks should not, if it is possible to avoid it, be placed under steam or water service pipes, or if they have to be placed there, they should be made thoroughly water-tight, since the condensation of moisture due to varying temperature is often considerable. The wooden backs of switches or cut-outs, as well as brackets, should be filled in, where the wires lead through them, with an insulating cement, otherwise, with a sweating bulkhead, the horizontal holes become receptacles for the dripping water, and corrosion of the contacts, and earth leaks ensue. It is also a great help to sweat the lighting wires into the cut-out block, thereby reducing the number of surface contacts and the heating. If the man who wires a ship knows his work, he will place the switches and cut-outs in places where they are reasonably get-at-able, not, as is only too often done, some 10ft. overhead on the underneath side of the deck above, or high up out of reach on a vertical bulkhead. As may well be imagined, it is an exasperating thing replacing such cut outs with the ship rolling. On such occasions a screwdriver, kept in the mouth, will prevent the active use of emphatic epithets. Whenever a cut-out is placed in the lead, and another in the return (as always should be the case), one should be a switch cut-out; if this is done it often means a great saving of time to the person replacing the cut-out, as he can at once switch off the circuit and replace the wires, otherwise he would be obliged either to switch off the whole circuit, or every individual light beyond.

Laying the Wires.—On board ship a favorite method of laying wires used to be to bed them in putty in wood casings, this, if carefully done, was often a very successful way; but if, as often was the case, the wire was put in first, and then putty pressed in on top, it was worse than useless for the putty never fairly surrounded the wire, and there was invariably a space behind, not only for the wet to creep along, but to lodge and collect, and this, of course, put the first faulty place to earth, or in the case of a leak in each wire connected the two. In vertical casings the ends should be made water-tight. Leaks are often traced either to water in a vertical casing, or to water which has come down such a downtake, and lodged in a horizontal casing. This especially applies to places where pipes form the continuation of a wooden casing. Junctions or forks in insulated wires cannot be made with too much care. It is perfectly useless using wire of high insulation if the forks in it are carelessly made, especially as the forks in the main and return are often close together inside the same casing, and therefore particularly disadvantageous for "non-contact" if carelessly made. With lead-covered wires of course casing can be totally dispensed with, except occasionlly as "Scotchmen" in exposed places, clips and brackets of brass being used in lieu, consequently there is but little danger of water lying about the junctions in the wire. The junctions, however, in the class of wire should be most carefully made (and they require a little skill in making neatly), for the insulation or rather packing between the wire and the lead case is not water-tight, and, therefore, any water inside the lead puts the conductor at once to earth. For really trying places, where the wires are exposed both to heat and wet, if carefully put up, this class of wire is invaluable. Whenever wires pass through water-tight bulkheads, or any deck, water-tight glands should be used to preserve the integrity of the bulkhead, otherwise, in time, if this is not scrupulously adhered to, the bulkheads become honeycombed and rendered perfectly useless.

INTERESTING FACTS ABOUT ELECTRO-MAGNETS.

The following facts and fallacies about electro-magnets were given by Prof. Silvanus P. Thompson in concluding a series of lectures before the English Society of Arts:

Fallacies.—The attraction of an electro-magnet for its armature varies inversely, as the square of its distance from the poles.

The outer windings of an electro-magnet are necessarily less effective than those that are close to the iron.

Hollow iron cores are as good as solid cores of the same size.

Pole-pieces add to the lifting power of an electro-magnet.

It hurts an electro-magnet (or, for that matter, a steel magnet) to pull off the keeper suddenly. [It is the sudden slamming on that in reality hurts it.]

The resistance of the coil of an electro-magnet ought to be equal to the resistance of the battery.

A coil wound left-handedly magnetizes a magnet differently from a coil wound right-handedly. [It is not a question of winding of coil, but of circulation of current.]

Thick-wire electro-magnets are less powerful than thin-wire electro-magnets.

A badly insulated electro-magnet is more powerful than one that is well insulated.

A square iron core is less powerful (as Dal Negro says, eighteen-fold!) than a round core of equal weight.

The attraction of an electro-magnet for its keeper is necessarily less strong (one-third according to Du Moncel) sideways than when the keeper is in front of the poles.

Putting a tube of iron outside the coils of an electro-magnet makes it attract a distant armature more powerfully.

Facts.—A bar electro-magnet with a convex pole holds on tighter to a flat-ended armature than one with a flat pole does.

A thin round disc of iron laid upon the flat round end of an electro-magnet (the pole end being slightly larger than the disc) the disc is not attracted, and will not stick on, even if laid down quite centrally.

If a flat armature of iron be presented to the poles of a horseshoe electro-magnet the attraction at a short distance is greater, if the armature is presented flankways, than if it is presented edgeways. On the contrary, the tractive force in contact is greater edgeways than flankways.

Electro-magnets with long limbs are practically no better than those with short limbs for sticking on to masses of iron.

ELECTRIC TRACTION IN ENGLAND.

In view of the great interest in and rapid development of electric railways in this country a description of what is being done in this direction in other countries will be of interest to those concerned. In London recently an electric tram car was tried and, according to all reports, gave general satisfaction in its performance. The accumulator system is used, and the car was operated by the Electric Tramcar Syndicate, limited, who are working the Jarman patents.

The car is of a similar pattern outwardly to the new two-horse tramcars, providing accommodation for 44 passengers, the outside being fitted with garden seats. The motor is double, the two armatures being carried on one spindle. The field magnets are wound on the "gamut" plan, to facilitate the regulation of the motor and the consumption of power in proportion to the work to be done. The gearing consists of a single set of mortise wheels and pinions; the mortise wheels are of special construction, with vulcanized fibre teeth. The reduction in speed from the normal 650 revolutions per minute by the motor axle to 90 by the car wheels, provides for the propulsion of the car at the rate of between 7 and 8 miles per hour. This speed can be increased, when necessary, by using the full power of the motors in parallel to a maximum of about 16 miles per hour on the level. The motor and gearing are fixed to a steel frame attached to the axle boxes.

The driving arrangement is contained in a vertical case, enclosing a cylindrical commutator switch. By means of this switch all the manipulations requisite in working the car, whether for varying the speed, cutting off the current, or reversing the motor, are performed by turning one handle. The brake handle is on a somewhat higher level than the driving one, to avoid the chance of any interference one with the other.

The battery of E.P.S. accumulators supplying the current to the motor consists of 52 double cells of the E type—19 plates in each cell—the whole coupled in series. The capacity of the cell is 140 ampere hours.

To enable the car to turn sharp curves, one of the wheels on the trailing axle is loose; this furnishes end play enough to allow the wheel base to accommodate itself to the different degrees of curvature to be found in the track usually laid down in England.

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The McGuire Mfg. Co., of Chicago, was represented by Mr. McGuire and Mr. Cook, the vice-president. The company's exhibit consists of two new car trucks, on each of which a Westinghouse motor was mounted.

The New York Indurated Fibre Pipe Company had a full display of their goods, and was represented by Mr. C. G. Collingwood.

The Aluminum Brass and Bronze Co., of New York, represented by Frank C. Stone, general sales agent, had a handsome exhibit of a trolley made of aluminum, which has proved a very attractive feature of the exhibit.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Oct. 16, 1890.

The great mechanics' fair building presents a very beautiful appearance in the evening, illuminated by the most improved electric lighting apparatus.

The T.-H. Electrics outplayed the Woven Hose, of Cambridge, on the West Lynn grounds, Saturday afternoon in the presence of about one thousand spectators.

P. B. Downing, son of Jefferson Downing of this city, has sold his electric car switch to the Lewis and Fowler Manufacturing Company of Brooklyn for ten per cent. royalty.

Electric Hall, West Lynn, controlled by the employés of the Thomson-Houston Co., is rapidly becoming a popular meeting hall, and is now taken by some society nearly every evening in the week.

The conduit system, now being laid in the T.-H. E. tracks on Federal street, will, if pains taken count, be a success. Concrete is being used to fill in the space between the rails on the surface of the road.

Lewis R. Fletcher, superintendent of the Middlesex Electric Light Company, and Miss Annie A. Shedd, were married a few evenings since by Rev. George W. Bicknell. They left on a late train for New York on their wedding tour.

At a meeting of the board of aldermen at Lynn, last Tuesday night, the Lynn Belt Line Railroad Company petitioned for an extension of its tracks and for a permit to erect and maintain the poles and wires necessary for the electric system.

An effort is being made, with a good prospect of success, to establish an electric railroad in the town of Winthrop to connect with the South Ferry at East Boston. The enterprise is in the hands of men of means, and the plan is looked upon by the citizens generally with favor.

The directors of the Springfield Street Railway Co., voted Monday to call a meeting of stockholders to ask that the capital stock, $400,000, be doubled so as to use electricity on all the lines. The single trolley system has been successfully used one season on the line to Forest Park.

The Lower Mills Improvement Association of Dorchester met at Odd Fellows' Hall, River street, Saturday evening, and appointed committees to look after the interests of the section as regards extending the Grove Hall electric car line to Milton, and to try to secure electric lights along Washington street to Milton.

Last Saturday evening the Citizens' Association of South Boston met in Gray's Hall, President Albert F. Lauten in the chair. The committee on travel and transportation reported that they had seen President Whitney, of the West End road, and he had informed them that as soon as the East Cambridge bridge was opened a line of electric cars will be started from East Cambridge to Bay View, City Point.

The recently organized syndicate of stockholders of the Anglo-American Electric Light Company met in Kensington last evening. There were fifteen present, representing a majority of the stock. It was decided to offer the property to the city of Meriden for $35,000. The following officers and board of directors were elected: William H. Norton, president; Willis Upson, secretary and treasurer; Elma S. Kilby, Frank Wilcox and John Boyle, board of directors.

A new rosette cut-out is exhibited at the office of J. H. Coombs, 146 Franklin street, this city. This rosette, Mr. Coombs claims, will "beat the world," and it certainly seems so, for during the exhibition the rosette was entirely submerged in water and when taken out did not show the least sign of a leak. The model on exhibition was made of wood and in a very attractive shape. When put upon the market they will be made of porcelain.

The following officers have been elected by the stockholders of the Eastern Electrical Supply and Construction Co.: Maybin W. Brown, president; Albert Otis Smith, treasurer. These gentlemen, together with C Fred. Hutchinson, L. A. Dean and Samuel O. Mosely, were elected directors. This company have just filled a large order to be shipped to Paris, included in which was a large number of Burnley Dry Batteries. Mr. Henry F. Kellogg, formerly with the Thomson-Houston International Company, has connected himself with this house and is now on the road.

The East Side Street Railway Co. of Brockton held its annual meeting Wednesday, and of the 268 shares 261 were represented. The following board of directors was chosen: A. C. Thompson, W. C. Flagg, and John H. Kinman, of this city; Winthrop Coffin and A. A. Glasier of Boston, and G. W. Mansfield of Melrose. The reports of the treasurer and superintendent gave evidence of the prosperity of the road. The company will soon extend its tracks to Whitman, Stoughton, N. Easton, Holbrook, Avon and Randolph. Work on the Randolph, Avon and Whitman extension will begin this fall, and the contracts for the work have already been awarded. The majority of the stock is now held by a Boston syndicate, and it is expected that the work will be extended to other towns than those mentioned, and petitions with that end in view will be presented to the Selectmen in the spring.

The meteorological observatory at the Agricultural College at Amherst, has received a very delicate and expensive apparatus for measuring the electric potential of the atmosphere. This instrument was ordered by Prof. Charles D. Warner, chief of the meteorological department of the Hatch experiment station, a year ago, and ever since then has been in process of construction by Elliott Bros., London, Eng. Its cost was $600, and it is a most delicate and complicated machine It consists of a Thompson electrometer, a registering apparatus and a water-dripping apparatus. By means of the water-dripping apparatus the electricity of the air is conveyed to the electrometer, where a magnetic needle is hung between four quadrant magnets. A mirror is so arranged above this needle as to turn with every variation, reflecting a pencil of light thrown by a confined gas jet on to sensitized photographic paper stretched upon a cylinder in the registering apparatus. The cylinder is operated by powerful clock work. The wavy line of light is continuously photographed, and thus represents the variations of the electrical potential of the air, which are measured by a suitable scale on the chart. This instrument is the only one of its kind in the United States and one of the few in the world. W. J. P.

A. A. Honey and N. T. Collett, of Portland, Ore., both interested in the electrical business of the Pacific coast were visitors in New York this week. They made many friends while in this city.

NEW YORK NOTES.

Col. L. W. Burnham, of the Electric Gas Lighting Co., of Boston, was in town last week.

Owing to the increase in business the Crosby Electric Co., has removed its offices from the Judge Building to the factory, which is situated at 87 and 89 South Fifth Ave.

The American Type Telegraph Company was incorporated in Newark, N. J., Oct. 16th with a capital of $600,000 and $500,000 paid in. The incorporators are Horace P. Hussey, Cleveland; William Henry Smith, Chicago; Joseph G. Siebeneck and Robert H. Campe, Pittsburgh, and John E. Wright, New York. Mr. Wright is the inventor of a printing telegraph instrument for which great efficiency is claimed, and the company is organized to manufacture and sell the machines.

The Aerial Conduit Company, limited, with a capital of $35,000, was incorporated in Albany, Oct. 15th, by the Secretary of State. The company has for its objects the manufacturing and sale of conduits and tubing for electrical conductors and wires and other purposes, and posts and other supports for the same, together with supports for electric lights and wires and insulated wire cables and other materials, and the doing of all things incidental to carrying on such a business in the city of New York. The incorporators are John F. Gibley and Frank W. Rennell, New York City, and James Craig, Fred H. Smith, and Austin Gallagher, Brooklyn.

The Carnegie Music Hall, at the corner of 57th street and 7th avenue, is rapidly approaching completion. This place of entertainment is a gift of Mr. Andrew Carnegie the well-known iron manufacturer, and is conspicuous from an electrical standpoint in that it will have one of the largest and complete electric light plants in the country. It will be lighted throughout with electricity, the Thomson-Houston system being employed. There will be 4,000 incandescent lamps. The wiring of the building for these lamps is to be done exclusively with the Grimshaw White Core Wire, manufactured by the New York Insulated Wire Company, 649-651 Broadway, at a cost of about $15,000. Four dynamos will be operated, and the power will be supplied by four 150-h.p. Straight Line engines.

In speaking of Grimshaw White Core Wire, it is a fact worth noting that this celebrated wire has been used to a very great extent in wiring many of the new and prominent buildings. It is held in high appreciation by architects and builders and those who use it. The new *World* building is almost entirely wired with this favorite wire. R. J. G.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Ill., Oct. 18, 1890.

The increase in business of the Fletcher and Fletcher Electric Co., Cleveland, Ohio, has necessitated additions to their works, which now extends from South Water street through to the Big Four Railway tracks in their rear. Their low prices on annunciators, bells, pushes, switches, etc., have won for them a large trade in every State, Canada and Mexico.

The Chicago Auditorium is so well noted for presenting unique features in every department, that novel electrical appliances were there to be looked for, and many of these have attracted much attention. Others are now being added, among then being a set of electric floor indicators for the elevators. These, like the whole system of annunciators, guest calls and the like used there, were designed by Mr. Chas. G. Armstrong and possess the same stamp of originality. His new switch, which we mentioned recently, will be put on the market shortly by the Great Western Electric Supply Co., of Chicago.

F. M. I.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED OCTOBER 14TH, 1890.

438,116. Electrode for Secondary Batteries. Waldron Shapleigh, Camden, assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed Nov. 13, 1889.

438,118. Terminal Switch or Cut-Out Device for Electric-Lighting Systems. Walter F. Smith, Philadelphia, Pa., assignor to the United Electric Improvement Company, Gloucester City, N. J. Filed June 3, 1890.

438,127. Burglar-Alarm. William J. Ackerman, Grand Rapids, Mich. Filed Oct. 12, 1889. Patented in Canada.

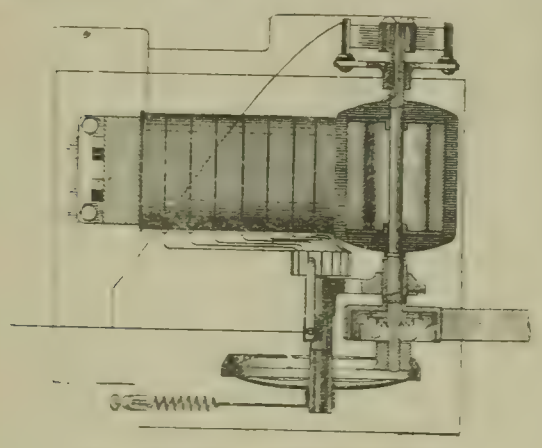
438,134. Electric-Arc Lamp. Alfred Apps, London, England. Filed June 17, 1890.

438,145. Regulation and Control of Storage-Batteries. Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Gas Improvement Company, same place. Filed July 30, 1890.

438,167. Circuit Closer. Thomas Marcher, Neumarkt, near Nuremberg, assignor of one-half to Ferdinand Ernecke, Berlin, Germany. Filed Jan. 7, 1890. Patented in England and Germany.

438,192. Electric Motor-Car. Jabea F. Shawhan, Detroit, Mich., assignor, by direct and mesne assignments, to the Shawhan Motor Company of Michigan. Filed May 10, 1890.

438,197. Gearing for Motor-Cars. Oliver C. Smith, Ipswich, Mass., assignor to the Electric Rapid Transit Company, of New Hampshire. Filed Dec. 26, 1889.



NO. 438,204—ELECTRIC MOTOR.

438,204. Electric Motor. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company of Connecticut. Filed Mar. 5, 1885.

438,211. Support or Hanger for Trolley-Wires. Herbert C. Wirt, Boston, Mass. Filed Mar. 12, 1890.

438,226. Apparatus for Measuring the Strength of Electric Currents. Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Gas Improvement Company, same place. Filed Mar. 29, 1890.

438,233. Telegraph-Instrument. John Geary, Philadelphia, Pa. Filed Jan. 11, 1890

438,234. Circuit-Closer. John Geary, Philadelphia Pa. Filed Mar. 3, 1890.

438,236. Electric Safe-Lock. William H. Hollar, Elizabeth, N. J., and Frederick S. Holmes, Malden, Mass., assignors to James W. Torrey, Merchantville, N. J. Filed Feb. 3, 1890.

438,260. Electric Switch. Charles W. Smith and Cornelius J. Lyons, Boston, Mass. Filed June 11, 1890.

438,262. Electrical Railway-Conduit System. Malone Wheless, Nashville, Tenn., assignor, by direct and mesne assignments, to the Wheless Electric Railway Company, Alexandria, Va. Filed Feb. 8, 1890.

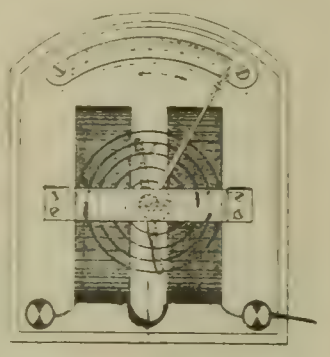
438,293. Electric-Railway System. Frank J. Sprague, New York, N. Y. Original application filed December 15, 1884. Divided and this application filed May 21, 1885.

438,298. Manufacture of Incandescent Electric Lamps. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Dec. 8, 1882.

438,299. Manufacture of Carbon Filaments. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Mar. 16, 1883

438,300. Gauge for Testing Fibres for Incandescent Lamp Carbons. Thomas A. Edison, Menlo Park, N. J. Filed June 7, 1883.

438,301. System of Electric Lighting. Thomas A. Edison, Menlo Park, N. J. Filed June 29, 1883



NO. 438,225—APPARATUS FOR MEASURING THE STRENGTH OF ELECTRIC CURRENTS.

438,302. Commutator for Dynamo-Electric Machines. Thos. A. Edison, Menlo Park, N. J. Filed Oct. 10, 1883

438,303. Arc Lamp. Thomas A. Edison, Menlo Park, N. J. Filed June 10, 1884.

438,304. Electric Signaling Apparatus. Thos. A. Edison, Menlo Park, N. J. Filed Dec. 15, 1884.

438,305. Fuse-Block. Thomas A. Edison, Menlo Park, N. J. Filed October 14, 1885.

438,306. Telephone. Thomas A. Edison, Menlo Park, N. J., and Ezra T. Gilliland New York, N. Y. Filed Feb. 19, 1886.

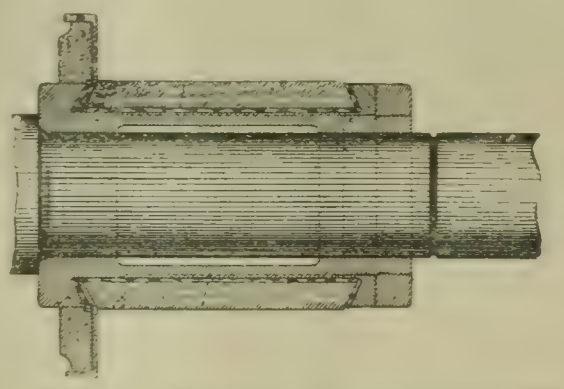
438,307. Manufacture of Incandescent Electric Lamps. Thomas A. Edison, Llewellyn Park, N. J. Filed July 17, 1886.

438,308. System of Electrical Distribution. Thomas A. Edison, Lewellyn Park, N. J. Filed Dec. 6, 1886.

438,309. Method of Insulating Electrical Conductors. Thomas A. Edison, Lewellyn Park, N. J. Filed May 11, 1889.

438,310. Lamp Base. Thomas A. Edison, Orange, N. J. Filed May 5, 1890

438,326. Automatic Cut Out. George W. Richardson, Philadelphia, Pa., assignor of one-half to Edward D. Gross, same place. Filed May 20, 1890.



NO. 438,302—COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES.

438,344. Circuit-Interrupter. Nicolas Chaize and Jake Chaize, St. Etienne, France. Filed Sept. 23, 1889. Patented in France and in England.

438,357. Method of and Apparatus for Magnetic Separation of Ores. John M. McMahan, New York, N. Y., assignor to John D Cheever, same place. Filed Feb. 20, 1889.

438,359. Trolley-Wheel for Electrically Propelled Vehicles. Louis Pfingst, Boston, Mass. Filed July 14, 1890.

438,400. Connector for Electric Conductors. George J. Brennen, Lynn, assignor, by direct and mesne assignments, to Edward Frost, Littleton, and Arthur W. Tufts, Boston, Mass. Filed February 5, 1890.

438,404. Contact for Overhead Electric Railways. Albert H. Chadbourne, Philadelphia, Pa. Filed July 9, 1890.

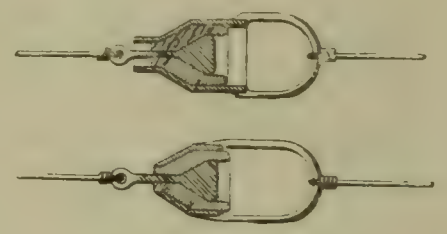
438,406. Method of Utilizing Electricity in the Formation of Sheet-Metal Articles. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed May 17, 1890.

438,407. Apparatus for Forming or Shaping Sheet Metal Electrically. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed July 28, 1890.

438,408. Apparatus for Forming or Shaping Sheet Metal Electrically. Mark W. Dewey, Syracuse, N. Y,, assignor to the Dewey Corporation, same place. Filed July 28, 1890.

438,409. Method of Utilizing Electricity in the Formation of Metallic Cartridge Cases. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Original application filed May 17, 1890. Divided and this application filed Aug. 8, 1890.

438,419. Electric-Light Shield. Alfred A. McCreary, New York, N. Y. Filed Sept. 16, 1889.



NO. 438,495—INSULATING JOINT.

438,431. Incandescent-Electric-Lamp Socket. James W. Collier, New York, N. Y. Filed Aug. 15, 1890.

438,434. Magneto-Generator. Noel B. Ginochio, New York, N. Y., assignor of one half to Elias M. Greene, same place. Filed Feb. 4, 1890.

438,452 Electric Railway-Brake. Charles J. Van Depoele, Lynn, Mass. Filed Apr. 9, 1890.

438,495 Insulating-Joint. Sidney H. Short, Cleveland, Ohio. Filed Dec. 10, 1889.

438,525 Method of and Apparatus for Working Metals by Electricity. George D. Burton, Boston, Mass. Filed Aug. 12, 1890.

438,530 Telegraph-Key. Charles H. Crockett and Lansing C. Dedrick, Schenectady, N. Y. Filed Apr 2, 1890.

438,532 Insulating Appliance for Electric Batteries. Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Gas Improvement Company, same place. Filed June 18, 1890.

438,564 Electric Railway. Horace E Swift, Boston, Mass., assignor to Frank F. Corliss, same place. Filed May 15, 1890.

438,579. Electric Means for Preventing Boiler Incrustation. Albert B. Faunce, Quincy, Ill., and Samuel G. Cabell, Washington, D. C., assignors of one-third to Milton S. Cabell, Quincy, Ill. Filed June 7, 1890.

438,586. Galvanic Battery. Robert E. Murphy, St. Louis, Mo., assignor of one-half to William M. J. Crossmyer, same place. Filed Apr. 2, 1890.

438,590. Automatic Safety Cut-Out for Electric Circuits. Granville T. Woods, Cincinnati, Ohio, assignor to the Woods Electric Company, same place. Filed Apr. 8, 1890.

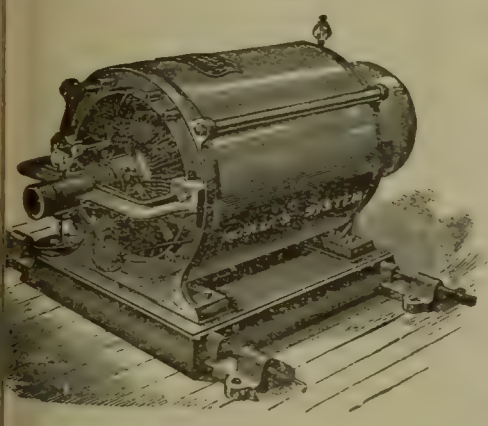
438,592. Electric-Wire-Distribution Box. William H. Eckert, Brooklyn, N. Y. Filed July 30, 1890.

PERSONAL.—Mr. David Chalmers has resigned his position with the Empire City Electric Co. and connected himself with Messrs. Alexander, Barney & Chapin, 20 Cortlandt street.

warded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889

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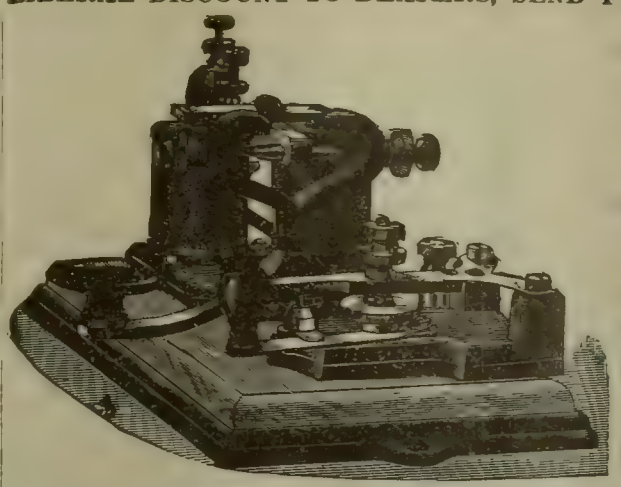
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No. 2 O. K. OUTFIT,

WITH SOUNDER AND KEY

On same base, or separate, as ordered

Complete Outfit,	$3.75
Sounder,	2.25
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The above Outfit consists of a beautiful Sounder wound to 20 ohms, and one of my unrivaled Nickel Plated, Legless, Steel Lever Keys; One Cell 5x7 Battery (or 6x8 Battery, 10c. extra); 15 ft. Insulated Office Wire, 1 lb. Vitriol, 1 Instruction Book, all safely packed and will be shipped on receipt of price, or sent C. O. D., subject to inspection, if you send me $1.00 with order. State whether you wish Key and Sounder on same Base or separate. Write your address plain and full, also state by what Express Co. wish goods shipped. Address,

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Warranted Stronger and of Longer Life than any other Sal-Ammoniac Battery made.

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EDISON'S GENIUS.

The following story is told by Dr. Wm. D. Gentry, of Rogers Park, Ill., who is a life long friend of Mr. Thomas A. Edison, the great inventor. It will be read with interest at this time.

"When I look back to twenty-five years ago," says Dr. Gentry, "and put Tom Edison as I then knew him alongside of the Thomas Edison of to-day, and note what has taken place, I am prepared almost for anything. Twenty-five years ago, as I sat by Edison in a New York telegraph office, I little thought that there slumbered within that man the fire of a genius that would one day startle the world. There was nothing wonderful about Edison. A plain and unpretentious man, he came and went without troubling any one with his conversation. Perhaps he spoke to me more than to any other man in the place, because we sat at adjoining tables.

"One day his wire gave out or went wrong in some way. He was working New Haven, I was operating Boston. He started to fix it, and while thus engaged his message came back over my wire. I called him. 'Tom, can you explain this?' He looked for a moment, and then remarked, 'Why, that is caused by induction; the two wires are near each other.' He went off, and shortly afterward came back, seemingly lost in thought. 'Yes; that's what causes it,' he repeated. 'I wonder if we could devise a plan like that to make two circuits on one wire, so that two men could send and two others receive at the same time?' And he went back to his instrument.

There is a tide in the affairs of men
Which, taken at the flood, leads on to fortune.

"Tom Edison took it then. Out of that little accident, he devised the duplex telegraph system. Then followed the quadruplex, and these have saved the telegraph company millions of dollars.

"He had been working on a telegraph system, but he discovered that the Wheatstone system—I think that is the name—covered the ground, and he gave it up. You know the rest. Edison's achievements are now no secret.

"The steps leading up to that perfected phonograph, how Edison discovered that the sound waves of the human voice might be so directed as to trace an impression upon a solid substance, are just as wonderful. Edison found it almost accidentally while he was experimenting with a different object in view. In manipulating a machine intended to repeat Morse characters, he found that when the cylinder carrying the indented paper was turned with great swiftness, it gave off a humming noise. That led to several experiments, such as fitting a diaphragm to the machine, which would receive the vibrations made by the voice. The cylinder, when rapidly revolved, causes a repetition of the original vibrations, just as if the machine, itself were speaking. That settled the matter, and Edison found that the problem of registering human speech so that it could be repeated by mechanical means as often as might be desired was solved. Yes; Edison is a genius."

A Beautiful Cable Chart.—The Direct United Cable Company have just issued a beautiful and artistically designed chart emblematic of their business and showing the route of their cables between America and England. In one corner is given a view of operators at work in the London office transmitting despatches to America, while in the opposite corner the operators in the New York office are seen receiving the despatches. The two offices as shown on the chart are connected by a cable which is artistically intertwined with the various figures and devices shown on the chart and which also forms a border for the whole picture. In the centre is represented the world floating in space, across which, between England and America the cable threads its way, and at the bottom is a view of an ocean beach along which another portion of the same cable lies. The whole thing is beautifully colored, and is very ornamental and suggestive.

BUFFALO CONVENTION NOTES.

Every spare bit of space in the Iroquois hotel down-stairs was occupied with apparatus connected with street railway traffic. Up stairs the parlors were likewise occupied. Headquarters for many noted manufacturers were pitched in the hotel, and the good qualities of the various appliances were extolled to all who would listen.

Every delegate received from the Buffalo Street Railway Company a handsome souvenir book containing complete information for the guidance of delegates during the convention. The book contained in a little pocket a set of 20 coupon tickets good for passage on the Buffalo lines from Oct. 15th until Oct. 19.

The *Street Railway Journal*, of New York, was published daily during the convention, J. H. McGraw is the Editor.

Telephone Companies, Supply Houses, Bell Hangers, Physicians, and all users of open circuit batteries are requested to write the

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NEW YORK.

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Pat. Mar. 15, 1887. THE OLD STYLE.

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BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the standard grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

THE WESTON STANDARD

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These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work. Address:

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BUSINESS NOTICES.

Advertisements under this head not occupying over one-half inch of space, $1.00 per each insertion.

INTERESTS IN A PROFITABLE ELECTRICAL BUSINESS will be sold to the proper party. Address PROFIT, ELECTRIC AGE Office, New York.

SITUATION WANTED by an experienced electrician, who is capable of taking care of a central station plant of any capacity. Address SITUATION WANTED, ELECTRIC AGE, New York.

ARMATURE WINDER.—We want a practical winder—Siemens—to take charge of our winding department. A good chance for the right man. State where employed. All communications strictly confidential.

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EXPERIENCED MECHANICAL DRAUGHTSMEN wanted immediately; those having experience with electrical apparatus preferred. Permanency to good men. Address E. KOLBEN, Edison General Electric Company, Schenectady Works, Schenectady, N. Y.

S. W. REESE & CO.,

MANUFACTURERS OF

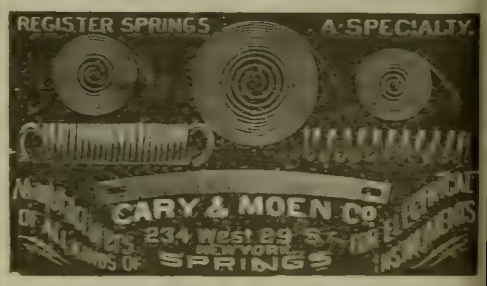
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MASON'S BATTERY.

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SMALL ELECTRIC LIGHT PLANTS.

The following list will illustrate the expense attending the purchase and use of small installations, and serve as guides when ordering plants for different purposes.

PLANT NO. 1.

4 No. 6 Cells at $1.25	$5.00
1 6-C.P. Incandescent Lamp, large bulb	.85
1 Key Socket	1.25
1 Shade and Holder	.50
50 Feet of Insulated Electric Wire	.50
2 Charges of Depolarizer will run 40 hours	.40
	$8.50

PLANT NO. 2.

4 No. 6 Cells at $1.25	$5.00
1 6-C.P. Incandescent Lamp, large bulb	.85
1 Key Socket	1.25
1 Shade and Holder	.50
50 Feet of Insulated Electric Wire	.50
2 Charges of Depolarizer will run 40 hours	.40
	$8.75

*PLANT NO. 3

6 No. 6 Cells at $1.25	$7.50
1 6-C.P. Incandescent Lamp, large bulb	.85
1 Key Socket	1.25
1 Shade and Holder	.50
50 Feet of Insulated Electric Wire	.50
3 Charges of Depolarizer will run 60 hours	.60
	$11.20

*This plant will be found useful for lighting small rooms, dining tables, desks, and for reading purposes. It will also properly light two stalls in a stable. Note.—Any number of 6-C.P. incandescent lamps can be employed, provided that not more than one is used at any one time.

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AGENTS

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NEW YORK, NOVEMBER 1, 1890.

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ROADS TO FAME.

Instructor Shephardson, of the electrical engineering department, of Cornell University, in a recent address to the senior electrical association, composed of students in that University, gives some very sound advice to graduates in the electrical department.

As a rule it is the practice for graduates to go at once into some large electrical establishment in order to gain practical experience in electricity. This means that they drift almost exclusively into the electric lighting and electric power fields. These are exceedingly important industries, of course, but there are many other branches of the science of electricity that are being neglected. Mr. Shepardson takes occasion in his address to bring this fact prominently before the future graduates, and points out the various fields into which investigation should be carried, and he advises that some attention be given these by graduates who wish to make a name for themselves.

If the advice is acted upon—and we think that it should be—there is no doubt that many of the young men who are just stepping out into the practical world from college life would figure more prominently before the world by taking a new direction for the application of their theoretical knowledge. In the electric light and electric power fields they would, in nine cases out of ten, become swallowed up in the great army of workers in these branches and be lost sight of entirely, whereas by going into one of the comparatively unexplored fields they might win for themselves a name and fame that would shine for all time to come.

DOMESTIC ELECTRIC LIGHTING.

On another page will be found an interesting article giving some valuable points on domestic electric lighting. Every intelligent housekeeper is hoping to soon see the day when domestic lighting will be a real and practical thing. Every one knows that the electric light is the healthiest and most convenient of all lights, and these considerations more than any others, appeal to the housekeeper. Electric light in the home in the summer time would be a luxury on account of the little radiation of heat. The article referred to puts great stress upon the use of the gas engine as one of the steps towards the realization of these hopes. For domestic electric lighting, the gas engine certainly has no equal. It is peculiarly adapted to domestic use on account of the ease of management, no steam boilers to look after and economy in fuel, *i.e.*, gas.

An economical source of power to run a dynamo of course, is the greatest consideration, and the gas engine stands at the front in this respect. This, of course, is understood to apply to the operation of small plants, such as would be required to light a small house.

The storage battery feature of the plant is an interesting and valuable one, and is another step in the direction of economy in the maintenance of the installation.

For domestic lighting, the plant should not necessarily require expert care; it should be economical as compared with other methods of illumination; it should be free from all elements of danger, and it should be simple.

Here is a great field for development. Commercial electric lighting has been made a success, now some of our ingenious electricians should turn their attention to devising a practical method of lighting our homes by electricity.

ELECTRICITY IN WARFARE.

In the event of a sudden outbreak of war, electrical engineers and electricians now engaged in industrial pursuits would of necessity be called upon to aid in the defense of the government's integrity. This was the predominant idea in the interesting lecture delivered before the New York Electrical Society, Thursday of last week, by Lieutenant Bradley A. Fiske, U. S. Navy.

That electricity would be the most important factor in warfare, next to generalship, is acknowledged by all who have watched the wonderful progress it has made in its application to the science of warfare. Electricity is doing about everything now in military and naval operations when it is commanded to, and it is indeed difficult, at least for a civilian, to appreciate its vast importance to these departments of our government. It gives light, performs the work, fires guns, and by its aid the guns are trained on the enemy with wonderful accuracy. It also enables the enemy to be located at night, quite as easily as by day—in short it does everything of transcending importance in warfare. A thorough knowledge then of electrical science would be essential to the rapid equipment of forts and vessels with electrical apparatus of all kinds, in the case of a sudden outbreak, and in such an emergency the government would necessarily be compelled to call for volunteers in this line.

Lieut. Fiske's proposed plan of organizing an electrical corps for the army and navy is a feasible one, and with such a body of men in reserve the government would indeed have a strong bulwark of defense in time of need.

STORAGE BATTERY CARS.—Mr. D. H. Bates in his paper on storage battery cars, which was read at the convention of the Street Railway Association, brought out the valuable features of this system of street car propulsion very prominently, and in a telling manner. His remarks made a deep impression upon those who heard them, and no doubt many of the delegates returned home with a better feeling toward the storage battery system than they had when they first came to Buffalo. "Seeing is believing," and those who saw the storage battery car in practical operation were constrained to believe it a practical thing.

EFFICIENT MOTORS.—The statement made by Mr. George W. Mansfield, one of the representatives of the Thomson-Houston Company, at the recent street railway convention at Buffalo, that his company had turned out in the neighborhood of 3,500 motors, and that nearly all were still in use, is a showing that the company may well be proud of. "We feel that we have planned on the correct principle," said Mr. Mansfield, and this claim certainly seems to be borne out by facts. Another interesting statement made by Mr. Mansfield, and one which still more verifies their claim that they have the right principle, is that the first motors the company put out are yet in operation, and that all of the parts constituting the motors that are built to-day can be used with the first motors put out. A motor that survives the test of time without undergoing any material change in its parts must be a good one, and there is no gainsaying the fact that the Thomson-Houston motor belongs to this class.

QUESTION OF MANAGEMENT.—"It is a question of management and lies directly with you, gentlemen," said Mr. E. E. Higgins, of the Edison General Electric Company, to the street railway delegates at Buffalo, "as to the success of electric traction," and that is indeed sound logic. There seems to prevail an idea that an electric motor is a machine that will work in spite of everything so long as it is fed with electricity. The result is it becomes inefficient through neglect, and the electrical apparatus becomes at once the object of unfavorable criticism. The electric motor is a machine, and requires care and attention just as other pieces of mechanism do, and when it receives proper care it becomes a faithful servant. Mr. Higgins was right in his assertion. The electrical part of an electric railway is all right, but it must be cared for.

IMPROVED COMMUTATOR.—The commutator of a dynamo or motor is the most delicate part of the machine, and requires constant care and watching. The metallic dust resulting from the wearing of the brush on the commutator segments causes trouble sometimes by bridging over the insulation between the segments, causing a short circuit, and burning out. There are other troubles peculiar to the ordinary commutator which are too well-known to mention. A perfect commutator, therefore, is a desideratum, and much time and ingenuity are applied by many electrical engineers with this object in view. Mr. Harry H. Blades, of Detroit, is the inventor of an improved commutator which seems to possess some very meritorious features, and is a step forward in the direction of a perfect commutator. We describe and illustrate the device on another page.

THE WESTINGHOUSE RAILWAY MOTOR.—At the recent convention in Buffalo, of the Street Railway Association, the advantages of all of the electric railway systems, but the Westinghouse, were set forth on the floor of the hall. It is regretable that the Westinghouse interests were not represented in a similar manner, then the chain would have been complete. It was a golden opportunity to expatiate on the merits of the various systems, and the opportunity was seized by those who were prepared to talk.

CAR STARTERS.—The car starter, described and illustrated on another page, is a device as ingenious as it is valuable. With its aid considerable power is saved in the starting of a car on grades, and when the car is stopped all danger of running away, down hill, is removed. There is a demand for such a device as this, and it ought to meet with favor.

LIGHTNING RODS.—Usually it is a difficult thing to understand the cause of the great damage sometimes done by lightning when striking lighting rods which are supposed to be efficient. An article on another page in this issue explains, in a very plain manner, the cause of such destructive effects and to a great extent takes away a good deal of the mystery surrounding the action of lighting.

THE HEDGEHOG TRANSFORMER.*

At the British Association meeting of last year, Mr. Swinburne contended that an open iron circuit could be made more efficient than any form of closed iron-circuit transformer. In calculating the efficiencies of transformers, the loss in the iron has generally been left completely out of account, and the loss in copper alone considered. If the loss by hysteresis is taken into account the loss in iron in closed circuit transformers, as usually designed, is some 10 per cent. of the full load. As the loss in iron goes on all the time a transformer is in circuit this is very serious. The proportion of actual to possible output of energy per day varies in different districts, but in most stations the average use of lamps is less than two hours a day, including all the lamps installed. The transformer must be large enough to feed all the lamps installed, so it runs, say, an average of two hours of full load a day. If there is a loss of 10 per cent. of full load in the iron, this gives an actual efficiency of 45 5 per cent., even neglecting the loss in copper. In the hedgehog form (see figure) the proportion of iron is very much reduced. The result is, that even in small transformers the iron loss is under 1 per cent. of the full load. One per cent. of the full load gives 89 per cent. all day, neglecting copper loss, against the 45 per cent of the closed circuit. This is neglecting copper, however, and the copper loss is greater in the hedgehog form, so this is an exaggerated comparison. Such a transformer really has an efficiency of about 87 per cent. all day.



HEDGEHOG TRANSFORMER.

If a closed iron circuit is used, the iron circuit must be long to embrace the copper coils. The only way to shorten it is to make the copper coils smaller. This means using a higher current density, which is wasteful, or fewer turns of copper. Fewer turns of copper demand a higher induction in the iron, or a greater cross-section, and both of these mean greater loss by hysteresis. If the iron circuit is opened, the sides of the embracing core can be removed, so the loss by hysteresis is divided by three. As there is now plenty of room for copper, the turns and cross-section can be increased, and the iron reduced still further. The object of introducing the closed-iron circuit was to reduce the magnetic resistance. An open-circuit transformer has much higher magnetic resistance. The question of magnetic resistance is not so important as might at first sight appear. Its increase demands more excitation or more magnetic-motive force, and this increases the loss in copper. The best form is thus a compromise. The hedgehog ends are to reduce the magnetic resistance. In a conductive circuit the resistance is low if the current density is low in all parts where the specific resistance is high. Similarly, in a composite magnetic circuit of iron and air, the magnetic resistance is low if there is never a high magnetic current density or induction in the air, which has high specific magnetic resistance. The magnetizing current in a hedgehog is high, but as it is a quarter of a period behind the primary current in phase, and as the primary wire has to be large enough to carry the primary current, the loss in watts is small. As this loss goes on all day, however, it is by no means unimportant, and has to be included in getting out the efficiencies of these transformers.

The construction of these transformers, as carried out by Messrs. Swinburne & Co., of Toddington, is very simple. A gun-metal casting of cross-shaped section forms the backbone. It is spread out at each end, forming legs at one and taking the circular terminal board at the other. It also carries insulating flanges, which form the ends of the coils. Into the four recesses in the core are put four bundles of soft iron wire. These are taped over, and the secondary is wound on. The secondary is then covered with two layers of ebonite, and the flanges are also faced with the same material. The primary is then wound on in two compartments, separated with ebonite, after the manner invented by Gramme so that both ends come outside, and as far removed from each other as possible. The ends of the core are then spread out, and the transformer tested under 4,000 or 5,000 volts; the insulation in megohms being read by an instrument which measures the effective resistance under an alternating current. As iron cases cannot be used, as they would be magnetized by the transformer, and as any metal would have Foucault currents generated in it, stoneware jars, specially made for the purpose, are used for cases. These have lids bolted down, with holes for the heads.

* London *Electrician*.

NEW YORK ELECTRICAL SOCIETY.

Notwithstanding the inclement weather there was quite a good attendance at the opening meeting of the season of the New York Electrical Society, which was held Oct. 23d, in Prof. Chandler's room, School of Mines, Columbia College.

Lieut. Bradley A. Fiske, U. S. N., the inventor of that extremely important and serviceable apparatus known as the "Fiske Range Finder," read a most interesting paper. His subject was "The Modern Electrician in Time of War," and the purpose of the lecture was mainly to bring forward a plan by which, in time of war, all the electrical resources of New York, both in supplies and in men, would become instantly available for the defence of the city and the country. The lecturer adverted to the indispensable part which electricity now plays in naval and military warfare, as employed in the search light, which is almost as much a feature of the equipment of a modern ship as are her guns and her torpedoes; the telephone, which is coming into use for ship work and which will unquestionably supplant the unsatisfactory speaking tube; in the handling of the monster apparatus used in forts for guns, disappearing carriages, ammunition, &c.; for military service in the field, where the telegraph enables the General to manœuvre large bodies of men with precision and rapidity; and, not least, in the elaborate system of submarine mines which is now adopted for the defence of harbors. He drew a brief sketch of what would take place if war were suddenly declared, which served to suggest the immense amount of electrical work which would have to be done, and done on the instant. He showed conclusively that the regular army and navy could not perform all the necessary electrical work if war should break out suddenly.

To meet the contingency of a sudden war, Lieut. Fiske proposed the formation of a corps of naval and military electricians to assist the regular army and navy in its work. Such a corps might exist in every principal seaport town on the coast; the principal one, of course, to be the corps in New York. While the members of the corps would be men of technical knowledge, the organization should be a military one, and would be governed, with some modifications, by the same principles which govern all military bodies. Being a military body, under the governor of the State, it would at once become available on the outbreak of war. To this corps would be intrusted the arranging and fitting of gun carriages, the storage of ammunition, the assembling of guns, and the like. Their more immediate and obvious field, however, would be the installation and fitting of electric lights, motors, telegraphs, telephones and other electrical appliances on board the vessels of war suddenly called into requisition. The course of necessary instruction could be readily carried out, as it would mainly embrace the naval and military applications of the purely technical science with which the members of the corps would be already familiar. The system of instruction would naturally differ with the different ranks of the corps. With the higher ranks, it might embrace the theory and practices of gunnery, navigation, including compasses and seamanship and a certain amount of infantry drill, and occasional runs in the torpedo boat Cushing, and frequent short trips to sea for target practice in modern war ships. Lieut. Fiske suggested that the corps or battalion should include about 250 members, and that it should be officered, uniformed, and drilled in much the same way as the other corps of the National Guard. He was of opinion that such a body would be of immense value to the country.

Without the co-operation of the electrician in time of war, said Lieut. Fiske, the captain of a fine ship might lose an important action through his limited knowledge of electrical matters. On the small matter of touching a button might depend important results.

In describing the probable uses of electricity in the event of an attack, the lecturer said submarine torpedoes would come to the front at once. Electric launches fitted with torpedoes would dodge about noiselessly; electric picket boats would perform an important service, and electric sub-marine boats would carry enough explosive to destroy the finest ship of war.

The Lieutenant also referred to the immense advantage that would result in the co-operation of the civilian electricians with the army and navy in the event of war, on account of their acquaintance with business men, and knowledge of factories.

In conclusion Lieut. Fiske said a war would stimulate electrical invention to a greater degree than ever before attained, and the next war will produce electricians, now unknown, whose names will go down the ages.

ELECTRIC RAILWAYS.

The Galveston, Tex., City Railway Co., has contracted with the Detroit Electrical Works for a full electrical equipment of Rae motors and generators. The first installment of twenty motor cars and four generators, with full station equipments, will be in operation on or before January 1st, 1891. Col. Sinclair, president of the Galveston railway system, made very exhaustive investigations of the various systems and his ultimate decision is a very high compliment to the Rae system. The Detroit Electrical Works have forwarded to Portland, Ore., the first shipment of their standard 30-horse power motors and trucks (the Rae system) as the forerunner of a large order.

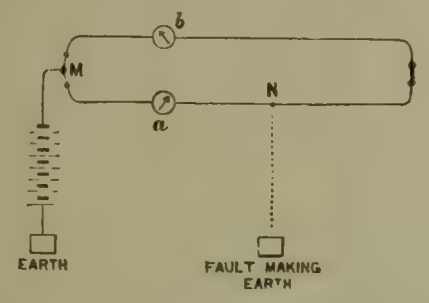
DISCLOSURE OF INVENTION.

It has been decided by the Commissioner of Patents that the mere statement of an applicant for a patent that he disclosed the invention is of no avail, either to constitute evidence of disclosure or to impart sufficiency to a statement of facts in themselves inadequate, unless he states by what agency the disclosure was made and the details of which it consisted. Sketches and models should be produced, if possible, or else reproduced from memory. If verbal disclosures are relied upon, the language used should be stated as nearly as possible.

LOCALIZING DEFECTS ON ELECTRIC LIGHTING CIRCUITS.

Mr. Henry Wilbrant describes in *La Lumière Electrique* a speedy method of localizing defects in an electric lighting circuit, which method he recommends for its simplicity. It is as follows:

An earth connection had formed in the negative conductor of a double line, the latter being composed of two parallel and identical protected cables laid in the clay. The following diagram indicates the way in which the defect was localized:—An amperemeter is attached to each conductor where the line commences, and both conductors are united together to a powerful battery of accumulators. At the end of the line the conductors are looped together. The battery being connected to the earth at its other extremity the current is closed by the defect and by the conductors forming the shunts, M *b* N, and M *a* N. Measures have been taken for obtaining an intensity of current that will render the reading of the amperemeter an easy matter. The readings, *a* and *b*, are inversely proportional to the resistances of the circuits in which the in-



struments have been inserted, and, as the conductor cables are identical, the resistances are directly proportional to the lengths in metres. It is as well to take into account any resistances from accessory loose cables in effecting the junctions with the amperemeter and the battery.

Let x represent the length in metres from the commencement of the cable to the defect (shunt M *a* N); L the length in metres of the two cables (this length having been previously ascertained), and *a* and *b* the number of the amperes indicated by the instruments, the ordinary calculation of the ramified circuits is:—

$$x = \frac{b\ \mathrm{L}}{a+b}$$

In applying this method to the total length of a 900 metres line, an approximation was obtained of close upon 5 metres, the difference being attributable to difficulty in reading from amperemeters of the ordinary type.

ENGINES FOR ELECTRIC LIGHTING PURPOSES.

Mr. Lewis F. Lyne in *Power Steam* compares the merits of slow and high speed engines for electric light work.

The chief advantages claimed for the high-speed engine for electric lighting are as follows:

The small floor space occupied is the prime consideration, as for example, in large cities, where space is very valuable, a number of small engines are often placed in a room where it would be impossible to locate a single engine of larger size. It is also claimed that by dividing up the power into small parcels, as it were, there is less probability of having the lights out through an accident to the engine than when a single large engine is used. Also when a number of engines are employed, and the full load (as is true in most instances where lights only are furnished) is on for about two hours, then, as the load is thrown off, one engine after another may be shut down. This gives an opportunity to make repairs and inspections. It is also asserted that one can afford to wear out and throw away small engines on account of their low first cost, as compared with larger engines.

It is admitted that small high-speed engines use all the way from four to ten pounds of coal per horse-power per hour, depending upon the condition and make of the engine. We were told recently of a test of a high-speed engine driving an electric light plant where fourteen pounds of coal were consumed per horse-power per hour, but the valves and packing were in a wretched condition, so this is an exception. The water consumption ranges all the way from thirty to thirty-six pounds per horse-power per hour. We desire to say that quite recently small high-speed compound engines have been introduced, working in connection with a condenser which have brought down the water consumption to about sixteen pounds per horse-power per hour, and the coal averaging about two pounds per horse-power per hour.

The advantages claimed for slow-running engines are as follows: By slow-running we do not mean a snail pace; say, for example, an 18 in. × 36 in. engine running 100 revolutions per minute. Economy of fuel (when we require, say, 100 H. P.); economy of water and oil; for large engines running at a moderate speed require about half the oil used by a small high speed, unless one of the enclosed trunk type is alluded to, in which case we will make an exception.

A large engine in good hands is likely to run for years without repairs, as, for illustration, we will mention an 18 in. × 36 in. running 100 revolutions per minute, which has done so for the past five years and upwards, without an expenditure of one cent in repairs. This engine is doing a horse-power with three pounds of coal per hour. High pressure compound condensing engines are coming into use quite extensively for electric lighting, and we know of one having cylinders 20 in. × 42 in. × 48 in. doing a duty of one and three-quarter pounds of coal per horse-power per hour, and using but thirteen pounds of water. A guarantee has recently been made for a triple expansion engine to do a horse-power on twelve pounds of water and one and a half pounds of coal per hour. It is understood that with the compound engine first alluded to but about half the boilers are required which are necessary to run the small high-speed engines developing the same horse-power. For electric lighting purposes the large engine running at a moderate speed, is gaining favor daily in places where it can be used to advantage.

EFFECTS OF HEAT ON COPPER.

Sir W. Thomson, twenty-five years ago, made some experiments on the "elastic fatigue" of wires. It was found that copper wires heated very hot in powdered charcoal, kept hot for a considerable time, and then, allowed to cool very slowly, became very brittle. The subject was not pursued, but it seemed that there was an effect from the powdered charcoal. He mentioned this fact during a discussion recently in Leeds, before the British Association, on the subject of Electrical Standards.

During the same discussion Lord Rayleigh mentioned an experience he had last summer, which showed some of the effects of minute traces of impurities in copper. He was passing pure hydrogen over copper. The copper wire was of the kind ordinarily used for electrical apparatus of high conductivity. He found that the hydrogen, after passing over, contained sulphuretted hydrogen; it seemed impossible to get any copper which did not give off sulphur, and give it off apparently for an almost indefinite time. Some of the wires were heated for hours nearly every day for weeks, but they yielded sulphuretted hydrogen at the end. When they were taken out they were found to be absolutely brittle; suggesting the idea, at any rate, that the removal of the sulphur, and possibly of oxygen, had been fatal to their mechanical properties.

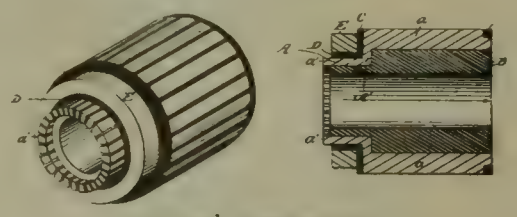
A NEW COMMUTATOR.

Mr. Harry H. Blades, electrician of the Detroit Motor Company, Detroit, Mich., has recently brought out an improved commutator for dynamos and motors which possesses some novel and valuable features, of which the following is a description.

Figures 1 and 2 show respectively perspective and longitudinal sectional views of the commutator.

This commutator is constructed with much greater facility than commutators that are ordinarily made, and has the great advantage of being made cheaply. The parts are so arranged that as the periphery of the commutator is worn by the friction of the brushes the commutator still remains serviceable.

Referring to the figures: A cylinder or thimble A, from which the segments *a* are formed, is first sawed radially for a distance from the end having the shoulder A′ into segments the desired width. The core B of insulation is then introduced. The outer surface of this core B conforms to the shape of the cylinder A and is adapted to receive the shaft. The ring C of insulation is then introduced over the ends of the segments *a* and rests laterally against the shouldered ends A′ of the segments. Next, the ring D of insulation is introduced over the ends of the segments, and over this ring D and resting against the ring C is tightly fitted the metallic ring E. It will be seen that the shouldered ends of the segments are now held firmly in place by the ring E, which is thoroughly insulated from



BLADES' COMMUTATOR.

the said segments by the rings of insulating material C and D. The formation of the segments *a* may now be completed by sawing from the opposite end of the block, and the ring of insulation F introduced into a rabbeted recess on the ends. Sheets of mica are now firmly packed between the segments *a*, except at the ends *a*′, where the insulation is omitted to admit of the wires being attached to the segments.

One of the great features of this method of constructing commutators is, that the insulation between the segments will not burn out.

The segments having been formed after the insulating core has been inserted by sawing radially through the metallic cylinder, they are of necessity perfectly spaced.

The saw-kerfs may extend simply to the surface of the insulating-core, or one or more of them may be projected into the core itself. In the latter case the mica filling extending to the bottom of the kerf will serve to key the segments firmly to the core and so avoid the possibility of the core getting loose and turning within the segments.

Mr. Blades has obtained letters-patent on this improved method of constructing commutators, which is an ingenious one.

SHAVER TELEPHONES.—The Shaver Molecular Telephone Exchange in Littleton, N. H., is now in practical operation. The exchange has a capacity of forty subscribers but the full number is not yet connected. The routes comprise numerous angles, the longest line being about three-fourths of a mile, and the largest connection through central is about one and three-eighths miles. The articulation is satisfactory and the power of the instrument phenomenal. There is a call for the service in neighboring towns, and the local company intend introducing it in these places at an early day.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part XI.—Alternating Current Dynamos (continued).

208—In alternating current dynamos, which part moves when the machine is in operation?

In some machines, and most all those of American make, the armature rotates while the field magnets remain stationary, and in others the armature remains stationary and the field magnets revolve. In another class of machines both the armature and field magnets are fixed and the currents are induced in the armature by the revolution of appropriate pieces of iron.

209—Give examples of the first class?

The Westinghouse, the Brush, the Thomson-Houston, and the Slattery.

210—Give examples of the second and third classes named?

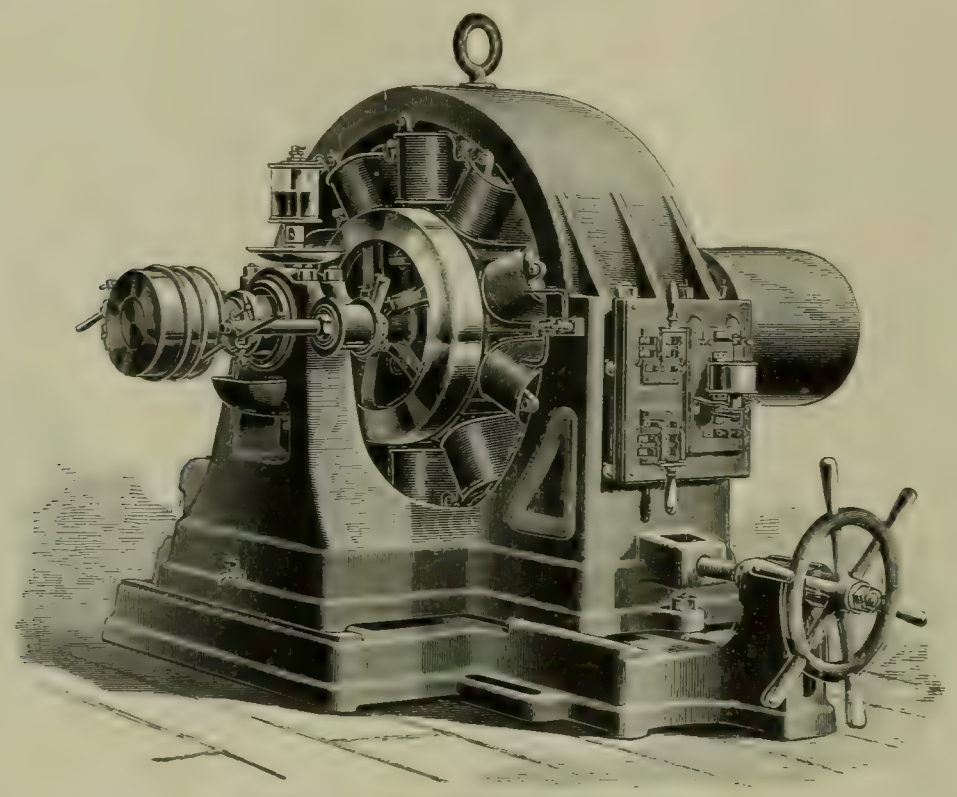


FIG. 1. WESTINGHOUSE ALTERNATOR.

The Gordon machine, and the Kingdon machine, both of English make.

211—Are permanent magnets used on alternators to any extent?

Not now. Many of the older machines had permanent magnets for field magnets.

212—How are the currents generated in an alternating current dynamo collected therefrom?

By means of collecting rings and brushes.

213—What are collecting rings?

The collecting rings are metal rings placed on the shaft at one end of the armature, and insulated from it. The rings represent the terminals of the whole series of armature coils. From these rings the current is collected by the brushes which are kept in constant contact with the rings as the latter revolve. See figure 2, which shows method of connecting the coils with the rings and the brushes.

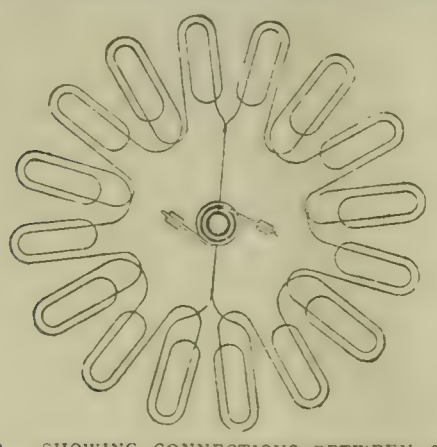


FIG. 2. SHOWING CONNECTIONS BETWEEN COILS AND RINGS.

214—What part of a direct current dynamo corresponds with the collecting rings of an alternating current dynamo?

The commutator.

215—How many ways are there of connecting up the armature coils of an alternator?

Two.

216—What are they?

In parallel and in series. (See Fig. 3).

217—For what purpose are the coils of an alternator connected in parallel?

For lighting incandescent lamps.

218—For what purpose are they connected in series?

For arc lighting and for supplying distant transformers.

219—Are iron cores used for the armatures of alternators?

Not always.

220—Why not?

Because iron heats so much when encircled by alternating currents.

221—What material is used for armature cores besides iron?

Sometimes wood is used. In the new Brush alternator the cores are made of porcelain.

222—How many types of armatures are used in alternating current dynamos?

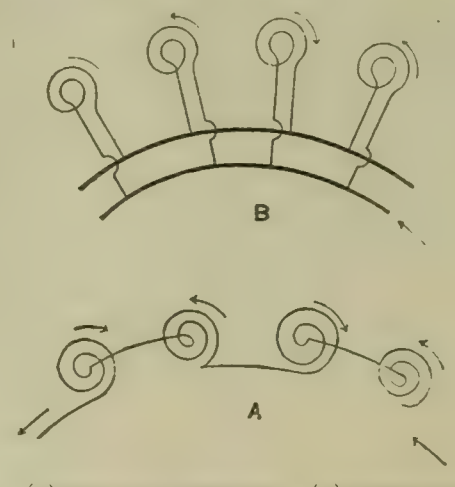


FIG. 3. (B) PARALLEL WINDING. (A) SERIES WINDING

Four: the ring, drum, pole and disk.

223—Give examples of machines using these armatures?

The ring type may be represented by the armature of the Gramme alternator; the drum type by the Westinghouse machine; the pole armature by Lontin's dynamo and the disk type is represented by several foreign machines.

224. When armature cores are made of iron, is solid metal used?

No; iron cores are laminated, the same as the cores for the armatures of direct current machines.

225—Are the brushes on an alternating current dynamo fixed or movable?

They are fixed.

226—Do they not require any resetting?

No.

227—Is there any sparking at the brushes of alternators?

No.

228—Why is it not necessary to reset the brushes of an alternator?

Because there is no neutral line, consequently no sparking.

229—What is the neutral line?

The neutral line is a line on the commutator cylinder of a direct current dynamo connecting the neutral points.

230—What are the neutral points?

The neutral points are the points in the commutator of a direct current machine, representing the maximum positive and negative difference of potential.

(To be continued.)

*Copyrighted.

ELECTRICAL NOTES FROM CORNELL.

Instructor George W. Shephardson, of the electrical engineering department of Cornell University, Ithaca, N. Y., addressed the senior electrical association recently on "Opportunities open to a Technical Graduate."

He advised graduates of electrical schools not to immediately go into some large construction shop, but rather to seek some undeveloped field. Among such fields of work he mentioned the following: Electric metallurgy, electroplating appliances, electricity as applied to chemistry, the simplification of the dynamo, the obtaining of electricity directly from heat, the improvement of the arc lamp as to carbon efficiency, electric car lighting, decrease of weight of storage batteries, gas batteries—possibly the obtainment of electricity directly from heat is through this agency; seeing at a distance, the telephone, the electrical utilization of the energy of the tides, "animal electricity or personal magnetism," electro-therapeutics, utilization of atmospheric electricity and earth currents, the improvement of gas lighting apparatus, a constant current dynamo regulator, an electric car truck in which armatures may revolve whether car is running or standing still, thus allowing the car to stop quickly when going down hill and to start easily, a method of connecting armature to wheels to do away with gears and allow the armature to always revolve in the same direction, which ever way the car is running. This avoids the necessity of designing pole pieces so as to give broad "neutral point," with the consequent loss of efficiency. armature gearing which is not a rigid ratio, allowing the armature to attain its velocity before the car starts; a trolley wheel combining good lubrication with conductivity, the avoiding of loss of energy when going around curves, lightning arresters for cars, and the getting rid of magnetism within electric cars.

At the next regular meeting of the American Institute of Electrical Engineers a paper will be read by Messrs. W. B. Tobey, '90, and G. H. Walbridge, '90, entitled: "Investigation of a Stanley Alternate Current Arc Dynamo," and the data for this paper was taken at the University.

THE BEST LIGHT KNOWN.—When we consider what the the arc lamp is, it is obvious beyond all doubt that it is the best light that has ever been known.—*B. E. Sunny.*

THE EDCO STORAGE BATTERY STREET CAR.*

BY D. H. BATES.

The horse is a noble and extremely useful animal, but he seldom combines high speed with great endurance. The fast trotter is made to run his mile in from two and a quarter to three minutes, but he does it only on rare occasions and is well fed and cared for between times.

It was not until yesterday when Mr. Odell's very interesting paper was read that I had any idea of the innumerable obtacles to be surmounted in first securing a perfect street car horse and second in maintaining him in a constantly efficient condition.

Judging from the expressions of a large number of street car men with whom I have talked on the subject of storage battery cars, I have inferred that your street car horse was ready for continuous hard work at all hours of the day or night, that it took no time to change horses at the end of a trip and that you only fed them at night after a sixty mile run, and that oats and hay were always cheap.

For all these or like requirements must be met with in our storage batteries, if they are to satisfy the average street car official. But when we undertake to show that the energy requisite to propel a sixteen foot car with its average load of passengers at the horse car rate of speed must be increased one-hundred per cent. if the speed be doubled and that the cost of producing that increased energy by whatever means you employ must necessarily be doubled, the scientific fact is perhaps admitted, but if the storage batteries are the medium it is always taken for granted that they ought to do double the service at half the cost.

The overhead systems in operation throughout the country have demonstrated to you, gentlemen, the fact that electricity is not the coming power but the power already come. The mileage of street roads in the United States which in June, 1890 were operated electrically is, according to the Eleventh Census, eight and twenty-six-one hundredth per cent. of the entire mileage, but omitting fifty-nine cities the proportion runs up to twenty-five per cent. This means one of two things, either that as a rule the authorities of our large cities will not allow overhead poles in the streets or that street car managers prefer to await the result from the use of the electric system on a small scale in the towns and smaller cities before introducing it in the cities on a scale of greater magnitude.

* Paper read at the American Street Railway Convention at Buffalo, Oct. 16th, 1890.

The overhead systems already introduced in many places have so far improved upon the horse and mule that the public, once given rapid transit, would not go back to slower methods and are clamoring everywhere for such facilities. You street-car owners and representatives, however, must look at the resultant in the matter of cost per car mile and net profits, and before some of you yield to the loud demands of the public for rapid transit, by adopting the overhead system, we beg of you to carefully consider the merits of the storage battery.

1. It will propel a car just as fast and just as efficiently, with all that that implies, as the trolley system applies equally to the storage battery.

A storage battery car is capable of much work that a trolley car cannot accomplish.

a. Storage battery cars can be introduced gradually, one or two at a time in connection with horse cars, cable cars or trolley cars.

We have already had proposals from a cable road for a few cars to be run at night when the cable road could only run at a greater proportionate expense, and from a trolley road where an extension was needed on a route that did not permit of trolley poles.

b. Storage battery cars can be run over any track or route where a horse car can run, thus avoiding blocks in cases of fires, processions and other obstructions.

Transfers of cars can, with this system, be made from one road or route to another in cases of necessity or convenience in handling an unusual traffic.

c. In cases of breakdown at power station, during hours of heavy traffic, storage battery cars could run forty-two or three hours with the 33⅓ per cent. reserve always remaining in the double sets of batteries.

Now, as to the figures relating to the battery system.

What is the cost of a storage battery car plant? What does it cost, per car mile, to maintain? What does it cost, per car mile, to operate?

Let us take a unit of fifty cars: 50 cars at $1,000, $50,000. Storage plant engine, nominally 500 H. P. (triple expansion) $12,500; 500 nominal H. P. boilers, fifty per cent. margin, $10,000; 50 sets of car motor equipments, each consisting of two 15 H. P. slow-speed motors, capable of being exerted up to 20 H. P. each for brief periods, with dust-tight covers, gearing and motors running in oil; starting, regulating, reversing and speed, switches, lamps, signals, batteries, etc., complete, $249,000.

Central station equipment, including dynamos, rheostats, switches, reserve batteries, shifting appliances, etc., complete, $128,400.

Grand total, $450,300; say, $9,000 per car for everything except buildings, road bed and track.

MAINTENANCE PER ANNUM.

Steam Plant, 10 per cent.	$2,250 00
Cars, 10 per cent.	5,000 00
Electric Plant, exclusive of Batteries, 10 per cent.	21,500 00
Batteries, 20 per cent.	31,680 00
Shifting Appliances, 5 per cent.	200 00
Total maintenance per annum	$60,630 00
Maintenance per car, per annum	$1,212 00
" " " day	3 32
" " " mile (on basis of 120 miles per day)	02¾ cents.

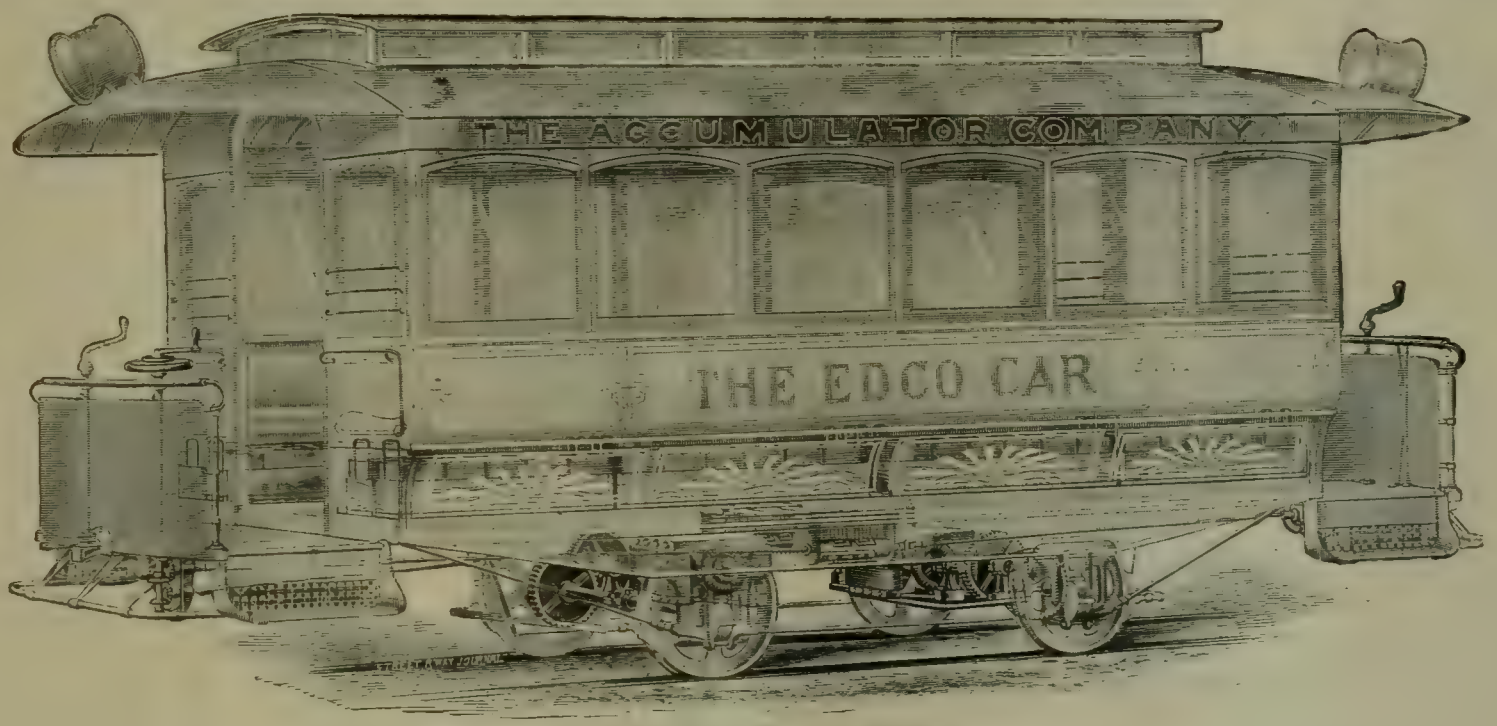
With a smaller run the wear and tear would, of course, be reduced.

SUPPLIES.

Water per day	$ 5.00
Oil and waste	2.80
Appurtenances and miscellaneous	2.80
Total Supplies	$10.60

RECAPITULATION AND SUMMARY.

Fuel per day	$27.00
Labor per day	37.00
Supplies per day	10.60
Total cost per day for operating	$74.60



THE EDCO STORAGE BATTERY STREET CAR.

Cost per car day for operation	1.48
Cost per car mile for operating	.01 34/100 cents
Cost of maintenance per car mile	.02 75/100 cents
Total cost of maintenance and operation per car mile	.03 99/100 cents

DATA REPOWER PLANT AND COST.

Horse-power required	500
Time required for producing such power	18 hours.
Total horse power hours	9,000 "
Coal, per horse power hour, with triple expansion engine	2 lbs.
Coal, per day	18,000 "
Or	9 short tons.
Coal being estimated at $3	$27 00

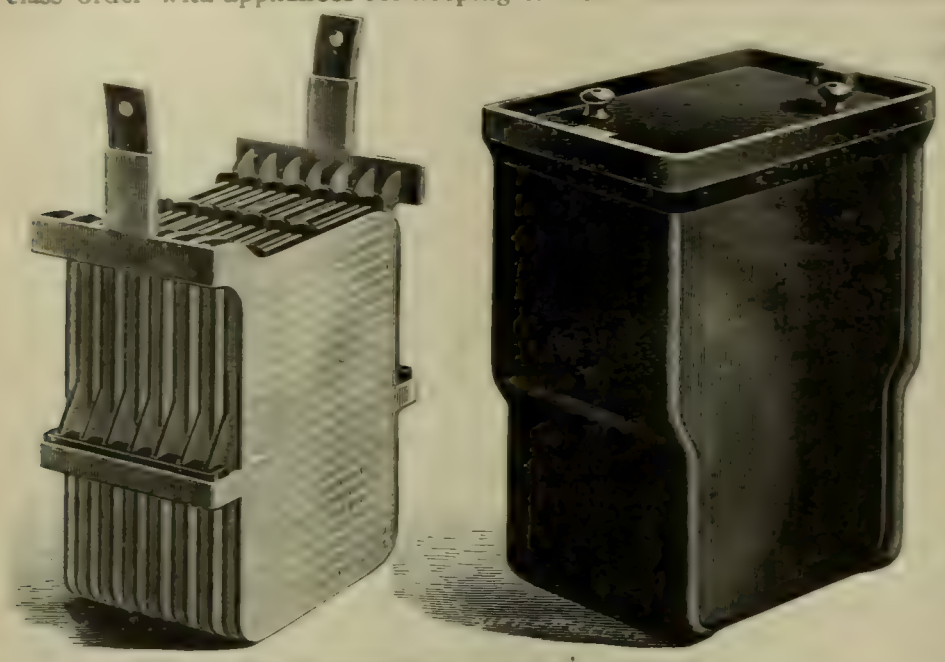
LABOR.

One Chief Engineer	$4 00
Two Assistants, at $2.50	5 00
Two Firemen, at $2.00	4 00
Two Assistants, at $1.50	3 00
Six Shifters, at $1.50	9 00
One Electrician	4 00
Two Assistants, at $2.50	5 00
One Dynamo Man	3 00
Total Labor	$37 00

The following are some of the conditions

fulfilled by this company with its storage battery cars

1st. That each car will be delivered in first class order with appliances for keeping it well



THE ACCUMULATOR COMPANY'S BATTERY.

under control and for readily operating it with such skill as would be possessed by an intelligent car driver after suitable instruction.

2nd. That each car will be run fifteen (15) miles an hour on a straight level and suitable track in good order, when carrying fifty (50) passengers, or an equivalent weight not exceeding 6,000 pounds.

3rd. That each car with the above load will ascend grades not exceeding five per cent. and not longer than 500 feet at the rate of at least five miles an hour.



FIG. 1.—FLOOD'S PATENT CAR STARTER FOR GRADES.

4th. That two sets of batteries per car shall be delivered, either of which when fully charged shall be capable of propelling a loaded car, as above, on a straight level and suitable track for a distance of sixty miles if required, when it shall be replaced by the reserve battery, which meanwhile shall have been fully charged. Each battery can be charged while its alternate is being used. As a matter of policy, we advise retaining one-third of the charge of the battery, as a reserve for emergencies.

5th. That the batteries when treated according to printed instructions and their parts renewed as required, will remain in an efficient condition.

We have already touched upon some points of advantage in the storage battery traction over the trolley system.

We will now refer to the inherent defects of the trolley system which do not pertain to storage traction.

1st. The disfigurement of streets by double lines of poles and trolley wires, with cobwebs at every curve

2nd. The frequent interruption of the entire system by a break-down at the power station or in the feeder wire.

3rd. The great and sudden fluctuations in the load which make such break downs of the power plant extremely frequent, many such breakdowns having already occurred, with trolley and cable lines, the extreme of no load and full load are reached suddenly from one to a dozen times every five minutes. This is not only destructive to the machinery (steam, electric and cable), but frequently causes a breakdown of the whole line, involving heavy outlays for repairs, serious loss of revenue and dissatisfaction on the part of the public.

4th. Bad economy in the power station due to the fact that maximum power must be provided in the engines and dynamos instead of the average power as provided in the storage system, causing the engines with the trolley system to run, with an average of about half their load, and, therefore, uneconomically; with storage battery traction the engines and dynamos run with an even and unfluctuating load continuously, giving the best possible economy of coal and increasing the life of the plant.

5th. Economy and inconvenience of operation requiring an expenditure of energy in all portions of the line, even though but one or a few cars may be running. For suburban roads and all night runs this feature is of special importance.

6th. Liability of generators and motors being burned out by lightning passing from the bare trolley wires through the motors to the ground.

7th. Liability to motors burning out with the high voltage current.

8th. The business public is inconvenienced by the derangement of the telephone service due to induction and leakage from the trolley lines to such an extent as to make the telephone service useless and dangerous.

Last and perhaps most important, at least to the general public, the trolley system requires a current of high potential conducted along bare wires extending over the entire route of the line, always liable to contact with electric light, telegraph, telephone, district messenger, fire alarm and police alarm wires, the system thus being a constant menace to life and property throughout the city. Contact with any foreign wire may lead to a conflagration such as destroyed immense values of property in Lynn and Boston within a year, and death to horses and human beings, numerous instances of both having been frequently reported in the public prints. Therefore we feel warranted in asking street car companies to give storage battery traction, which possesses none of these disadvantages, and involves none of these dangers, a fair trial under reasonable conditions and under the supervision of men experienced in the various branches of engineering involved in the business, and who have had nine years' experience in the manufacture and use of storage batteries.

FLOOD'S PATENT CAR STARTER FOR GRADES.

Everyone knows how difficult it is to start a car after it has stopped on a grade. A great amount of initial energy is required to get it in motion again, whether the car be propelled by horse-power, electricity, cable or steam, and various devices have been invented for the purpose of aiding and reenforcing the propeling power at the moment a start is made.

An ingenious device of this character is the Patent Car Starter for Grades of Mr. Patrick Flood, of 441 Central avenue, Albany, N. Y., which will be readily understood by the description and illustrations.

This starter consists of a dog or engaging bar, the end of which is pointed to facilitate its engagement in the pavement or ground between the tracks, and is pivoted to a sliding bar running under the rollers which reduces the friction to a minimum. On the sliding bar is a spring which compresses with a load, and the compression will be proportionate to the load. As soon as the car starts forward the resilient force of said spring aids in propelling the car in its forward movement.

Fig. 1 shows a view of the car with starter attached, and Fig. 2 a view of the details of the apparatus. The dog serves as a check or stop to prevent the car from running backward, and could and is meant to be used should the brake fail. It is operated by the driver by raising and lowering a foot lever attached to the dog by cables running on pulleys. When he wishes to stop on a hill, he drops the dog, applies the brake, and when the car stops, releases it, allowing the weight of the car to rest on the dog. Railway experts can readily see the great advantage over the old way in starting with the brake on, and what a great saving of power there is. These starters are in use on all the thirty-two cars of the Albany Railway Company, Albany, N. Y., and are so satisfactory that no car is allowed on the road unless equipped with one. The grades on this road are amongst the steepest in the world, but with this starter they are able to stop



FIG. 2.

when and where they please. They are simple, reliable and easily kept in order, and do not interfere with the wiring or motor mechanism of electric cars, and can be placed on any style of car or truck. If needed, they can be attached to both ends of truck.

An invention of this kind would surely have averted the frightful accidents at Cincinnati, Chattanooga and Lancaster.

THE QUESTION OF SUBWAY RENTALS.

The discord between the electric lighting companies using the subways and the company controlling the subways has broken out afresh, and this time it seems a more serious affair than any of the previous squabbles. The trouble, this time, involves the whole subway question and the cost of lighting to public and private consumers.

Suits have been instituted against the Consolidated Telegrapn Electrical Subway Company by the United Electric Light and Power Company, The United States Illuminating Company and the Brush Electric Illuminating Company, the Harlem Electric Lighting Company, and the Manhattan Electric Light Company. The suits are instituted to determine the amount of rental which the Subway Company has a right to charge, and also restrain the Subway Company from interfering with the cables and other property of the lighting companies in the subways.

The electric light companies allege this state of facts. The Consolidated Telegraph and Electrical Subway Company has heretofore, by virtue of its contract with the Board of Electrical Control, enjoyed a monopoly of building subways. Of the $3,000,000 of stock of this company, $1,605,000 is owned by the Metropolitan Telephone and Telegraph Company, $600,000 by the Edison Electric Illuminating Company, 4,380 shares by Edward Lauterbach, 2,500 shares by the North American Underground Construction Company, and the remaining shares by miscellaneous holders. It was stated by Mr. Lauterbach at a recent meeting of the Board of Electrical Control that bonds had been placed upon the subways to the amount of $4,750,000.

The Telephone Company is supposed to have furnished most of the money heretofore needed for the building of subways. About 550 miles of duct for telephone and telegraph purposes, have been constructed, 510 miles for general electric light and power purposes, and the Edison Company, by reason of its being a stockholder, has been specially favored, and has been allowed to build its own system of subways, and has laid for its own use about 70 miles of ducts. The other electric lighting companies have been compelled to occupy the subways built by the Subway Company, and at the present time are doing the greater part of their business through them, using for this purpose altogether about 180 miles of duct. At the present time, although a great amount of the work laid out for the present season has not yet been done, the work of building subways has been practically stopped by the Subway Company.

During the last year there has been serious controversies between the electric lighting companies and the Subway Company over several matters. The principal trouble, however, has been over rentals. The Subway Company has claimed the right to collect rentals at the rate of $1,000 a mile for ducts three inches in diameter. This is the size of almost all the ducts used by the electric lighting companies, and they have always regarded these rentals as unreasonable and refused to pay them.

All of the electric lighting companies affirm that the rentals are unfair and illegal, and they resist the collection on this ground, although many of the companies have paid the Subway Company large sums of money under protest. This has become especially necessary recently, s the Subway Company refused to allow any company to occupy a new duct unless rental at the rate prescribed was paid yearly in advance. Matters have been brought to a crisis by notices served upon all the electric lighting companies by the Subway Company, demanding payment at once, and threatening to cut and remove from the subways the cables of the electric light companies in case the payments demanded were not made. Thereupon the companies obtained injunctions, and they propose to contest the matter vigorously.

On the part of the Subway Company the assertion that excessive rentals are charged for the use of the subways is denied. The secretary of the company said that most of the statements made to the Supreme Court for injunctions were false or misrepresented the facts. He denied that the stock of the Subway Company was held in the manner described by the electric light people. He said further that the companies had put their wires into the subways with a distinct understanding as to the rental to be charged. Far from being exorbitant, the rate charged ($1,000 a mile for three-inch ducts) did not yield a profit, for the company was losing money in the present situation, and it would feel justified in raising the rent.

In all other cities, except Chicago, the subways are owned by the electric companies which use them. In Chicago the Subway Company charges $1,000 a mile rent for 2½-inch ducts. The New York Company charges only $850 for 2½-inch ducts. The latter ducts carry four electric light wires, and the 3 inch ducts carry six.

The argument on the applications of the electric light companies for injunctions restraining the Subway Company from interfering with their use of the subways was set for October 28th.

LIGHTNING DISCHARGES.

A discharge of lightning through a conductor may be roughly illustrated by hydraulic analogy. Let us suppose a long perpendicular pipe with a number of lateral holes at intervals, its bottom extremity opening into a large empty cavity. A mass of water caused to fall suddenly into its upper end would descend through the pipe into the cavity, and having no resistance but the friction of the pipe and the resistance of the air in the pipe to overcome, it would so fall without any, or but little, of the water escaping through the lateral holes. This answers to a lightning conductor of sufficient capacity having a good earth. A pipe of small diameter opening into a large cavity would represent a conductor of insufficient capacity though with a good earth. Through this thin pipe the water could only flow comparatively slowly, and the tendency to leakage through the lateral holes would be considerably increased.

Now, imagine a large pipe with an obstacle placed at its bottom so that the diameter is reduced one-half, or a large pipe opening into a cavity incapable of containing the water let down; then the water descending with a tremendous impact is partially stopped by the obstacle, or by the filling up of the cavity. The water will rebound and spurt violently out of the lateral holes. This corresponds to a conductor of sufficient capacity connected to an insufficient earth, and the effects will be exaggerated proportionally as the aperture at the bottom is reduced. If the same pipe is taken with the bottom end plugged up, the stoppage and spurting of the water will be greatly augmented, and perhaps the pipe will burst from the suddenly exerted lateral pressure. This answers to a conductor with a very imperfect earth. The analogy is striking here; the water, like the electricity, is seeking earth, its lowest level, but failing to find it through the pipe, spurts or bursts out laterally, and then recommences its descent by the nearest channel it can find. The water may have to turn corners and run down flights of stairs on the way, so the electricity may have to avail itself of anything conducting whether it lies directly in the path or not.

FOREIGN NOTES OF INTEREST.

Telephonic communication is about to be established between Madrid and the Royal Palace of La Granja, a distance of 100 miles.

The Allgemeine Elektrictäts Gesellschaft are about to apply the Thomson-Houston-Huber system to the Wilmersdorf-Königgrätzerstrasse line.

A new departure in cremation is reported. A patent has been taken out in France, for an electric furnace for the rapid incineration of human remains.

The Vienna Electric Company (not to be confounded with the International Electric Company, also established in Vienna), has erected in the Neubad Gasse, an electric central station, with the use of the five-lead system.

The Spanish Postal and Telegraphic Administration has requested the telephone company of Madrid to carry out the contract entered into with the State in regard to placing its cables underground within the term of a year.

Experiments with the electric arc, when set up between carbon points in dry oxygen, show that there is a formation of a mixture of carbonic oxide and oxygen, and that the carbon is not at once burned to carbonic acid.

The India Rubber, Gutta Percha, and Telegraph Works Campany, have just completed the shipment of about 2,000 miles of telegraph cable for the Central and South American Telegraph Company, to be laid from Lima to Iquique, and thence to Valparaiso, on the west coast of South America.

According to *La Lumière Electrique*, a "telephonic bonnet" has just been adopted in the Italian garrison artillery, the idea being that the gun detachment commanders should array themselves in this headgar so as to be in constant communication with the officer commanding the battery or fort.

On Tuesday last the Barnsley Town Council sat for nearly four hours discussing the desirability of carrying out the tender of the Westinghouse Electric Company, which has already been endorsed by a large majority of the Council. In the result, the Council decided by eleven votes to seven to go on with the matter.

At the Innsbruck electric central station an interesting case has occurred. A spider was climbing, during the work, on one of the lightning protectors, and occasioned an earth connection, in consequence of which an induction bobbin was damaged by breaking the insulation. In order to prevent similar occurrences for the future, the lightning protector plates are closed up in glass boxes.

The Buda-Pest electric town tram-line makes constantly so satisfactory advances, that it already appears necessary to enlarge the central current installation of this line. On behalf of the undertaking of the town line which is applying for the concession of the execution of this extension, its necessity is urged along with the establishment of a new line, on account of the increased traffic on the most important lines

A deputation from the Glasgow Corporation recently visited the General Electric Power and Traction Company's electric cars and installation on the Barking road section of the North Metropolitan Tramways Company. On this report to the Glasgow Town Council, the Committee on Tramways recommended that application should be made to Parliament in the ensuing session for authority to use electric and other power on the Corporation tram lines. The recommendation was unanimously approved of.

Milan Cathedral.—It is proposed to place a powerful projector at the top of the highiest twer of Milan Cathedral.

DOMESTIC ELECTRIC LIGHTING.

An English paper publishes an article on the title subject which contains a good many interesting things. Domestic electric lighting offers a great field for the inventor, and he who devises a perfectly satisfactory and successful method of lighting dwellings, small or large, by electricity will be able to experience the blessings of a fortune, if he has not one already. Not only this, but he will receive the blessings of thousands of people who are anxiously looking forward to the day when the possibility of electrically lighting our homes, successfully and conveniently, is beyond peradventure.

It is comparatively easy in these days of advanced science, says the article, to provide for the efficient lighting of large buildings by electricity, for in the first place the cost of such large installations is not a prime consideration, so that there be no failure in the light; and secondly, the complete sets of apparatus forming the specialties of the best firms enable the contractors to fulfill their engagements with success. But the more humble requirements of the householder who wishes to indulge in the luxury of the electric light on a small scale, and is not inclined to wait for those happy days when the electric mains will be "laid on" like water or gas, is a matter of greater difficulty, partly because he is necessarily restricted as regards expenditure, and also because it is a *sine qua non* that there must be no trouble involved in maintenance, or any element introduced that is likely to be a nuisance to himself or his neighbors.

We will, for purposes of illustration, assume that the proprietor of a twelve-roomed villa wishes to fit up an installation of electric light at the smallest possible cost. The hall, we will presume, is sufficiently lighted by one 20-candle power incandescent lamp, and the dining and drawing rooms both by an electrolier of four 20-candle power, and two brackets with a 10-candle power lamp upon each. It is not necessary that both of these rooms should be fully lighted at once, therefore the side brackets may be left alight, and the electrolier switched off in the room that is not in use. We will presume that four other 20-candle power lamps are in use about the house, in addition to those already mentioned, therefore the total candle power of the installation will be:

Dining or drawing-room (full light)	100 c. p.
" " (partial light)	20 c. p.
Hall	20 c. p.
Other rooms, offices, etc.	80 c. p.
Total	220 c. p.

Adding to this the loss of energy in the main leads and branches, generator, etc., the total energy required would be represented by 1½ horse power, whatever source of power be employed. This may be a gas engine driving a dynamo, which is coupled directly to the main leads, or a hot air or atmospheric engine may be used as a substitute for the gas engine

But the best and most efficient installation, although costing more at the outset, is to use a gas engine of one indicated horse-power, and permanently fit it up in the cellar, or any part which may be partitioned off, so as to form an engine-room that may be locked up and kept free from meddlers. This should be lined with match boarding, for the better exclusion of dust, and, if possible, the engine and dynamo should be fixed to an anti-vibratory foundation. The dynamo should preferably be driven by friction gear directly from the fly-wheel, and the leads coupled to the accumulator cells, standing on a raised bench round the walls of the engine house. The gas main should be looped, so as to be carried out of the engine-room to any part of the house that may be desirable, and there the tap or cock may be fixed, and in connection therewith a switch, coupled to one of the leads between the dynamo and the accumulator in such a manner that the action of turning on the gas also establishes connection between the generator and the secondary cells. Every journal and bearing upon the engine and dynamo should be provided with automatic lubricators, holding a sufficiency of oil. A voltmeter and ammeter are also indispensable in the engine-room, and a small shelf, with a diary and pencil, are also useful adjuncts. A 20-candle power lamp, the holder of which is continued to form a handle, with a ring for hanging up when not in use, should be connected by means of a flexible double wire to the main leads, serving the purpose of a handy lamp for the engine-room, with all the portability of a candle or oil lamp without the dirt or danger thereof.

The article then goes on to describe the manner in which the master of the house can easily start the engine, charge the accumulators, and do all the necessary work to get the plant in condition for the night's work, and then estimates the first cost of such an installation. The latter, according to ruling figures in England, would be about $1,200 of American money.

A table given in a suppositious case, shows that in seven days the consumption has been equivalent to 309 ampere hours, and the charging equivalent to 520 ampere hours. As a matter of fact, the article concludes, the consumption of gas by the gas engine is really much less than would be used by the burners supplied through the meter in the usual manner, to afford an equal degree of illumination. Accumulators do not deteriorate rapidly but will work well for many years upon such an installation as that described, and although somewhat costly in the first instance, possesses many advantages. For instance, when systematically charged, the light is always available, in the sick-room or for an evening party, independently of the engine, which may always be stopped on Sundays at least. A man that desires to become his own electrican may mount his hobby to his heart's content with such an installation, and may indulge in other applications of the electric current. For instance, he may drive the sewing machine, organ bellows, or a punkah, by means of small electric motors; he may divert himself by scientific demonstrations to his friends of the uses of electricity for welding pieces of metal together (on a small scale, of course), photography at night, chemical decomposition, and hundreds of similar interesting and instructive experiments. He may take the entire management of his installation, and perform all the duties entailed without soiling his hands, neglecting his business, or curtailing his leisure.

A Batch of Patents for Mr. Edison.—On October 14th Mr. Thomas A. Edison was granted letters patent on thirteen separate inventions, as follows: a gage for testing fibres for incandescent lamp carbons; a system of electric lighting; a commutator for dynamo electric machines; an arc lamp; an electric signaling apparatus; a fuse block; manufacture of incandescent electric lamps; a system of electrical distribution; a method of insulating electrical conductors; a lamp base; method of manufacturing incandescent electric lamps; manufacture of carbon filaments; and a telephone.

Timing Sprinters by Electricity. — During some recent foot races in Canada some tests were made of an electrical device for taking the time of the runners. At the start the concussion caused by the firing of the pistol as a signal to start caused a record to be made on an automatic time register, and at the finish the breaking of the string or tape stretched across the track, by the leading contestant caused a similar record to be made on the same register. By this method quite accurate timing can be obtained, yet there is room for improvement in some of its details.

NEW YORK NOTES.

Great complaint is made by travellers on "L" roads of the miserable and dingy lights supplied on the cars after dark, and the question raised is why cannot the company give electric light?

The way people crowd into the Fourth avenue storage battery cars, as evening draws on, and their clear, strong electric lights flame out, testifies public appreciation of the slightest effort on the part of the carrying corporations to increase the comfort of the travelling public. The John Stephenson Company is turning out more cars for use on this road under the storage battery system.

The Department of Electricity of the Brooklyn Institute, will on Friday evening, October 31st, make an exhibit of electric batteries of various forms. The exhibition will be held in the large hall of the Union for Christian Work, 67 Schermerhorn street, between 7:30 and 10 p. m., and will include not only batteries in working order, but the parts of batteries and appliances used in the manufacture of them.

The New York Insulated Wire Company the sole manufacturers of Grimshaw White Core Insulated Wire, have just received an order for wire to be used in the Executive Mansion in Washington. The company having furnished the wire for the Statue of Liberty, New York harbor, Washington Monument, and the State, War and Navy Department buildings at Washington, deserves the title of "National Wire manufacturers." The fact that the government are largely using this company's wire is abundant evidence of its excellence both in quality and durability.

The store of Messrs. Alexander, Barney & Chapin, No. 20 Cortlandt street, has been made very attractive by the hanging of handsome electroliers down through the entire length of the room. Shades of various designs and colors are used on the electric lights and the effect thereof is very attractive. McCreary half shades of different colors, and shades with etched lace designs are artistically disposed, giving a beautifully soft light throughout the interior. The electroliers, are handsome and artistic in design, and were made by the Bergmann Electric and Gas Fixture Company of this city.

A recent issue of the *India Rubber World* (an English paper) refers to the experiment recently made of sending an alternating current of 1 [illegible] volts pressure through a submarine cable which connects the electrically-lighted buoy off Robbin's Reef, New York harbor. It will be remembered that the experiment was for the purpose of testing the insulating qualities of the cable, and the result was, that it withstood the pressure without breaking down or developing a fault. It is interesting to note that the cable was insulated with gutta percha, and that it was made by the Bishop Gutta Percha Co. of this city. The same company also manufactured the cables used for the lighting of the Gedney's Channel buoys.

Some tests were made with the Huntington Search Light on the night of October 22, in the yard of the New Jersey Central Railroad, at Communipaw. The light used was 3,200 candle-power, and was placed on a switch signal bridge 20 feet above the tracks. It was turned on every part of the yard, and the letters on cars over a third of a mile distant could be distinctly read. The experiment was a success and was for the purpose of demonstrating the value of search lights in railroad work at night. The inventor of the light asserts that dynamos weighing only a few hundred pounds could be set in front of locomotive boilers and run by the steam from the engines, and that it would furnish sufficient electricity to operate the light. Equipped with the light, he says, any obstruction on the tracks, no matter how small, could be seen by the engineer at a sufficient distance ahead to stop his train and avoid accident.

R. I. G

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED OCTOBER 21ST, 1890.

438,598. Electrical Water-Alarm. Francis M. Ashton, Lima, Ohio. Filed Jan. 15, 1890.

438,602. Alternating-Current Generator and Motor. Charles S. Bradley, Yonkers, N. Y. Filed June 23, 1890.

438,603. Electric Motor. Charles S. Bradley, Yonkers, N. Y. Filed Aug. 13, 1890.

438,619. Arc and Incandescent Lighting System. John E. Giles, Hazleton, Pa. Filed July 12, 1889.

438,620. Electric Crossing-Gate. Harleigh Gillette, Highland Park, Ill. Filed Mar. 24, 1890.

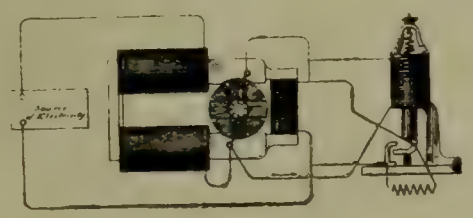
438,631. Telephone-Transmitter. Archibald J. MacDonald, North Tiverton, R. I., assignor to Henry E. Townsend, trustee, Boston, Mass. Filed Dec. 12, 1889.

438,632. Telephone. Archibald J. MacDonald, North Tiverton, R. I., assignor to Henry E. Towsend, trustee, Boston, Mass. Filed Dec. 12, 1889.

438,653. Electric Guest-Call. Alexander Striemer, Sleepy Eye, Minn. Filed Mar. 28, 1890.

438,656. Electric Motor. Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed Jan. 15, 1885.

438,657. Process of Electric Welding. Elihu Thomson, Swampscott, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed June 14, 1890.



NO. 438,656—ELECTRIC MOTOR.

438,658. Electric Welding of Pipes. Elihu Thomson, Swampscott, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed June 26, 1890.

438,668. Brush-Holder for Dynamo-Electric Machines. Charles F. Winkler, Troy, N. Y. Filed July 26, 1890.

438,698 Insulating Composition. Anthony E. Menuez, St Paul, Minn., assignor of one-seventh to Walter Ruan, same place. Filed Feb. 24, 1890.

438,721. Thermal Cut-Out. Geo. H. Whittingham, Baltimore, Md., assignor to the Automatic Switch Company, same place. Filed June 9, 1890.

438,723. Electric Blank Heating and Feeding Apparatus for Forging Machines. George D. Burton, Boston, Mass, Filed Aug. 22. 1890.

438,767. Electro-Pneumatic Clock. Victor Popp, Paris, France, assignor to the Popp Compressed Air and Electric Power Company, Limited. Filed Apr. 7, 1888. Patented in France, England, Germany, Belgium and Italy.

438,773. Electric-Light Pole. Patrick J. Dinn, Boston, Mass. Filed Apr. 15, 1889.

438,779. Extension Device for Incandescent Lamps. Samuel O. Newton and Mellville A. Newton, North Pitcher, N. Y. Filed Dec. 2, 1889.

438,780. Electro-Magnet. Frederick M. Schmidt, Brooklyn, N. Y. Filed July 31, 1890.

438,784. Telephone. John C. H. Stut, San Francisco, Cal., assignor to the American Bell Telephone Company, Boston, Mass. Filed Sept. 16, 1889.

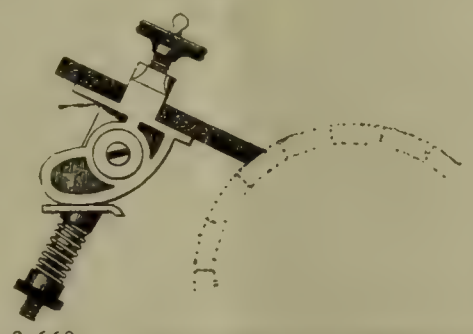
438,788. Lightning-Arrester. Anthony C. White, Boston, Mass. Filed July 19, 1890.

438,818. Telephone. James W. McDonough, New York, N. Y. Filed March 9, 1888.

438,827. Secondary Battery. Emile N. Reynier, Paris, France. Filed August 23, 1890. Patented in France and Germany.

438,828. Telephone. Wilton L. Richards, Malden, Mass. Filed August 13, 1890.

438,837. Electric Drill. Gordon Buchanan, Chicago, Ill. Filed Mar. 31, 1890.



NO. 438,668—BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES.

438,847. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.. assignor to the Thomson-Houston Electric Company, of Connecticut. Original application filed Mar. 16, 1888. Divided and this application filed June 24, 1890.

438,870. Magneto-Electric Transmitter. Archibald E. Todd, Providence, R. I. Filed July 23, 1890.

438,882. Portable Reflecting Galvanometer. Charles P. Frey, East Greenbush, N. Y. Filed Dec. 26, 1889.

438,891. Electrical Speculum. Samuel H. Linn, Rochester, N. Y. Filed Mar. 30, 1889.

438,894. Trolley-Switch for Electric Railways. Henry Marcy, Utica, N. Y. Filed July 17, 1890.

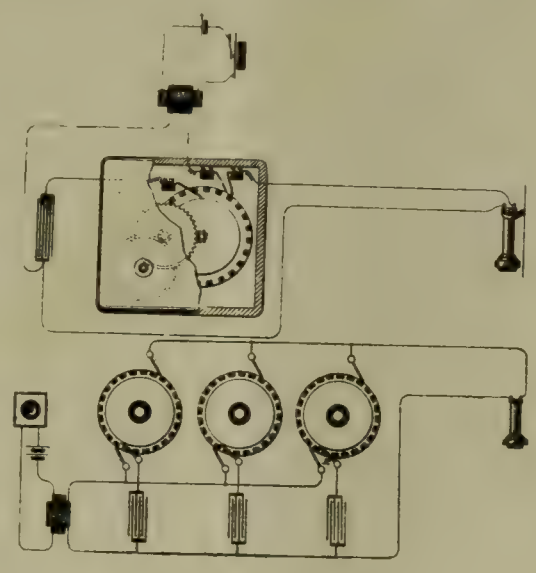
438,897. Magnetic Separator for Paper-Pulp. Francis H. Richards, Hartford, Conn. Filed Aug. 29, 1890.

438,934. Insulator. Fidel Miro, Cienfuegos, Cuba. Filed June 6, 1890.

438,982. Telephone-Exchange Apparatus. Franklin G. Beach, Chicago, Ill., assignor to the American Bell Telephone Company, Boston, Mass. Filed Feb. 5, 1889.

439,011. Arc Lamp. John Kent, London, England. Filed July 26, 1890. Patented in England.

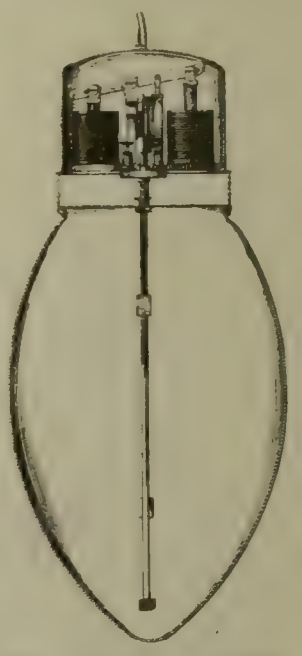
439,015. Electric Station-Indicator. George H. Kirwan, Wilkes-barre, Pa. Filed Jan. 8, 1890.



NO. 438,818—TELEPHONE.

439,017. Apparatus for the Rhythmic Generation of Electric Currents. Charles Langdon-Davies, London, England. Filed Aug. 16, 1889. Patented in England, France, Belgium, Germany, Switzerland, Luxemburg, Turkey, Cape of Good Hope, Natal, Victoria, New South Wales, Tasmania, South Australia, New Zealand, Queensland, Transvaal, Spain, Brazil, Austria-Hungary, Norway, India, and in Western Australia.

439,023. Device for Raising and Lowering Electric or other Lights. David B. Matson, Watkins, assignor of three-fourths to Rachel I. Smith, Catlin, N. Y. Filed Nov. 4, 1889.



NO. 439,011—ARC LAMP.

439,042. Electrical Transmission of Power. William Stanley, Jr., Great Barrington, Mass., assignor to the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa. Filed June 12, 1889.

ELECTRICAL EXHIBIT AT BOSTON.

The electrical exhibit at the Mechanics' Fair, Boston, though not what could be desired makes nevertheless quite a presentable display. Some of the early applicants for space did not materialize and the room was given to parties more punctual. At the present time the management is seeking to make space for new applicants by crowding the present ones more closely together. Among those who have engaged space for the display of electrical apparatus of all kinds are the following-named: Albert L. Russell, Boston, electrical and scientific instruments; Holtzer-Cabot Electric Company, Boston, electrical goods; Mr. E. H. Rowe, Boston, electric safety device; New England Phonograph Company, Boston, phonographs and graphophones; Electric Machine Company, Boston, electric time stamp; Isolated Department Thomson-Houston Company, incandescent dynamos; Mather Electric Company, Manchester, Conn., arc and incandescent dynamos; Belknap Motor Company, Portland, Me., small dynamos and water motors; Tripp Manufacturing Company, Boston, trucks for electric railways; Robinson Radical Car Truck Company, Boston, trucks for electric railways; Evans Friction Cone Company, Boston, system of driving dynamos; The "C. & C." Motor Company of New York, motors; Interior Conduit and Insulation Company, New York, display board of pipes, joints, etc., for interior wiring and construction work; American Tool and Machine Company, Boston, patent dynamo belt controller; Westinghouse, Church & Kerr, Boston, the Rodney mechanical stoker and patent steam loop; the Rodney Hunt Company, Orange, Mass., turbine water wheels; Mason Regulator Company, Boston, damper regulators; Otto Gas Engine Company, Philadelphia, engines; Wheeler Reflector Company, Boston, shades and reflectors for electric lights; B. S. Hale & Sons, Malden, Mass., insulated electric wires; and the Park Manufacturing Company, Boston, the Park injector. Some of these have not got their display into shape yet, but they undoubtedly soon will. The Thomson-Houston Company, to the surprise of many, makes no attempt at display, merely having a couple of incandescent dynamos for furnishing light.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Oct. 23, 1890.

The West End Railway Company are building the electric snow plows for use on their electric lines this winter.

The Putnam, Conn., Light and Power Co., have raised the sides of their brick building, and are to put on an iron roof.

One of the finest displays of machinery in Machinery Hall, Mechanics Fair, is that of the Brown & Sharpe Manufacturing Co., of Providence, R. I.

The Springfield Street Railway Company has voted to increase its capital stock from $300 000 to $700,000 for the purpose of introducing electricity as a motive power.

The East Side Electric Road Company has purchased the franchise of the local road in Whitman, and work under the new management will be pushed as fast as possible.

The Essex Electric Street Railroad Company have asked permission of the Salem board of aldermen to change the system from the double trolley to the single trolley, and a hearing has been ordered for the evening of Oct. 31.

The trial trip of the steamer "Elihu Thomson" was made at Lynn a few days ago. The steamer is named after Prof. Elihu Thomson, of the Thomson-Houston Electric Company, but is in no way connected with that concern.

The regular meeting of the board of aldermen of Cambridge was held Tuesday evening. The order reported from the committee on roads and bridges, revoking the electric location now in use by the West End Street Railway on Brookline street, south of Henry street, was put to a vote, and failed of a passage, five members of the board voting in the affirmative and five in the negative.

The severe storm of last Sunday did considerable damage to the wires of the Western Union Telegraph Co. in this vicinity, and messages were received subject to delay. One of the company's wires became crossed with an electric light or trolley wire and the current burned out a number of lines in the tower but did no further damage.

C. J. Van Depoele, of Lynn, has designed an electric railway brake, the combination of a working current, including translating devices of a fixed resistance, a continuous current supply and an electro-dynamic counter-electromotive force device spanning it, and means for varying the potential of the current supplied to the working circuit by increasing and decreasing the effect of the counter-electro-motive force device therein.

D. A. Murphy, a Boston electrician, engaged in running an electric light plant at Kellogg Terrace, Great Barrington, the home of E. F. Searles, was badly burned about the face Monday afternoon by the explosion of an alcohol lamp used by him in soldering a wire. The skin was torn from a greater portion of his face, and his eyebrows and moustache were burned off.

The switch board for the new office of the New England Telephone and Telegraph Company has arrived, and work will be commenced to get it in position next week. This company are re-building their old construction as fast as possible, and in Cambridge something like 200 sawed poles have been set, and the McClure system entirely re-built. This work is being done under the direction of Mr. Geo. Dresser, the assistant superintendent of construction. Mr. J. A. McCoy, the superintendent of construction has gone to Canada to make contracts for next year's poles.

The Newton Street Railway Co. is reported as seriously considering the plan of extending its lines in Waltham, and has already applied to the aldermen for new locations. It is stated that the storage battery system will be used on a portion of the route, and that a location between Watertown and this city will again be sought.

The new experimental conduit railway has been tried at the Thomson-Houston works this week, and the result was highly satisfactory to Superintendent Rice, Messrs. Van Depoele, Rohrer, Lieut. Cahoon, E. M. Bentley, of the Boston office. The travelling crane for factory K, will be put in some time this week. The spur track is nearly completed but a big granite sill has been dropped down upon it within a day or two, on the Federal street side of factory L, which must be cut before it can be completed.

The Boston *Transcript* suggests an evening school in that city for the instruction of electrical and kindred sciences. Such a school, it thinks, would be a great benefit to many young men who are engaged in the day time in the practical work connected with electricity, and who cannot afford to attend schools or colleges to learn the theoretical part of the science. An evening school with a laboratory and the necessary instruments, etc., for proper instruction in the science would, it argues, be well attended by progressive young men.

Prof. Elihu Thomson has designed an invention in railway motors, consisting of the combination, with an electric motor, of a device responding to changes in the speed of the motor, an electric switch, and an intermediate mechanical or engaging device for operating the switch from the power of the motor, the parts of said device being brought into engagement by a change of speed of the motor, as, and for the purpose described. By this arrangement a higher speed will be required to cause a complete movement of the adjusting devices than is required to produce a limited movement.

The Page Belting Co., of Concord, N. H., report very active business in the staple and special goods manufactured by them. They have recently received some large orders for belting. Their special "Acme" belts are much sought after, and several large orders for them are now on the company's books. Their works at Concord are taxed to their utmost capacity and the several branches of the company are full of business.

W. J. P.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Ill., Oct. 25, 1890.

Harold P. Brown is now general manager of the Belding Electric Company, Chicago, Ill.

The Greenville, Illinois, City Council is considering the advisability of lighting that city by electricity.

It is rumored that George M. Pullman, president of the Pullman Palace Car Company, will build a hotel at Hyde Park, this city, which will cost in the neighborhood of a million dollars.

Mr. A. B. Lyman, the electrical manufacturer of Cleveland, O., is getting up models for a new electric bell which contains an entirely new principle. The bell is simpler than anything at present on the market. It will be ready in about one month.

The Western Electric Benevolent Association, gave a ball at Apollo Hall, Thursday evening, about three hundred couples being present. This association is composed entirely of employés of the Western Electric Company, and has about 480 members. It is purely a benevolent organization, and last year paid over $1,200 in sick benefits.

The Electric Light Company at Waukegan, Wis, have most of their machinery in position and will turn on the lights November 1st. They have a 200-horse power Corliss engine and use the Edison electric system. T. P. O'Brien will be the superintendent.

The Electric Merchandise Company of Chicago have just issued a "Sprague Material" supplement to their general catalogue. This company issues special catalogues on the various systems, giving the price list of the different parts in each. Any of these supplements as well as the general catalogue can be had on application.

THE MATHER ELECTRIC COMPANY, through their Chicago office, report the following recent sales: Iowa Soldiers' Home, Marshalltown, Ia., 300 lights; Herman Zoerlandt Leather Co., Milwaukee, Wis., 100 lights; George Martin, Jr., Co., 100 lights; Milwaukee Lithograph and Engraving Co., 75 lights; F. Layton & Co., Milwaukee, 100 lights; New Monopole Hotel, Denver, Col., 800 lights.

THE CHICAGO ELECTRIC CLUB held its first regular meeting of the season at its club parlors Monday evening. Mr. B. E. Sunny read the paper of the evening on the subject of "The Central Lighting Station as an investment," after which remarks were made by Prof. Barrett, Mr. Wilmerding, Mr. Degenhardt, Mr. Cutter, Prof. Badt, Mr. Sperry, Mr. Cushing and others, all endorsing Mr. Sunny's views. Following this, Mr. C. C. Haskins read Mr. Holmes's poem on "The Broomstick Train."

St. Louis is awakening to the objections to overhead electric wires and the question of putting all wires underground is occupying the attention of the press of that city. The experience of the fire department at a recent large fire has strengthened this movement, as the operations of the firemen were greatly hindered and the work made dangerous on account of the overhead street railway wires. The Bell Telephone Co. is before the Council with an ordinance asking a franchise to construct subways under streets and alleys. In case of the granting of this permission it is possible that the city may retain the right to place their wires in the same conduits.

Through the courtesy of Mr. M. J. House of Mather Electric Company, your correspondent was shown through their lighting plant in the new Chamber of Commerce building in this city. This building is one of the finest office buildings in the country, is fourteen stories high, and is finished in the most elegant style throughout. The electric plant is probably one of the best appointed isolated plants in this or any other city. Four Mather incandescent dynamos of about 1,000 light capacity, each are driven by two 200 horse power Corliss engines, rope transmission being employed. The connections from the dynamos to the switchboard are laid in cement conduits under the pavement. Twenty-eight circuits lead from the switchboard to various portions of the building. The building is in the form of a hollow rectangle, the roof above the central portion being of glass so as to give sufficient light. About this central portion, lamps are arranged in clusters of seven, each floor having about twenty of these clusters.

F. M. I.

NEW CABLE.—A recent despatch to the New York *World* stated that it was rumored in London that a new cable service is to be established between Great Britain and New York. It is said that one end of the cable will be situated within a few miles of New York and the other in Valentia Bay, County Kerry, Ireland. C. W. Bonynge, of London, but formerly of San Francisco, is said to be at the head of the scheme. None of the New York officers of the various cable companies know anything of the project.

ELECTRIC LIGHTS AT THE WORLDS' FAIR.—Speaking of the electric lighting of the buildings and grounds at the World's Fair in 1893, a Chicago paper says: "When the extent of the buildings and grounds at Chicago is definitely known some estimate may be formed of the lamps required. It is not unlikely that anywhere from 50,000 to 100,000 incandescents can be used to advantage in interiors, with a countless number for 'structural' and decorative effects. For the grounds and larger spaces perhaps 2,500 arcs would suffice."

PERSONAL.—Mr. W. F. D. Crane has been appointed superintendent of the Electric Traction and Manufacturing Co., with headquarters in New Orleans, La.

NEW TELEGRAPH COMPANY.—The Philadelphia Printing Telegraph Company has been organized on a basis of $3,000,000 capital. The company will operate under the Essick patents, and its territory embraces one-half of Pennsylvania, one-half of New Jersey, and all of the State of Delaware. Lines are being built in these sections and rapid progress is being made.

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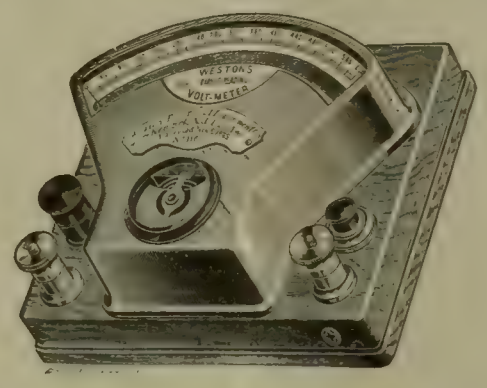
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No. 85 WATER ST.,

BOSTON, MASS.

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Voltmeters and Ammeters



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work. Address:

Weston Electrical Instrument Co.,

Send for Illustrated Catalogue. 114 & 116 William St., NEWARK, N. J.

BUSINESS NOTICES.

Advertisements under this head not occupying over one-half inch of space, $1.00 per each insertion.

INTERESTS IN A PROFITABLE ELECTRICAL BUSINESS will be sold to the proper party. Address PROFIT, ELECTRIC AGE Office, New York.

SITUATION WANTED by an experienced electrician, who is capable of taking care of a central station plant of any capacity. Address SITUATION WANTED, ELECTRIC AGE, New York.

ARMATURE WINDER.—We want a practical winder—Siemens—to take charge of our winding department. A good chance for the right man. State where employed. All communications strictly confidential.
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EXPERIENCED MECHANICAL DRAUGHTSMEN wanted immediately; those having experience with electrical apparatus preferred. Permanency to good men. Address E. KOLBEN, Edison General Electric Company, Schenectady Works, Schenectady, N. Y.

Telephone Companies, Supply Houses, Bell Hangers, Physicians, and all users of open circuit batteries are requested to write the

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MANUFACTURERS OF

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GENTLEMEN: You have only to try the SAMSON Battery to become convinced of ITS SUPERIOR QUALITIES. It justifies all statements as to ITS GREAT STRENGTH AND DURABILITY for open-circuit work, such as Call-Bell, Annunciator, Burglar Alarm, Gas-lighting, Telephone, Watchman's and Time Clock Service. It is not only the BEST, but the CHEAPEST BATTERY IN THE WORLD TO-DAY! Every day you defer using the SAMSON WILL RESULT IN A LOSS TO YOU, equal to the percentage of its superiority over the cells you now use, which will aggregate 50 to 75 per centum. Address, for further particulars,

THE ELECTRIC GAS LIGHTING CO.,
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Over 70,000 now in use in this country! *Sole Mfg. Agents for the United States.*

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Catalogues Furnished. Correspondence Solicited.

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W. R. MASON, - General Manager.

MASON'S BATTERY.

Electric Light without machinery—Specially adapted for private houses—A good and reliable battery at last—Unequalled for sewing machine and fan motors—Portable electric light.

SMALL ELECTRIC LIGHT PLANTS.

The following list will illustrate the expense attending the purchase and use of small installations. and serve as guides when ordering plants for domestic purposes.

PLANT NO. 1.		PLANT NO. 2.		*PLANT NO. 3.	
2 No. 9 Cells at $1.50	$3.00	4 No. 9 Cells at $1.25	$5.00	6 No. 9 Cells at $1.25	$7.50
1 1-C.P. Incandescent Lamp (large bulb)	.85	1 3-C.P. Incandescent Lamp (large bulb)	.85	1 6-C.P. Incandescent Lamp (large bulb)	.85
1 Key Socket	1.20	1 Key Socket	1.20	1 Key Socket	1.20
1 Shade and Holder	.50	1 Shade and Holder	.50	1 Shade and Holder	.50
50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.50
4 Charges of Depolarizer (will run 80 hours)	.40	2 Charges of Depolarizer (will run 40 hours)	.40	3 Charges of Depolarizer (will run 70 hours)	.90
	$6.45		$8.15		$11.45

*This plant will be found useful for lighting small rooms, dining tables, desks, and for reading purposes. It will also properly light two stalls in a stable.
NOTE.—Any number of 1-C.P. incandescent lamps can be employed, provided that not more than one is used at any one time.

JAMES H. MASON,

Office and Factory: 114-120 Park Ave., Brooklyn, N. Y.

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NOVELTY ELECTRIC COMPANY, 50-54 North Fourth street, Philadelphia, Pa.
THE ELECTRIC GAS LIGHTING COMPANY, 195 Devonshire Street, Boston, Mass.

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MONTREAL, QUE.

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C. & C. Electric Motor Co., Electric Motors 402 and 404 Greenwich Street.

Clark Electric Company, Arc Dynamos 191 Broadway.

Crocker-Wheeler Motor Co., 124th and Washington Sts.

Charles A. Schieren & Co., Leather Belting 45 to 49 Park Street.

Clay & Morrison, Springs, 194 West 19th Street.

Crosby Electric Co., Batteries, 69 South 10th Avenue.

Dean Novelty Co., Electrical Devices, 47 Murray St.

Detroit Electric Co., Electric Signals, 47 Broadway.

Edison General Electric Co., 44 Broad Street.

Electric Manufacturing Co., Batteries, 21 Dey Street.

The Electric Construction and Supply Co., 16 Cliff and Street.

Empire City Electric Co., General Electrical Supplies, 27 Dey Street.

E. S. Greeley & Co., Electrical Supplies, 5 and 7 Dey Street.

Freeman, Walter K., Transformer System, 150 Nassau Street.

Hall Signal Co., Railway Automatic Signals 50 Broadway.

Interior Conduit and Insulation Co., Electrical Conduits 16 and 18 Broad Street.

John Stephenson Co., Tram Car Builders, 47 East 27th Street.

Kintner, Charles J., Patent Expert, 25 Broadway.

Lynch, Eugene J., Jr., Electrical Engineer, 100 Broadway.

Law Telephone Co., Batteries, 83 John Street.

Leclanche Battery Co., Batteries, 124 West 18th Street.

National Electrical Manufacturing Co., Electrical Supplies, 12 and 21 Vesey Street.

New York Insulated Wire Co., wires of all descriptions, 44 to 52 Broadway.

Okonite Co., Insulated Wires and Cables, 253 Pearl, Row.

Prescott, George B., Jr., Wires, 21 Dey Street.

Packard Nut & Magneto Watches, 192 Broadway.

River and Rail Electric Light Co., Storage Batteries, 45 Broadway.

Reese, S. W. & Co., Stencils, Stamps, etc., 212 Fulton Street.

Sabine, J. P., Patent Attorney, 181 Broadway.

Sawyer-Man Electric Co., 510 to 524 West 23d Street.

Shaver Corporation, Molecular Telephones, 207 Broadway.

The S. T. Smith Co., Typewriter Supplies, 14 Park Place.

Wyckoff, Seamans and Benedict, Typewriters, 110 Broadway.

W. H. Wiley & Co., Wires, Electric Light and Power Supplies, 111 Broadway.

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Standard Underground Cable Co., Wires.

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Hesler Electric Light Co., Incandescent Electric Lights, 810 to 816 South 4th Street.

ST. PAUL, MINN

Acme Electric Co., Manufacturers Dynamos and Motors, Gilfillan Bros.

Ames, Wright & Co., Agents Western Electric Co., 124 East 4th Street.

TORONTO, ONT

TRENTON, N. J.

Roebling's, John A., Sons Co., Wires.

THE ELECTRIC AGE'S ELECTRICAL DIRECTORY.

In order to meet a demand for an electrical trades directory in a weekly electrical paper we have decided to establish such a feature in the ELECTRIC AGE.

The above is the beginning of this new and valuable feature and orders to have names and addresses inserted are beginning to come in at a rapid rate.

One important feature of this directory will be readily noticed and appreciated, and that is the arrangement of the names in alphabetical order under the heads of the proper cities and town, the name of the places being also arranged in like manner. **This arrangement makes it extremely easy to find a name in any city or town.**

The importance and value of this directory to those engaged in electrical business cannot be over estimated.

It is important that all persons firms or corporations engaged in any line of electrical industry should be represented therein and to all these we would say that any desiring to get your address will consult the directory, and you will do likewise when you want the address of others.

The importance of being represented in our directory is therefore obvious. The entire country will be covered, and we propose to make the electrical directory a reliable one and as complete as possible.

Terms: For name, character of business, in small type $10.00 per year. Same in bold face type $12.00 per year.

Address: ELECTRIC AGE PUBLISHING Co., 5 Dey street, New York.

INTERESTING EXHIBIT.

At the Arcade in Brooklyn there is an exhibit that is attracting a good deal of attention. It is that of James H. Mason, the well-known manufacturer of Mason's batteries, and he has an attractively decorated booth which might be taken for a corner in fairyland, so beautiful is the effect produced by the electric lights. These are artistically arranged about the place, giving a beautifully soft effect. In the centre of the booth hangs a 16-candle power lamp with a Mason reflex holder, which sheds a soft light all over the room.

In front of the booth hangs a hall lamp which calls forth very complimentary remarks when the light is turned on, and the effect is seen. The lamp, which was loaned to Mr. Mason by the Edison General Electric Company, is of Oriental design, and as the soft light from the 25-candle power lamp within, filters through the delicate frame work of the lamp the effect is indeed beautiful, and the scene is very suggestive of Oriental luxury.

The question of using electricity for locomotive headlights is engaging the attention of many electrical engineers just now. Mr. Mason exhibits such a headlight having a 16 candle power lamp. The reflected rays are very powerful, and the reflector is so arranged that the rays may be elevated or depressed to any degree. The necessary battery to maintain such a light can be put into a space 3 feet long by 8 inches wide, and it will give light for a week without any attention whatever. This is an important step towards the solution of this difficult problem, and Mr. Mason seems to have a practical thing.

In the rear of the booth is a Christmas-tree studded with fifty 2-candle power lamps. These shine like diamonds when lighted and the effect is truly beautiful. There is nothing to equal this method of decoration, and the great beauty of it is, that it requires but 6 cells of battery to run 50 5-volt lamps. The cells used are Mr. Mason's new type, known as the "Giant" cell. Each cell has an e.m.f. of 2.5 volts, and delivers a current of 30 to 40 amperes. Its dimensions are 13½ inches in height, 4 inches long and 3 wide. When charged it weighs 12 ½ lbs. This type of cell is admirably adapted to running small boats.

For advertising purposes, the multiplying reflectors shown by Mr. Mason are very effective. At the centre is a two candle power lamp, the light of which is multiplied many times by the various reflecting surfaces of the reflector, producing a symmetrical figure of lights.

In the centre of the booth is a display turntable in constant motion, showing lamp shades of various colors, lamp standards, etc. The motor which supplies the power is run by one No. 9 cell. Eight cells of other styles of battery are ordinarily used to accomplish the same work.

Among other applications of electric power to be seen, is a sewing machine in operation; also a fan. Annunciators, fire-alarm gongs, call bells, etc., arranged about the place, are all rung by one No. 9 cell of Mason's battery.

A very sensitive thermostat is shown. The heat from a burning match will cause the alarm to sound. There are many other examples of the application of electricity to useful purposes, and for decorative effects, which are full of suggestions.

The exhibit entire, is a most interesting one, and there it is proved beyond question the value of Mason's batteries for domestic lighting, light power, and other kindred uses. It is creating a very favorable impression. Mr. Mason is ably assisted by Miss Decker in demonstrating the useful and interesting features of the battery.

On Saturday and Monday last, Mr. Mason entertained his visitors with excellent phonograph music. A large funnel served to render the music audible for a large space around the phonograph.

THE ELECTRIC AGE.

PUBLISHED EVERY SATURDAY.
By THE ELECTRIC AGE PUBLISHING CO.

Registered Cable Address, "Electage," New York.

ENTERED AS SECOND-CLASS MAIL MATTER.
Reading Notices, 25 cents per line.

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Great Britain and other Countries, -	4.00

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T. R TALTAVALL, Editor
J. B. TALTAVALL, Business Manager,
R. J. GRAY, Manager, Advertising Dept.

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NEW YORK, NOVEMBER 8, 1890.

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THE ELECTRIC AGE'S NEW OFFICES.

The offices of the ELECTRIC AGE are now located in the new *World* building, corner of Park Row and Frankfort street.

This is the second time within a year that the ELECTRIC AGE has been compelled to move in order to secure more room to accommodate the rapidly increasing business. Our offices are now in the finest office building in the entire country, and in the heart of that section of the city occupied by the greatest daily papers on the American continent.

LARGE USERS OF MICA.—As an evidence of the vast quantities of mica used in the manufacture of electrical apparatus it is interesting to note that in one establishment alone—that of the Thomson-Houston Company's works at Lynn, Mass.—3,000 pounds of this mineral is used per week. The scraps of mica are all saved and shipped to various concerns for use in the manufacture of insulating material. Of scraps the Thomson-Houston Company ships 500 pounds a week.

SMALL QUANTITY OF HEAT.—We are informed by two eminent English scientists that the heat given off by a fire fly is not enough to raise an ordinary mercurial thermometer one millionth part of a degree centigrade, and yet this infinitesimal amount of energy is measurable by the aid of the bolometer. While the knowledge of the fact that the heat emitted by a fire fly is so small does not add one jot or iota to the sum of human happiness, it serves to show that there is nothing so small or insignificant that man will not be curious to investigate.

LIGHTNING DISCHARGES.—In a paper read by Mr. A. R. Bennett before the East of Scotland Engineering Association, on September 5th last, that gentleman cites a case of a lightning discharge which seems to substantiate the belief that these discharges in many instances are double. It is a now generally accepted belief that lightning discharges frequently, if not invariably, have a return, that is to say, at the moment a discharge takes place from clouds to earth, another occurs from earth to clouds. This phenomenon has been frequently observed, and it has received the name of "back" or "return stroke."

PRIMARY BATTERIES.

This might be justly called the primary battery era. Primary batteries, good, bad and indifferent are constantly making their appearance. For most of these batteries absurd claims are made, but which were never realized, and many of them disappear from the scene as rapidly as they appeared, leaving nothing in their wake but regrets on the part of investors

There are, however, some primary batteries that have real merit, and the doctrine of the "survival of the fittest" applies as will here as anywhere else. Any battery that will survive the fierce condemnation heaped upon primary batteries in general by victimized capitalists and users naturally should be classed as a successful battery. It is not necessary to look far in New York city for such a battery, but in the face of the feeling engendered by the experience with fraudulent goods it is up-hill work to win popular favor.

We would say to those who are skeptical on the subject that a successful primary battery can be had, but only of reliable electrical houses. These wonderful batteries that cost nothing to run and yield brilliant light without expense should be looked upon with distrust. A successful primary battery will cost something to maintain, but not as much as most people imagine. Something from nothing is no more possible in a primary battery than anything else. To get a reasonable return from the investment is what people are after, and if the investment is to be represented in a primary battery get a good battery while at it.

CLOSE RECKONING.

The characteristic shrewdness of the Yankee was never more positively exemplified than in the case of a Hartford firm in their reckoning with the Long-Distance Telephone Company for the use of the latter concern's valuable apparatus. It is the practice for business houses who have occasion for the dai'y use of the long-distance telephone to engage a circuit for a definite length of time each day.

This Yankee firm is one of these, and no other concern keeps a closer record of the actual use of the telephone than they. A prominent officer of the Long-Distance Telephone Company states that this firm invariably returns the telephone company monthly bills with a request for rebate. These requests for deduction are usually based on such entries as these, of which the firm keeps a strict account: To 30 seconds' interruption on such and such a date; 15 seconds' interruption by Central Station operator,' etc., etc.

The firm gets their money's worth every time. It occasionally happens that the Central Station will interrupt with the announcement "5 minutes is up" (or whatever the time limit may be) a few seconds before the time is fully up. This firm has been known to subdue the Exchange man with such a shot as this: "No, it isn't; it's only 4 minutes and 53 seconds. Get out!"

WIRING OF BUILDINGS.—The municipality of Hanover have got the right idea in the matter of installing electric lights in buildings. Contractors for wiring have to obtain a certificate from the Town Council, and these certificates can only be obtained by those firms who have previously carried out electric light work in a satisfactory manner. In case of any damage arising from work carried out in a faulty manner, these certificates are liable to be withdrawn, and the holders are liable for compensation to the town for such damage. This is a sensible way of meeting the evils resulting from poor workmanship in the wiring of buildings, the same policy might be pursued in this country with profit. It would result in a greater appreciation of electric lighting on the part of the general public. Remove the cause of danger and danger will disappear.

ELECTRIC BELLS.—Many people think that the future great things in electricity will be accomplished by the improvement of present apparatus rather than by new inventions. Some of the things in ordinary and every day use are capable of vast improvement, and the same may be said of every electrical device for whatever purpose it may be used. We describe and illustrate on another page, an improvement in electric bells which is as simple as it is efficient, and when its simplicity and effectiveness are considered, one naturally asks the question "Why didn't some one think of it before?" This improved bell is remarkable for its simplicity, and it is a very great advance over the old style which requires a strong current to operate it, without getting a fair return in the shape of work. In the new bell the full value of the current is obtained in the shape of mechanical power, which gives greater force to the stroke of the hammer.

SUBMARINE TELEPHONY.—An article on Cables for Long-Distance Submarine Telephony is printed on another page in this issue, and will, no doubt, be read with much interest by our readers, particularly that portion of them interested in telephony. It is a remarkable fact that many of the great advances made in some special applications of electricity are the result of a determination to make a success of a thing which theory declared to be wholly impracticable. Long-distance submarine telephony may be classed as one of the accomplishments which theory said was impossible. Perseverance overcomes many obstacles when an end is to be gained.

ENGLISH VISITORS AT LYNN.—Undoubtedly the English visitors at Lynn's greatest industrial establishment last week were highly pleased with what they saw. There are many things to be seen at the Thomson-Houston works—the welding apparatus being of especial importance and interest. After seeing first Mr. Edison's laboratory, inside and out, then the Westinghouse Company's great plant at Pittsburgh, and finally the Thomson-Houston establishment at Lynn, the English party must have some conception of the vast importance electricity is to the material progress and welfare of this great land. Many members of the party expressed great astonishment at the extent to which electricity is used in this country, in one form or another. The visitors no doubt will return home with a favorable impression of America, particularly as to the part electricity plays in the wonderful development of this wonderful country.

ALLOYS FOR FUSES.—The following proportions for fusible alloys may be of interest; they are due to Weisbach, and have been used in actual practice:

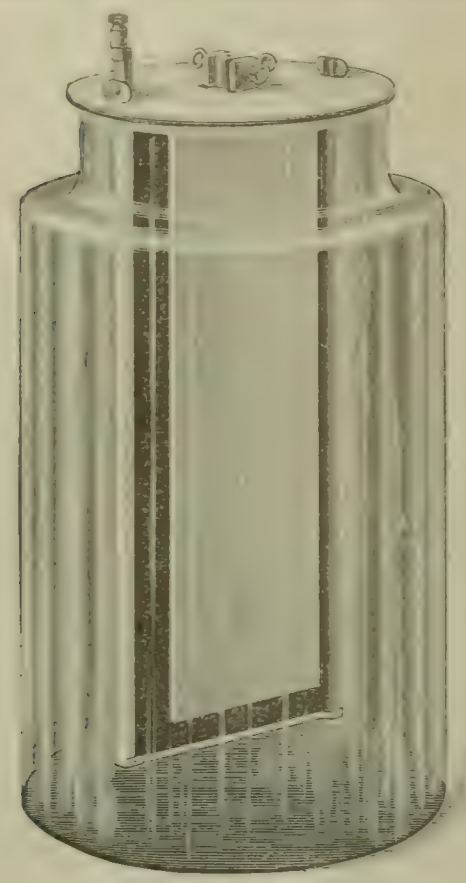
Lead.	Tin.	Bismuth.	Melting points in degrees Centigrade.
1	1	4	93.8
5	3	8	94.4
2	3	5	94.4
1	4	5	118.8
1	4	1	125.0
1	1	1	241.1
1	2	1	167.7
1	3	1	167.7
1	3	1	200.0

DAYS TOO SHORT FOR MR. EDISON.—Mr. Edison is such a hard worker that it is said that if he could have chosen his birthplace he would probably have selected Mars, so as to have secured the advantages of a day forty minutes longer than ours.

EXHIBITION OF BATTERIES.

An exhibition of batteries took place at the Brooklyn Institute in the evening of Oct. 31st. The exhibition proved to be a very interesting one and brought to the spacious hall a very large number of people interested in electrical industries.

Almost all of the batteries now in use were



EDISON-LALANDE BATTERY.

on exhibit. The Mason battery was represented by Mr. W. M. Petty. Nine cells of Edison-La-Lande were shown to the best possible advantage.



NATIONAL ELECTRIC MF'G CO.'S MICROPHONE CELL.

The interests of the Accumulator Company were well looked after by Mr. E. V. Baillard. Four accumulators fully charged were on exhibit. The battery ran a motor and fan, also supplied current for seven 4 C. P. lamps, which formed a very pretty cluster. The lamps were of various colors and showed off to the best possible advantage.

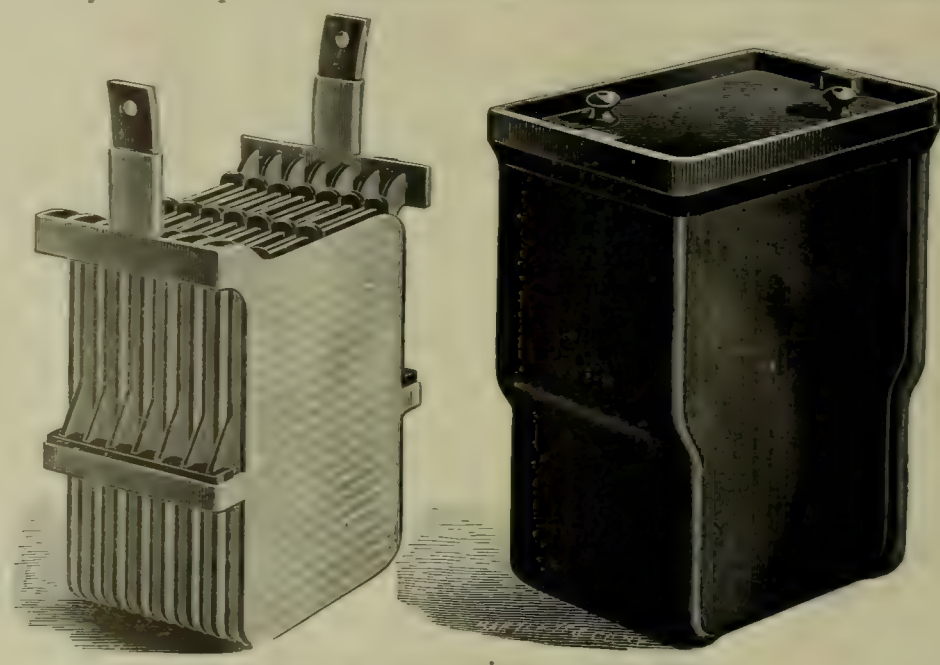
The National Electric Mfg. Co., had three microphone and four dry batteries, together with bells, etc., which they kindly presented to the institute.



CARBON OF MICROPHONE CELL.

The Crosby Electric Co. had quite an exhibit of the famous dry cells, as well as one or two samples of the Hussey and other batteries.

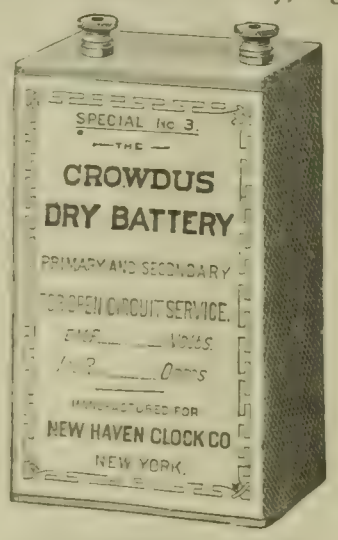
Dr. Van der Weyde had quite an exhibit of



ACCUMULATOR COMPANY'S STORAGE BATTERY.

the various batteries including Leclanche, Grove, and others, many of which he had used in his laboratory, and for which he had made a complete record for efficiency, etc.

The Law Telephone Company had quite an exhibit of its celebrated battery, together with



THE CROWDUS DRY BATTERY.

medical apparatus, and other interesting exhibits in the shape of carbons, etc., which was sufficiently interesting to keep before it a large crowd the entire evening. The exhibit was in charge of Mr. R. J. Terrett.

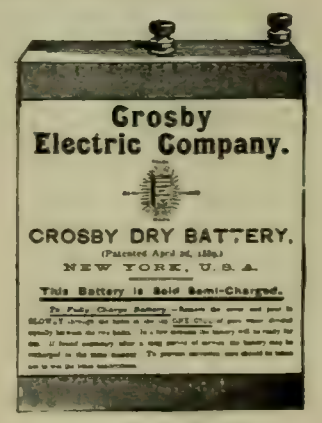
The president of the institute, Mr. James Hamblet, the well-known manager of the time service of the Western Union Telegraph Co., is



LAW BATTERY.

to be congratulated upon the excellent work he is accomplishing in the city of Brooklyn through his very worthy department of electricity.

FOREIGN INVENTION.—The lapsing of the foreign patent by the non-observance of, or by the happening of, a condition subsequent, imposed by the country granting such foreign patent, does not cause the United States patent to expire before the end of the period for which such foreign patents was granted.



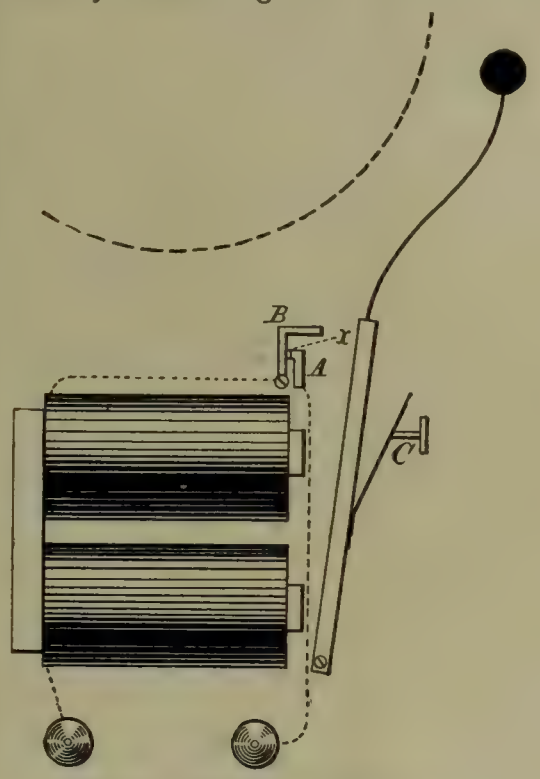
CROSBY DRY BATTERY.

TELEPHONY IN THE SOUTH.—Metallic circuits are now used altogether in telephone work in Nashville, Tenn., and the trouble between the telephone company and the United Eelectric Company, which was caused by the inductive interference of the two systems has been settled. The metallic telephone circuits are free from induction troubles.

IMPROVED ELECTRIC BELL.

In the rapid strides the electric light, the electric motor, and other important electrical industries are making, the small things are generally being overlooked. There are "unconsidered trifles" in the electrical line as in all others, and electric bells have been, up to the present time, classed as one of these. Mr. J. Weber, of 193 Pearl street, Brooklyn, N. Y., has however, taken up this particular "unconsidered trifle," and greatly improved it, as will be seen by the accompanying illustration and description thereof.

In the ordinary electric bell, as is well-known, the best results are not obtained from the magnetic power, for the reason that as soon as the armature begins to move toward the magnets, under the impulse of the current, the magnetism is almost immediately suspended by the breaking of the current. This break is caused by the armature itself moving toward the magnets. The armature therefore is carried forward more by its own momentum than by the magnetic power exerted on it by the magnets. This necessarily entails a great waste of current.



WEBER'S IMPROVED ELECTRIC BELL.

Any device by which the full power of the magnets my be availed of up to the moment the hammer strikes the gong, would obviously be a vast improvement over the old method of bell construction. This is done by Mr. Weber's improvement, as will be seen by reference to the diagram, showing the construction of his bell.

The point A in the diagram is fixed and is in electrical connection with one of the wire terminals. The spring B has an angular projection which will be referred to more particularly presently. This spring B is connected with the other wire terminal through the magnets. Starting from the left-hand wire terminal the circuit is traced through the magnets to spring B, through the closed contact points X to A, thence to the other wire terminal.

Now, when the current is applied the armature is drawn towards the magnets in the usual way, and not until the armature comes in contact with the angular projection of spring B does the magnetism cease. When the armature strikes the projection the circuit is broken at X by the separation of the points, and the magnetism, of course, is suspended. By the cessation of the magnetism the armature falls back to its starting point, and in so doing the circuit is re-established at X, and the operation is repeated so long as the push button is pressed.

As will be readily understood, the great advantage of this improvement is in the fact that the magnetic field is maintained until the armature advances towards the magnet almost as far as it will go, and not until then is the current broken. In this way a very much stronger blow can be applied to the bell by the hammer, and the power of the current is wholly availed of and utilized.

In the construction of these bells the parts can be so arranged that the armature will reach the back contact point before the current is again automatically closed. Thus all possible latitude of motion and greater power is given to the hammer, and less retractile spring is necessary to draw the armature back from the magnets.

This style of contact is not shown in the accompanying illustration, as the same result can be accomplished in several different ways. The illustration, however, illustrates the principle involved.

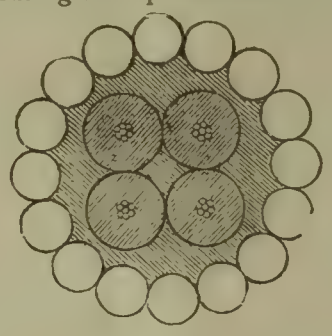
The various features of this improved bell are covered in the patent specifications filed by Mr. Weber, and the fact that this bell never requires adjustment, and as the moving parts never become disarranged, makes it especially adaptable to electric street railway use.

The advantages claimed for this bell are:

1. Increase of power.
2. No adjustment necessary.
3. Less cost.

CABLES FOR LONG DISTANCE SUBMARINE TELEPHONY.*

At the Newcastle meeting last year, I gave the reasons and experiments which led to the conclusion that telephoning between London and Paris was practical. New and distinct ærial lines of four copper wires are now being erected by the respective Governments from each capital to the coast, and a new cable, the joint property of the two Governments, will be laid during this year, between the Kent coast and Sangatte, to connect these two lines. There will thus be two metallic circuits between the two capitals. The K R, that is the product of the capacity K, and the resistance R of each circuit, upon which the clearness of articulation depends, will be 5,900, indicating that speech should be excellent.



SECTION OF SUBMARINE TELEPHONE CABLE.

A somewhat similar circuit has been established, since October last, between Buenos Ayres and Monte Video, under my advice. The cables across the La Plata are each 28 miles long, for there are two separate single-wire cables, and the total distance between the two cities is 180 miles. Subscribers, who have metallic circuits in each city, have no difficulty whatever in speaking to each other from their respective offices, although the K R is as high as 10,400.

The cable across the Channel will be a four-wire cable, and the specification for its construction has been based on the following mathematical development by Mr. H. R. Kempe:

The working capacity of the whole line is dependent upon the product of the total resistance, R, and the total capacity, K. Therefore, if we take the resistance of the ærial portion of the line to be a fixed quantity, there will be a particular size of cable conductor which will give the smallest possible size of dielectric, sufficient to enable a particular value of K R not to be exceeded. For, if we make the conductor larger than this size, and thereby diminish its resistance, we can, it is true, do with an increased capacity; but the diminution in the thickness of the dielectric which could thereby be allowed, is more than compensated for by the fact that the surface of the conductor is larger; in other words, we increase the capacity in a greater proportion than we diminish the resistance. If, on the other hand, we diminish the size of the conductor, we increase the resistance in a greater proportion than we diminish the capacity. Strictly speaking, the requirements of the problem are to determine the size of cable core which shall *cost less;* but inasmuch as the costs of gutta-percha and copper, *bulk for bulk*, do not differ greatly, the problem resolves itself into the determination of the smallest outer diameter which can be employed.

Let r = total resistance of ærial line,
ρ = " " cable,
k = " capacity of aerial line,
κ = " " cable

Then $$K R = (k+\kappa)(r+\rho)\ldots$$

Let D = diameter of dielectric of cable,
x = " conductor "

Then $$\rho = \frac{a}{x^2} \text{ and } \kappa = \frac{b}{\log_\varepsilon \frac{D}{x}}$$

where a and b are constants.

We have, therefore,

$$K R = \left(k + \frac{b}{\log_\varepsilon \frac{D}{x}}\right)\left(r + \frac{a}{x^2}\right)$$

*Abstract of Paper by W. H. Preece, read before the British Association, Leeds, September, 1890.

PATHOLOGICAL EFFECTS OF THE ELECTRIC LIGHT.

A paper by a German medical authority upon the pathological effect of the electric light is printed in the *Wissens Wochenschrift.*

The glare of the electric light, says the paper, exercises a deleterious effect upon the eyesight of people who are exposed for too long a time to its action, and this effect is proportional to the power of the lamp. It might be thought that the injurious effects of the electric light upon the eyes are due to the fact that this light contains a preponderance of chemical rays, violet and ultra-violet, but this is not the case, for the eyes are not similarly affected by illuminations of that character. According to the writer, the "tired" sensation in the optic nerve and the local inflammation which accompanies it, are both due to the fact that the luminous waves proceeding from a powerful electric lamp are of very great intensity. The general symptoms induced in the eyes of people who have been exposed to the glare of unprotected lamps for too long a time are: (1) Transient irritability of the retina; (2) local inflammation; (3) tears and "flashing" of light before the eye; (4) incipient paralysis of the eye. Usually, people experience sensations which are analogous to those which are felt when particles of foreign matter are present beneath the eyelid. In order to prevent the sight being permanently injured, it is necessary to adopt hygienic shades, though these do not act thoroughly in reducing the intensity of the luminous waves. Rest must be sought, and the pain relieved by the application of cold water compresses. When the pain is almost unbearable—a calamity frequently suffered by those who have been exposed for many hours per day and for some time to the glare of powerful lamps—a medical man may relieve it by the injection of cocaine and atropine. The French call this peculiar malady *coups de soleil electriques.*

In a New Dress.—The first number of volume 2 of Whipple's Reports (October) appeared in an enlarged form and with a neat and attractive cover.

THE ELECTRICAL RESISTANCE OF METALS*

I have shown, in a previous communication (*Comptes Rendus*), how the determination of electrical resistance can be turned to account for the study, at high temperatures, of the molecular transformations of metals. I propose to-day to extend the applications of this method to a new series of metals and alloys.

The metals that show no molecular transformation before fusion, possess electrical resistances, the variation of which is a linear function of the temperature. Here are some examples:

Resistance in ohms of wires 1 millimeter in diameter.

Pt	0.140 + 0.000325 *t*
Pt + 10 per cent. Rh.	0.335 + 0.000350 *t*
Cu	0.032 + 0.000101 *t*
Cu + 10 per cent. Sn.	0.150 + 0.000109 *t*
Cu + 20 per cent. Ni.	0.420 + 0.000110 *t*
Ag	0.023 + 0.000105 *t*

It will be observed that copper, silver and their alloys have an incremental coefficient that is to all intents identical, amounting to about 0.000105; that of platinum and its alloys is three times as great. Generally speaking, the introduction of small quantities of foreign substances into a metal raises its resistance curve, causing it to take a direction parallel to its original position. Silver showed an interesting peculiarity. On being heated in oxygen, its resistance curve remained perfectly rectilinear, its mechanical properties were not modified, and its melting point was found to be 945°, given by M. Violle. When, on the other hand, it was heated in hydrogen, all its properties were modified after 650°; the electrical resistance increased more rapidly than in oxygen; the metal, after cooling, was extremely fragile; wires .25 of a millimetre in diameter could be bent without being broken. And, lastly, the melting fell to 915°. The metal assumes a dull appearance similar to that occasioned in palladium by the decomposition of its hydruret (hydrure). These facts show that silver absorbs hydrogen at red heat. I found that the quantity of hydrogen absorbed is insufficient to form a definite combination and that, after cooling, the metal does not retain it in any appreciable quantity.

Many metals show, like iron, sudden molecular changes, produced at certain fixed temperatures. At these temperatures the electrical resistances undergo no change on passing one of these points of transformation as it does at the melting points. The accompanying curves give different examples of these phenomena. They were most clearly shown with an alloy consisting of Cu = 70, Ni = 18, Fe = 11. The temperatures at which molecular transformations occurred were found to be for the three following metals:

Zn.	Brass containing 38 per cent. of Zn.	Alloy—Cu—Fe—Ni
360°	720°	609°

I ascertained directly in the case of brass that the transformation is accompanied by a considerable absorption of latent heat.

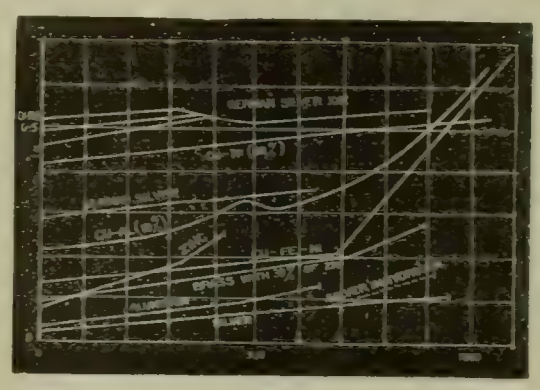
Some alloys show progressive molecular transformation, reminding one of those observed in the chemical equilibrium of saline solutions, in solutions of salts of chromium, of chloride of copper, etc. The transformation is not sudden, but is more often effected within certain limits of temperature. This is the case with slightly silicious aluminium bronze, the transformation of which takes place between 550° and 650°. It is above this last temperature that the tempering of the metal is effected. But this peculiarity is shown in a marked degree in German silver and in alloys of copper and nickel. When these alloys are heated, their resistance decreases rapidly between 300° and 500°. In order to observe this phenomenon, it is indispensable that we should obtain metal that has been annealed (recuit) and cooled very slowly. In the case of German silver, we can only avoid its being almost completely tempered, by making the fall of temperature from 500° to 300° occupy several hours. The transformation seems also to be impeded by the presence of small quantities of foreign matter; in any case the extent of the transformation varies considerably in different samples of metal, and may even be altogether absent, as in the case of the sample of copper alloyed with 20 per cent. of nickel (Cu-Ni 20 to 100) the resistance of which was given at the beginning of this note.

The following figures relate to three samples chosen from among a dozen that were tested:

	0.	200	300.	400.	500.	700.	000.
Cu 50, Ni 24, Zn 25	0.465	0.480	0.505	0.520	0.518	0.530	0.552
	0.495	0.513	0.527	0.525	0.518	0.530	0.552
	0.514	0.257	0.537	0.525	0.518	0.530	0.552
Cu 66, Ni 11, Zn 22	0.285	0.308	0.320	0.330	0.338	0.352	0.392
Cu 81, Ni 18	0.485	0.497	0.500	0.492	0.475	0.473	0.490

The first of these alloys showed the most marked transformation. The three series of measurements were taken from the heating of specimens cooled at different degrees of rapidity, and consequently unequally tempered.

These experiments give the reason of the fact, already observed, that standard resistances of German silver change in course of time; the magnitude of their resistance increases. This is because the wires employed are always partially tempered, and become annealed spontaneously under the influence of slight variations of temperature, of mechanical action, or even of the weather merely. We observe with wires of tempered steel a similar spontaneous annealing action, which is shown by a variation of resistance of a contrary sign.



CURVES SHOWING RESISTANCE OF METALS.

In conclusion, I will give the results obtained with alloys of iron and nickel. Certain of these alloys show, on being heated and cooled, different resistances, *i. e.*, the transformations produced by the elevation of temperature are not immediately reversible; they do not take place when the temperature falls again until it is nearly same as the surrounding atmosphere.

It will be observed that iron, nickel and their alloys show at temperatures above the transformation point, a law of variation of electrical resistance which is analogous to that of platinum and its alloys. At lower temperatures, on the contrary, the rate of variation is infinitely more rapid.

*M. H. Le Chatalier, in the London *Electrical Review*.

ELECTRICITY IN MINING.—An interesting electrical plant will be installed at the Gold King Mine, Telluride, Col. The mine is situated at the top of a mountain, 2,000 feet high. The cost of carrying coal thereto for operating the mine is an important item of expense. At the foot of the hill, however, is a waterfall, and it is proposed to use this cheap power to turn the dynamos to furnish electrical energy, which will be used in the mining operations.

COMPETITION.—Darlington, S. C., is the scene of lively competition between electric light companies, for the privilege of erecting a plant in that town.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part XII.—Alternating Current Dynamos (concluded).

231—What material is preferred for cores of alternate current dynamos armatures?

Wood.

232—Why is wood preferred to iron?

Because it is a non-magnetizable substance.

233—Is iron ever used for the cores of alternators?

Yes; to a limited extent.

234—What is the objection to iron for cores?

The objection to iron is that it becomes heated by the incessant reversal of polarity.

235—Why is the heating of iron cores detrimental?

Heating of cores means useless expenditure of energy.

236—What is the principal difficulty experienced in dealing with alternating currents?

Self induction of solenoids and magnets.

237—How is the self-induction reduced?

By the use of as little iron as possible and making the solenoids large.

238—Is copper wire always used for armature coils?

No. Copper ribbon or bands are used in some machines.

239—In what class of machines is copper ribbon used for the armature coils?

In machines designed to generate currents of large volume and low electro-motive force.

240—What is the character of the currents generated in an armature coil of fine wire?

Such a current will have a high electro-motive force and small volume.

241—How many revolutions per minute do alternators make?

The speed varies with the make of machine. Some of the Westinghouse dynamos are run at a speed of 1,100, or more revolutions per minute, while another make of machine runs as low as 180 revolutions.

242—Do not the reversals of current affect the steadiness of the light?

No; because they are so rapid that the current is practically constant. The eye is not sensitive enough to detect the rapid changes.

(To be continued.)

ELECTRIC LIGHT REGULATIONS.—A very elaborate set of regulations have been drawn up by the municipal authorities of the town of Hanover. On the recommendation of Prof. F. W. Kohlrausch, the Town Council voted 1,500,000 marks at the end of last year, for the erection of a 15,000 light central station. The Municipality are undertaking the laying of the mains on the three-wire system, the work being carried out by Messrs. Schuckert and Co. Contractors for wiring have to obtain a certificate from the Town Council, and these certificates, it appears, can only be obtained by those firms who have previously carried out electric light work in a satisfactory manner. These certificates are liable to be withdrawn, and the holders are liable for compensation to the town for any damage arising from work carried out in a faulty manner. Plans and samples have to be submitted before the work is commenced, and it has to be passed by a municipal inspector before connection may be made to the town mains.

NEARING ITS END.—I am so thoroughly convinced that electricity is the coming power for street railways, (except on heavy grades where the cable is situated), said President Thomas Lowry, in his address before the recent convention of the American Street Railway Association, and that it will prove so effective as a means of rapid transit for other cities, that I believe this is the last convention that will ever seriously consider horses for the operation of street railways.

*Copyrighted.

THE LONG DISTANCE TELEPHONE.

An interesting fact was developed at a recent conference between Mr. A. S. Hibbard, general manager of the Long Distance Telephone, and various district superintendents of that company. The figures were gone over, and it was shown that the maintenance averages of the company's oldest lines were higher to-day than when they were first built, six years ago. This is contrary to the usual experience, as it is well-known that telegraph lines deteriorate instead of improve. In the case of the Long Distance Telephone lines, however, this remarkable condition of the property may be readily understood when it is remembered that the lines are built in the best manner possible at the beginning, with a view to getting the very best service out of them as long a period as possible. It naturally happens in the case of any new line that at the beginning weak points will develop. The Long Distance Telephone Company watches for these, and as soon as anything is reported, the cause of the trouble is at once removed. The linemen are stationed not more than 30 or 40 miles apart, so there is in consequence no delay in remedying any defects on any section of the lines.

Mr. Hibbard feels proud of the fact that his company can show such a record in the maintenance of its property, which, he justly claims, is superior to anything before attained in this direction, and when it is remembered that the lines under his supervision are in better condition to-day than when first built, it is not difficult to understand why he is so exultant.

The Long Distance Telephone Company has completed its lines to Harrisburg, Pa., Elmira, Ithaca, Dunkirk and Jamestown, N. Y., and the Erie, Pa., office will be opened within a week. The lines are now being built in that city.

The line now in the course of construction between Erie and Pittsburgh will be opened about the first of the new year.

It is the Long Distance Telephone Company's experience that hard drawn copper wire when properly put up is ten times better than ordinary wire, as to general efficiency.

What is claimed to be the greatest telephone line in existence is that of the Long Distance Company, which runs from New York to Bedford, a distance of 55 miles. This line of poles carries 70 wires the entire distance, and this number of wires is three times greater than the next largest line in existence. On this noteworthy line there are not less than 3,905 miles of wire. This line is composed of some of the eastern and western trunk lines. At Bedford it is divided, some of the wires continuing to the eastern States, and the others northward and westward.

The company uses about 44 poles to the mile on highways as well as in towns and cities.

The Long Distance Telephone Company has 30 wires between New York and Philadelphia, with a total length of 3,000 miles.

NEW PUBLICATIONS.

One more volume of the Van Nostrand Science Series has just been put before the public, and its subject matter is of such popular interest that it would seem that the book has been brought out at the right time to supply a popular want. The title of the book is "Incandescent Electric Lighting," and it is a practical description of the Edison system, by L. H. Latimer, to which is added a section on the design and operation of incandescent stations, by C. J. Field, and a paper on the maximum efficiency of incandescent lamps, by John W. Howell.

A general explanation of incandescent lighting opens the book, and the lamp is described and illustrated. This is followed by a clear and concise description of the Edison three-wire system, which is well illustrated in all its parts. House lighting is then explained, as is also the Edison meter and its action.

The portion of the book referring to the design and operation of incandescent stations is of great value, showing, as it does, how the very best results may be obtained in the operation of such a station. Various steam engines of the most approved types for electric light work are compared in this portion.

The last section of the book is devoted to a discussion of the maximum efficiency of incandescent lamps. It is liberally illustrated by diagrams of curves showing lamp efficiencies under various conditions.

The book entire is a valuable addition to the class of literature to which it belongs—*i. e.*, the exposition in clear and untechnical language of scientific subjects. If the object of the book is to popularize incandescent electric lighting, we think it will be very successful in its mission, as it is a remarkably well written and timely work. The price of the book is 50 cents.

TELPHERAGE.*

Telpherage is a distinct and special application of electricity to traction particularly suitable for the carriage of goods over rough country where the cost of railways is too great. We do not suppose that it is likely to compete with heavy railways, but it is especially applicable to replace heavy cartage where the cost of transport frequently reaches 1s. per ton mile, which is many times the cost of carrying the same quantity on a telpher line.

Light railways have, up to the present time, been generally erected to supersede the primitive method of carting when the quantities to be carried reach from 100 to 500 tons per diem. The cost of a light railway where bridges, embankments, and cuttings have to be made is considerable, and far in excess of the cost of a telpher line over the same country. A telpher line spans rivers, crosses roads, bridges, valleys, and generally accommodates itself to the smoothing out of excessive gradients caused by the rough surface of the country, and even when the whole line is erected over a country continually rising from end to end of the line, the telpher locomotive can, with facility, be made to haul loads up gradients that are quite impracticable on an ordinary railway.

Ingenious devices were invented by the late Prof. F. Jenkin, and brought into practical use, to enable the train to travel automatically without any driver to control it, and a telpher train so equipped goes along the level and ascends gradients and descends gradients at approximately the same speeds, and with a delicacy of regulation that it would be hard to attain driving a train by hand.

It is the essential idea of telpherage that, instead of carrying heavy unit loads as in a railway and running but few trains a day to do the work, the unit loads carried should be small and the trains should follow each other frequently. As the trains move across miles of country unattended by a driver, and as the speed of any one train might be greater than that of the one in front, it is necessary to have a system of blocking that shall be absolutely certain, and here electricity lends itself splendidly to the object to be achieved.

With a steam locomotive, the most that can be done to stop it is to shut off the steam from he cylinders, but in an electric locomotive it is possible, so to speak, to remove the fire from the fire-box and the steam from the boiler, leaving the locomotive perfectly inert, and in arranging a block system on a telpher line the train in front is arranged to completely cut off the current from the section behind it, so that if the next train should run into this section it immediately loses all power of proceeding until the train in front has moved into a section further on; and thus all possibility of accidents by collision are completely removed.

*Abstract of paper by E. Manville and J. G. Slatter, read at Edinburgh International Exhibition before the Royal Scottish Society of Arts.

FOREIGN NOTES OF INTEREST.

Pipes for gas, water and electric cables, made of paper, have recently been exhibited in Vienna. The width of the paper is equal to the length of a given pipe. The paper runs first through molten asphalt and is rolled upon a mandril of wood, the size of which determines the inside diameter of the pipe. When cool, the mandril is removed, and the inside of the tube covered with a kind of enamel, the composition of which is kept secret. The outside is covered with a bituminous lacquer and sand. It is stated that a pipe of 2 centimetres thickness of material stands an internal pressure of 1,000 kilogrammes.

A committee, appointed by the Belgian Ministry of War, has been making trials at the works of the "Société de la Meuse" with the new armoured electric light towers, designed for the forts along the Meuse. These are steel turrets, intended as a protection to the projectors and the men in charge of them. The light is furnished by a very powerful self-focussing arc lamp, the current for which is obtained from a dynamo driven by a gas engine.

Although the Swedish telephonic system is probably unrivalled, the Swedish engineers evidently do not mean to rest on their laurels. The Swedish Government has placed a sum of 1,600 kr. at the disposal of the State telegraphs, asking them to send a suitable man to Holland, England, and America, in order to see whether any improvement has recently been made in telephones.

The Glasgow Committee of the Mutual Telephones Company, Limited, has decided to adopt the metallic system for Scotland, so as to enable subscribers to speak over long distances, as, for instance, between Glasgow and Manchester and London. The new system is proposed to be inaugurated with the new year.

The German Post Office officials have been experimenting with the North Sea cable, 75 kilometres long, between Heligoland and Cuxhaven, to test the possibility of using submarine cables of considerable length for telephonic purposes. The results have been very favorable, distinct communication having been obtained at both ends.

At a recent meeting of the Paris Academy of Sciences, M. Serullas read a paper on the *Isonandra Gulta*. The author gives an account of this plant, both as to its discovery and as to the growth of certain varieties. Some interesting information with regard to the employment of gutta percha for industrial and commercial purposes is also given.

The use of Tudor accumulators in Germany has been greatly extended during the past few years. So much has this been the case that the makers, Messrs. Müller and Einbeck, of Hagen, resolved to open branch works in Austria, and the accumulator factory of Messrs. Getz and Odendall has just been acquired for that purpose.

The driver of one of the accumulator cars on the Bristol road line Birmingham, lost control of it while descending an incline recently, but the car was ultimately pulled up before any mishap occurred.

The Telegraph Administrations of Greece, Sweden and Switzerland have, following the lead of France, adopted the bi-metallic "Martin" wires for their telegraph and telephone systems.

An important test of the capabilities of the Berthon telephone to work on telegraph wires is about to be made on the railway telegraph wires between Perth and Inverness, England.

Messrs. Siemens Bros. and Co. of London, have secured the contract for manufacturing the 4-cored cable to be use for telephoning across the Channel.

The Lichterfelde Electric Railway, the oldest in the world, has been extended to the Potsdam Railway station and opened for traffic.

ELECTRIC LIGHTING REGULATIONS.

In the regulations issued by the London Board of Trade for securing the safety of the public, and for ensuring a proper and sufficient supply of electrical energy, there is much that is interesting to American electric light managers. We give herewith a few of the regulations which will enable a comparison with American practice in like lines.

The expression "pressure" means the difference of electrical potential between any two conductors through which a supply of energy is given, or between any part of either conductor and the earth; pressure on any alternating current system being taken to be the equivalent of pressure on a continuous current system when it produces an equal heating effect if applied to the ends of a thin stretched wire or carbon filament; and—

(*a.*) When the conditions of the supply are such that the pressure cannot at any time exceed 300 volts, if continuous, or the equivalent of 150 volts, if alternating, the supply shall be deemed a low pressure supply.

(*b.*) When the conditions of the supply are such that the pressure may exceed the limits of a low pressure supply, but cannot exceed 3,000 volts, or the equivalent of 3,000 volts, whether continuous or alternating, the supply shall be deemed a high pressure supply.

(*c.*) When the conditions of the supply are such that the pressure may on either system exceed 3,000 volts, or the equivalent of 3,000 volts, the supply shall be deemed an extra high pressure supply.

Mains, service lines, and other conductors and apparatus are referred to as low pressure, high pressure, and extra high pressure mains, &c., according to the conditions of the supply delivered through the same or particular portion thereof.

The maximum working current shall not be sufficient to raise the temperature of the conductors or any parts thereof to such an extent as to materially alter the physical condition or specific resistance of the insulating covering, if any, or in any case to raise such temperature to a greater extent than 30° of Fahrenheit's thermometer; and efficient automatic means shall be provided which will render it impossible for this maximum working current by any accident to exceed such limit to the extent of 50 per centum, even for short intervals of time; and special care shall be taken that the cross sectional area and conductivity at joints are sufficient to avoid local heating, and that the joints are protected against corrosion.

Where any high pressure conductors are laid in subways, or in the same conduits with any low pressure conductors, they shall be completely enclosed in strong metalic casing efficiently connected to earth.

Where any high pressure conductor is laid within a less distance than 18 inches from any low pressure conductor or from the surface of the ground, or where any low pressure conductor is laid within the above mentioned distance from any previously laid high pressure conductor, efficient means shall be taken to render it impossible that the low pressure conductor or the surface of the ground shall become electrically charged by any leakage from or defect in the high pressure conductor.

Every high pressure conductor shall be continuously insulated with a durable and efficient material which shall be protected on the outside against injury or removal by abrasion, and every such conductor shall be tested for insulation after having been laid in position and before any joints for service line are made. The insulation resistance under these conditions shall not be less in any section of the conductor than at the rate 100,000 ohms per mile for every volt of pressure of the supply under a testing pressure of at least 100 volts, and the undertakers shall duly record the results of the tests of each conductor, or section of a conductor, and at all times permit an electric inspector to examine and take copies of such record.

The insulation resistance of any complete circuit used for high pressure supply, including all devices for producing, consuming, or measuring energy, connected to such circuit, shall be such that should any part of the circuit be put to earth through a resistance of 2,000 ohms, the leakage current shall not exceed 0.04 ampere in the case of continuous currents, or 0.02 ampere in the case of alternating currents.

All conduits used as receptacles for conductors shall be constructed of durable material, and of ample strength to resist any pressure due to heavy traffic or other forces to which they may be expected to be subjected.

Where the conductors in any conduit are not continuously insulated, adequate precautions shall be taken to ensure that no accumulation of water shall take place in any part sufficient to raise the level of the water into contact with the conductors.

All conduits for conductors constructed in streets in which gas mains are also laid, shall be efficiently protected against an accumulation of gas.

All street boxes shall be efficiently protected against an accumulation of gas or water, and their covers so secured that they cannot be opened except by means of a special appliance.

Where the general supply of energy is a high pressure supply, and transforming apparatus is installed on the consumer's premises, connected to the distributing mains by high pressure service lines, and to the consumer's terminals by low pressure service lines, the whole of the high pressure service lines, conductors, and apparatus, including the transforming apparatus itself, so far as they shall be on the consumer's premises, shall be completely enclosed in solid walls, or in strong metal casing efficiently connected to earth, and securely fastened throughout.

All terminals, low pressure service lines, or other apparatus, between the transforming apparatus or other source of supply and the consumer's terminals, so far as they shall be on the consumer's premises, shall be completely enclosed in insulating cases or coated with insulating material in such a manner that no part of them can be touched by any person without the removal of such case or coating, and, wherever exposed, shall be efficiently protected against injury to the insulation.

An aerial conductor shall not in any part thereof be at a less height from the ground than 20 feet, or where it crosses a street, 35 feet, or within 7 feet of any building or erection other than a support for the conductor, except where brought into a building for the purpose of supply.

Every aerial conductor shall be attached to supports at intervals not exceeding 200 feet where the direction of the conductor is straight, or 150 feet where this direction is curved, or where the conductor makes a horizontal angle at the point of support.

Where any aerial conductor crosses a street, the angle between such conductor and the direction of the street at the place of such crossing shall not be less than 60°, and the spans shall be as short as possible.

Every high pressure aerial conductor shall be continually insulated with a durable and efficient material to be approved by the Board of Trade to a thickness of not less than one-tenth part of an inch, and in cases where the extreme difference of potential in the circuit exceeds 2,000 volts, the thickness of insulation shall not be less in inches or parts of an inch than the number obtained by dividing the number expressing the volts by 20,000. This insulation shall be further efficiently protected on the outside against injury or removal by abrasion. If this protection be wholly or partly metallic it shall be efficiently connected to earth.

The material used for insulating any high pressure aerial conductor shall be such as shall not be liable to injurious change of physical structure or condition when exposed to any temperature between the limits of 0° and 150° Fahr., or to contact with the ordinary atmosphere of towns or manufacturing districts.

The undertakers shall not permit any aerial conductor to remain erected after it has ceased to be used for the supply of energy, unless they intend within a reasonable time again to take it into use.

TEMPERATURE ERROR IN VOLTMETERS.

In an article on the elimination of the temperature error in voltmeters, *L'Electricien* says:

In all voltmeters based upon electro-magnetic action, the current passing through the bobbin depends on the difference of potential to be measured, and on the resistance of this bobbin. If this resistance is increased by heating, the instrument is retarded, and if when it has been calibrated the heating caused by a great difference of potential producing a continuous current in the bobbin has been taken into account, the voltmeter can only give exact indications on condition that practically the same voltage is always maintained at the terminals. In order to remedy this inconvenience Dr. Kahle has conceived a method of winding the bobbins of voltmeters, which renders their indications independent of the temperature. The result is obtained by winding the bobbin with two parallel wires acting in opposite directions. The principal wire magnetizes, and the secondary wire demagnetizes the core of the voltmeter; but as the auxiliary wire has a greater resistance than the principal wire, the magnetizing action predominates. By taking for the principal wire a metal whose coefficient of temperature is higher than that of the secondary wire, we can easily see that a rise in temperature reduces both the magnetizing action of the principal circuit and the demagnetizing action of the secondary circuit. In order that the resulting electro-magnetic effect may remain the same, it is necessary that the difference between the two ampere-turns of the two bobbins should be the same for all temperatures, a result which is obtained when the ratio of the two windings is the same as that of their coefficients of temperature.

It is evidently advantageous to employ for the principal wire a metal of low specific resistance, and for the auxiliary winding one of high specific resistance. As, however, the coefficient of temperature of good conductive metals is generally somewhat high, and that of bad conductors rather too low, the condition indicated above for establishing a system of compensation cannot be fulfilled without an accessory arrangement, which consists in establishing an external resistance, the coefficient of temperature of which is not very high, in series with the principal wire. Dr. Kahle has constructed, on these principles, voltmeters whose indications remain quite independent of the temperature.

Electric Railway Statistics.—One hundred and eighty-five cities have 287 electric lines. Boston has 312 electric motor cars using single overhead trolley system; St. Louis, 207; Rochester, 200; Pittsburg, 170; Cleveland, 162; Minneapolis, 110; St. Paul, 88; Cincinnati, 77; Nashville, 61; Davenport, Ia., 60; Milwaukee, 55; Richmond, 45; Utica, 30; Scranton, Penn., 20; Albany, 16; Syracuse, 10, etc. The systems represented are Edison or Sprague, Thomson-Houston, Short and Westinghouse, all single trolley overhead. Four to ten storage battery cars are run on Fourth avenue line, New York. Two storage battery cars are run on the Beverly & Danvers road, and two were running in Providence, but are not now; six in Dubuque, Ia. Thomson-Houston have 130 lines and 1,630 motors; Edison, 108 lines, 1,460 motors; Short, 10 lines, 273 motors.

ON THE PROTECTION OF BUILDINGS FROM LIGHTNING.*

Considerable uncertainty is reputed to exist amongst architects and others who are occasionally called upon to erect lightning conductors. I have had quite recently two cases illustrative of this suspected uncertainty brought forcibly to my notice.

The first case occurred in connection with this Exhibition. The electrical and lighting committee decided that both the old and the new systems of protection should be illustrated practically; so the chimney of the boiler-house was ordered to be protected by a stranded copper rope of the ordinary type, and the minarets of the main building by iron wire, according to a design kindly furnished by Dr. Oliver Lodge. The erection of the chimney proceeded with unexpected celerity, and when the committee went to specify the precautions they wished to have observed in earthing the conductor they were informed that the conductor was up, earthed, and finished. The builder assured them that it was "all right;" but appreciating the ridiculous figure that would be cut by an electrical committee were a chimney under their special care struck and injured, it was resolved to do violence to the builder's feelings and dig up his earth. It was found that the end of the conductor was only a few inches below the surface, and was loosely embedded in builder's *débris*. This was the first case, and was detected and remedied in time. The second was only revea'ed by an actual visitation of lightning.

Last month, during a severe thunder storm, and while it was raining very heavily, the inmates of a house were startled by a tremendous report. The house is peculiarly situated, being erected on the slope of a rocky hill, about 600 ft. above the base and some 1,000 ft. below the summit. It is fitted with the electric light, all the leads being within the building. A telephonic connection exists with the stables in the valley below, some 1,000 yards distant; it consists of two copper wires thickly insulated with gutta-percha, which are used as a metallic circuit. They are underground the whole way, being laid in a wooden box buried in a trench, except at one point, when they cross a stream, in an iron pipe laid in its bed. When the flash occurred, light was seen in almost every room of the house. A flame appeared around the kitchen grate. The housekeeper heard a faint rustling sound in the direction of one of the electric lamps, and was immediately conscious of a blaze of light, which seemed to dart from the lamp to the grate. A ball of fire, of a deep red color, was seen, and a dazzling light of no defined shape appeared to play for an instant over the wall paper, which is embossed with metal. At the stables a ball of fire, of a white color, about the size of a cricket ball, appeared in the middle of the room, and instantly exploded with a report. An examination showed that the safety fuses of the electric light system melted. The hinged door of the box containing them, which was about 4 ft. from the telephone on the same wall, was knocked off and thrown to a distance. It was much scorched inside. The telephone wires were fused in three different places, once in the iron pipe in the bed of the stream, once midway between the stream and the stables, and once a few yards on the house side of the stream. At the second place the wooden boxing was completely destroyed for about 6 in.; at the third its bottom only was knocked out. In the stables the boxing was blown off the wall, but the wires escaped injury, as did the te'ephones at both ends. Where fused, the wires presented a sharpened or pointed appearance on the sections furthest from the house, and a rounded shape on those nearest it. At the moment of the discharge two bullocks grazing in the fields were struck dead. This tends to substantiate what has often been asserted, that lightning discharges frequently, if not invariably, are double; that at the moment a flash takes place from clouds to earth at one place another ascends from earth to clouds at another, a phenomenon to which the name of back or return stroke has been given.

The house is largely roofed with lead, and has several iron spires which are in contact with the lead. The highest spire was found to be bulged and blackened at the junction of the iron with the lead. There are numerous metal drain pipes down the walls for carrying off the rain-water. These are in contact with the lead work of the roof above; but no provision is made for earthing them below. When I add that there is no lightning conductor, and that the house is built on a thin layer of soil covering rock, it will be seen that all the elements necessary for a first-class catastrophe were present. The absence of a conductor was accounted for by saying that when the house was built the architect stated that one was unnecessary. When telephone wires, and especially metallic circuits, are taken into a building they should be fitted as near the point of entry as possible with a good lightning discharge. This necessity I recognized several years ago as a consequence of more than one accident, since when all metallic circuits constructed by the National Telephone Company have been so fitted. Such a discharger, costing only a few pence, would in all probability have shunted the lighting to earth, and the inmates of the house might not have even been aware that a discharge had taken place. Telephones working with an earth return do not require such care as metallic circuits.

I recommend iron wire because, for the theoretical reasons adduced by Prof. Hughes and Dr. Oliver Lodge, iron is now widely admitted to be as effective as copper for currents appertaining to the character of lightning. When the greatest use has to be made of a certain sum I consider, theoretical reasons apart, that it is beyond comparison wiser to invest that sum in six or eight iron conductors than in one or two copper ones. Copper would he preferable on account of its greater durability when buried; but still, galvanized iron will endure for years when so treated.

To secure immunity from lightning, certain invariable precautions have to be taken in all cases. These are specially, firstly, having at least one metal point—multiple points are much better—in as perfect connection with the earth as possible, preferably by several paths, raised above all stone, wood, and other non-conducting portions of the building. These points should be preferably over or quite close to the chimneys, unless wire cages are provided specially for them. Secondly, connecting all pipes, grates, bell-wires and other masses of metal in the house to the conductors, preferably by means of soldered connections; when this cannot be managed, as with light and telephone leads, then by providing a small air space across which the discharge may jump harmlessly. Thirdly, by securing a good earth. When a house is built on rock, or on a thin stratum of soil over rock, or on chalk, this point requires special attention and study. Where gas and water pipes exist they should be joined to the conductors both above and below the ground, and gas and water meters should be bridged by soldered No. 5 wire. Even when water pipes exist, Dr. Lodge considers it better to provide a separate earth for the conductor, also attaching it to the pipes; but this is a refinement I have not myself adopted when good water mains, always full, and jointed with lead, have been at hand.

In conclusion, I am able to show you some effects of a recent lightning storm, which emphasizes the necessity of having the highest point of any structure earthed. Last month a telephone wire erected on the tops of poles between Murtle and Cults in Aberdeenshire was struck. The wire was out of use, and was insulated at both ends, so that the lightning found no vent at the extremities. It accordingly struck through the solid porcelain insulators to the iron bolts supporting them, and jumped thence to the earth wire, which was stap'ed up the poles to within an inch or two of the bolts. It shattered the insulators on the 1st, 2d, 7th, 15th and 35th poles, counting from Murtle. At three of the poles the wire, No. 18 B.W.G. silicum bronze, was fused, and at the foot of one pole, the earth was disturbed and the grass burnt. Three of the insulators, with fragments, are on the table before you; the others were reduced entirely to small pieces, many of which could not be found. On one of those before you a metallic deposit from the fused wire is distinctly visible. Had each pole carried an earthed point raised above the topmost wire, the discharge would, almost to a certainty, have neglected the path of far higher resistance through the wire and porcelain and all the damage would have been averted. This is a weak point in our telegraphic practice common to post office, railway, and telephone companies, and one which I have raised my voice against for a good many years past. It is a curious question what the precise nature of the force is that splits porcelain in the manner shown. The destruction of trees and telegraph poles by lightning has been attributed to the sudden generation of steam in the pores of wood due to the heat of the discharge or expansion by the heat of the air which the wood contains; but in porcelain their is neither moisture nor air, yet as you see, when it chances to intervene in the path of the least resistance, that does not prevent it from being split up and utterly destroyed.

*Abstract of a Paper read by A. R. Bennett, at the Edinburgh International Exhibition, on September 5, 1890, before the East of Scotland Engineering Association.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Oct. 30, 1890.

The work of laying the track for the electric street railway on Central street, Milford, will commence this week. It is expected that the route will be completed and cars running by Dec. 1st.

It takes 3,000 pounds of mica to supply the weekly demand for manufacture in the Thomson-Houston factories. About 500 barrels of mica scraps are shipped away weekly to be manufactured into material for insulation.

Work in changing the Annisquam extension of the horse railway, from the double to the single trolley system, is progressing, the underground wire being laid from the Annisquam terminus to the Babson Farm, at Riverdale.

There are to-day a little over 2,600 men in the Thomson-Houston factories. An average of 100 are hired weekly. The men are secured from all directions, the Lynn, Boston and New York papers being used as mediums for advertising for help. At present skilled machinists are in demand. A force of very heavy men will be required for the new factory L.

The subject of an electric road is being agitated in Bridgewater at present, to run between Middleboro, Bridgewater and West Bridgewater. It is claimed that such a line is a necessity, and would be patronized so generously as to enable the payment of a dividend the first year. The projectors of the line cite as a successful one that of the Plymouth and Kingston road. Although the road is known by that name, yet its line terminates a mile this side of Kingston village, and it is wholly dependent in local travel in Plymouth. It is understood that already several thousand dollars have been guaranteed toward building the road.

R. M. Hunter has obtained a patent for an electric railway, the combination of a track, a series of posts or poles arranged along said track, supply conductor and a working conductor connected in parallel and suspended on the

opposite sides or portions of said posts, and at an elevation above the track, and so that the surface of the working conductor adjacent to the track is unobstructed; a car, electric motor, travelling contact, and motor circuit. Another of Mr. Hunter's patents is for electric railway having a main line and branch in siding formed with supporting rails, upon which the car runs and is guided, the main line conductors independent of the rails in combination with the conductors of the branching track or siding, also independent of the rails and electrical connections between the conductors by which current is supplied from the main source. A third is for working conductor from which a travelling motor receives electricity made in sections, part of which supply electricity of one polarity and part of the opposite polarity in combination with supply conductors and branch conductors, connecting them with sections of similar polarity.

A patent has been granted Prof. Thomson for an electric motor. It covers the combination, with a short circuiting magnetic bar and its coil, of a current-controller therefor, and a governing-magnet in a devised circuit around the armature. He also has a patent for a process of electrically welding three or four pieces together by placing them in abutment one with another in the desired relation, passing current through the joints until they assume the desired welding temperature, and welding the joints, as and for the purpose described. A third patent is for electric welding of pipes, in other words, a process of lap-welding joints between hollow metal pieces, consisting in heating the joint to the desired plasticity by passing an electric current through it, and then effecting the weld by laterally-applied light impact or pressure repeated a number of times and properly graduated as described, not to contract or produce collapse in the work.

A 20 foot fly-wheel on the 500 horse-power Corliss engine in the Lynn Gas and Electric Company's electric light station on Pleasant street, exploded Oct. 26th. The accident was caused by a crossing of the wires burning out the dynamos and relieving the engine from its immense load, causing the wheel to revolve at a terrific speed. The broken pieces went through the walls of the building, demolishing the brickwork and wrecking the big engine, but no one was injured. The damage is about $12,000. The city lights are being supplied by the reserve engine.

Mr. O. C. Hall has been chosen superintendent of the T.-H. welding works. He was acting superintendent during the illness of Superintendent John Tregoning, last year, and succeeds the latter, who has gone to England to select a site and establish the works of the European Welding Company. If Mr. Tregoning likes England he is likely to remain there. He will be a great loss to West Lynn, where he has made many friends by his pleasing personal qualities.

The capitalists of New Bedford are contemplating the extension of the West Side Electric Railway which has already been a great financial success. Their plan is to extend the system to the North End. It is not improbable that an independent company may be organized in the interests of rapid transit in this city. The public in general is strongly opposed to the extra transfer tax imposed by the Union Street Railway Co., and in consequence of this opposition an independent electric railway may be the result.

In the Providence Common Council, this week, the committee on street railways reported in favor of granting the Union Railway Company permission to use the single trolley system.

Secretary J. W. Gibboney, of Prof. Thomson, has been granted a patent for an ingenious type cleaner for type-writing machines. W. J. P.

ENGLISH VISITORS AT LYNN.

On Wednesday, Oct. 29th, the members of the British Iron and Steel Institute, now in this country, visited the works of the Thomson-Houston Electric Company, and the Thomson Electric Welding Company, at Lynn, Mass.

On their arrival at Lynn they were met by A. L. Rohrer, E. W. Rice, Jr. and O. C. Hall and escorted to the Thomson-Houston works on special electric cars. When the works were reached the party was introduced individually to Prof. Elihu Thomson. The welding process was explained and practically demonstrated by Prof. Thomson, Hermann Lemp and other experts.

First, two sections of an iron band an inch broad, a quarter of an inch thick, were put into a little machine and their ends clamped in position, almost touching one another. This occupied 15 seconds. Then a lever was pressed forward. It turned on the electricity. The iron was heated to a white heat for a quarter of an inch from the two opposing ends. A foot from this white heat the iron was cold as ever. Another lever was pulled and in five seconds the two pieces were one—perfectly welded. The power had come from a dynamo that was furnishing power for the incandescent lamps that lighted the shop.

Then another machine was shown, more remarkable than the first. A boy was working it. The pressure that brought the ends of the copper wire together was automatic. The pressure came from two little hydraulic pumps at one end. It was used for welding easily fusible metal, and was justified so nicely that the current was interrupted the second the weld was completed. The wires were put into the clamps, the boy pressed the button, and in an instant the machine did the rest—a hitherto impossible job. Some of the visitors were allowed to do a little work on their own hook at this machine, and it was so easy they seemed to like it.

Then there was a machine for welding steel cables. An inch cable, cleanly cut in two, was made as good as new by a simple twist of the wrist, the arm and the elbow, in 10 seconds, and no material was lost. This surprised the Britishers, for it has hitherto been necessary in joining a parted cable to splice some 15 to 30 feet, and skilled labor had to do it at the cost of much time and labor.

Machines for welding pipe for refrigerating coils, spinning rings, and parts of ordnance shells were also shown; then the visitors were shown the application of electricity to drills and pumps, where the drill is actuated by means of a piston working in two solenoids.

From noon until 1 p. m. the drawing-room was a place of feasting. Then the Thomson-Houston electric works where were arc and incandescent lights and dynamos and coal cutters for mining purposes, and one thing and another were looked upon and the processes explained.

At 3 o'clock every one took electric cars to the Boston & Maine station, where a special train was waiting to take the party to Boston. At the station here a majority of the party took West End electric cars that had been specially provided for them, and were rushed out to Chestnut Hill, just to see how rapid transit thrives in Boston.

In the evening the Thomson-Houston Company entertained its guests at a banquet at the Vendome, Boston.

Prof. Elihu Thomson was called upon for some remarks and he spoke briefly of the progress of the science of electricity and its relation to iron and steel, and predicted that in 20 or 30 years perhaps electricity would operate the railroads.

Electric Power in Newspaper Office.—The *Arkansas Press*, Little Rock, is operating its entire establishment by electric power.

NEW YORK NOTES.

The register at Alexander, Barney and Chapin's Electric Exchange, in the Telephone Building, 20 Cortlandt street, this city, shows a long list of visitors from the city and many from out of town. Among the latter names appear the following: E. H. Clark, Long Branch, N. J.; Rudolph Schmid, Rochester, N. Y.; C. A. Nichols, Springfield, Mass.; J. Pinckney Smith, New Orleans, La.; A. D. Newton, Hartford, Conn.; M. E. Baird, Windsor, Conn.; W. C. McIntire, Philadelphia, Pa.; A. H. Hayes, Newark, N. J.; Romeyn Boyden, H. E. Harrington, Hartford, Conn.; J. F. Noonan, Paterson, N. J.; J. H. Shay, Chicago, Ill.; J. W. Packard, Warren, Ohio; J. W. Peale, Wm. Witney Munroe, O. S. Carr, Greenpoint; G. F. Bulen, N. J.; Leo Daft, N. J.; W. R. Eckard, San Francisco; George W. Davenport, Boston, Mass.; P. L. Saltonstall, Boston, Mass.; George W. Adams, Boston, Mass.; W. R. Bennett, Hoboken, N. J.; C. R. Huntley, Buffalo, N. Y.; Wm. M. Brock, Paterson, N. J.; Frank Wheaton, Paterson, N. J.

The new incandescent lamp, the "A. B. C." is already in large demand among the trade. Messrs. Alexander, Barney and Chapin, of the Telephone Building, this city, report that they are receiving inquiries and orders from all over the country, and the prospects are that they will have to call on the factory to increase the product. They are now, however, making prompt shipments, and are going to endeavor to keep up with the demand, so that consumers can feel assured of having their wants supplied without delay.

The Exhibit of the Westinghouse transformer system in the arcade of the Equitable Life Insurance Company's building at 120 Broadway, is an endless attraction to strangers. Indeed, there is a fascination about the system that never fails to evoke admiration and wonder in the minds of those who understand it best.

It is a noteworthy fact that more messages are handled on the Long Distance Telephone circuit used by the Edison General Electric Company between their city offices and their machine works at Schenectady than on any other telephone circuit in existence.

The Bishop Gutta Percha Company of this city has closed a contract with an electric light company in Washington, D. C., for the supply of a cable. Alternating currents will be used and the cable will be placed in the underground conduits.

The Long Distance Telephone Company has recently laid 5 large lead-covered cables across the Brooklyn bridge. They were manufactured by the Norwich Insulated Wire Company of this city.

The Edison General Electric Company, hope to get into their new building, 44 Broad street, on November 1st. R. J. G.

TRADE NOTES.

The Brown & Sharpe Manufacturing Company, of Providence, R. I., has recently issued a circular entitled "Emery Wheels—Some Suggestions in Regard to their Selection and Use." The information is valuable to mechanics and manufacturers of electrical apparatus will find in the circular much that is of value and interest to them. A copy of the circular may be obtained by addressing the Brown & Sharpe Manufacturing Company, Providence, R. I.

Messrs. Pass & Seymour, of Syracuse, N. Y., manufacturers of china for electrical purposes, have succeeded in producing a china for insulators which is much stronger than the ordinary china. Some of the firm's customers are riveting brass directly to the china, instead of using screws. This is a test that no other china in the market will stand.

HEATING IN DYNAMOS.

The are three sources of waste—first, the energy spent in the conductors due to their having some resistance; secondly, the energy expended in continually changing the direction of the magnetism in the rotating core; and, thirdly, the energy of feeble parasitic currents generated in both conductors and core. The energy dissipated in the armature due to the first cause can be calculated from the resistance of the winding from brush to brush and the total current flowing. The loss from the third cause cannot be very readily calculated, but may be rendered almost negligible. The points necessary to be observed in construction, so that these might be eliminated as much as possible, are briefly, the core has to be supported so that no part of the supports is subject to inductive action, the core has to be laminated in planes perpendicular to the direction of induction, and parallel to the direction of motion, and the conductors have to be divided and grouped in certain ways in the winding. If these rules are carefully attended to, the loss due to parasitic currents becomes unimportant. Not so, however, is the second source of loss.

In carrying a piece of iron through a cycle of magnetization, there is expended in the operation a definite amount of energy depending on the induction and on the character of the iron. Starting with a piece of iron magnetized in one direction, a cycle defines the operation by which the induction is reduced to zero, reversed and brought up to the same strength in the opposite direction, again reduced to zero, and finally brought up to its first degree of induction. Imagining for a moment that ever molecule of iron is a small magnet, it will be readily perceived that, since the axial direction of the molecules is governed by the direction of induction, in one complete cycle each molecule must rotate once with reference to the mass of which it forms a unit. In producing this rotation involved by the magnetic cycle, work is performed either in overcoming a kind of frictional resistance, or in overcoming the magnetic forces which the molecular magnets exert upon each other, as has been suggested recently by Prof. Ewing. The energy expended in carrying annealed soft iron wire through cycles such as described, has been carefully determined by this experimenter showing that the energy increases at a somewhat greater rate than the reduction.

PHILADELPHIA NOTES.

De Kosenko, Hetherington & Co., will shortly move into their new and more spacious quarters in the Times Annex building, where they will occupy five floors in the manufacture of the latest designs of electroliers and combination fixtures. The first floor will be used for offices. The firm report a big demand for their goods, which are giving great satisfaction.

Mr. H. T. Paiste is manufacturing some very handsome designs in covers for his well-known switches. One of these will gain great popularity, we think, and merits special mention. The cover is gilded, and makes one of the prettiest ornaments that could be placed in a parlor or any room where gold paper is used. Mr. Paiste reports large orders and sales for his goods.

The Novelty Electric Co. reports business very brisk. This company are dealers in, as well as manufacturers of electrical specialties and novelties of all descriptions.

The Star Electric Co., reports orders far ahead of their present facilities. This company is rapidly coming to the front in the electrical trade.

ENLARGED ITS FACTORY.—In order to meet the extraordinary demand for the street car motor, the Westinghouse Electric and Manufacturing Company has been compelled to enlarge the capacity of its railway department.

SAFETY LAMP FOR MINES.

In a note M. Charles Pollak, in *Comptes Rendus*, describes a new safety lamp for use in mines, as follows:

A rectangular box of ebonite contains some accumulators of the Pollak type; this box rests on a metal tray. An ebonite lid serves as a support for an incandescent lamp, which is enclosed in a cylinder of thick glass. The whole is covered with a metal cap, fastened by means of bolts. A sheet of soft gutta-percha, interposed between the lid and the box, closes it hermetically. Rods of inoxidizable metal are inserted in the lid, passing right through it; at their bases are platinum contacts which rest upon platinum contacts in the accumulators, and at their other extremities are springs, one of which is connected metallically with one foot of the lamp. The other foot is insulated, and can be brought into contact with one pole of the accumulator by means of a needle which is introduced into a horizontal groove in the lid.

The contacts being on the inside of the box and the lid, neither the opening nor the closing of the circuit can cause any explosion. Thus the lamp may be lighted or extinguished in an inflammable atmosphere. If the system is thrown out of working order, or if the protecting glass cylinder is broken, the lamp is extinguished.

The lamp is charged, without being taken to pieces, by means of a fork, which is introduced into the grooves hollowed out in the lid.

The model in existence weighs 1,800 gr., and gives, on an average, 12 hours of perfectly constant light, the power of which = .7 to .8 of a candle-power.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Ill., Nov. 1, 1890.

The Western Electric Company of Chicago have secured the contract to introduce the electric light into Oil City, Pa.

The Central Electric Company's new fixture and electrolier department is now complete and adds materially to the showy appearance of their already handsome store.

Mr. Charles E. Brown, of the Central Electric Company, has just returned from an extended trip of over eight weeks' duration. Mr. Brown reports business good, and brings home some nice orders for Improved Candee Wire.

George W. Martin, cashier of the Ironwood Electric Company, of Ashland, Wis., is missing with the simultaneous disappearance of several hundred dollars of the company's funds. He led a fast life.

The Fletcher & Fletcher Company, of Cleveland, Ohio, are not only live business people, but they are somewhat poetic, too. The virtues of their "Medico Electric Jar," are set forth in verse by the firm, after the nursery rhyme of "Twinkle, Twinkle Little Star." This "Medico Electric Jar" is having a large sale, and the general electric supply business of the company is very brisk.

The Chicago Electric Club will hold its next meeting Monday evening, Nov. 3d, at which papers will be read by Mr. F. E. Degenhardt and Mr. Theo. P. Bailey. Mr. Degenhardt's subject is "Underground Electrical Work," and Mr. Bailey's subject "Street Railways."

Oscar Kleinsteinher, superintendent of the Milwaukee, Wis., police alarm and telegraph system, is said to have invented a system of carrying mails between cities by the aid of electricity. The apparatus, it is said, works on the same principle as the overhead electric street car system, except that the wires will be inclosed in pipes. It is expected that the mail carriage will travel sixty miles an hour.

The South End Electric Railway Company, of Chicago, has been incorporated with a paid up capital of $100,000; Lake Calumet has been obtained. The plan is to connect the territory on the ridge with the electric lines at Pullman and with the Calumet Electric Street Railway Line, which goes to South Chicago.

J. M. Lennon, electrical engineer, of Minneapolis, has established an electrical agency and offices at 22 Loan and Trust Building, where he will carry a full line of samples of supplies and apparatus. Mr. Lennon, it will be remembered, was the engineer who prepared estimates and plans which were submitted some time ago to the Minneapolis City Council, for the installing and operating of a municipal electric lighting plant.

The Great Western Supply Company report continued activity in all departments. Their orders for rail bonds, pole ratchets and curve insulators, are in keeping with the spread of the electric railways, and their new designs of fixtures are beautifying hundreds of homes. They are also supplying the coming generation with learner's telegraph instruments and with experimental apparatus.

The Central Electric Company are showing a piece of plain Okonite wire that was placed in the Lumber Exchange Building at Minneapolis years ago, and has been used continuoulsy ever since. The wire was stapled to the fireproofing and plastered over, and is now apparently in as good condition as ever. Okonite seems to become more popular with architects and electric light men each year and has so far withstood the severest tests that have been applied to it. The Central Electric people have a stock of fully two million feet in their warerooms.

Permission having been obtained from the North Chicago Street Railway Company, the Accumulator Company of New York will operate one of their cars on the Dearborn street branch of this road. The car to be used is the one which attracted so much attention at the recent convention of the Street Railway Association at Buffalo. Mr. Wm. Hood is the Chicago representative of the Accumulator Company, and it was through his efforts that Chicago will have the opportunity to witness the practical operation of the storage battery system of car propulsion.

The Electric Construction and Repair Company, formed a few weeks since, is now fairly established in excellent quarters in the new Springer Building, 205 Canal street, this city. This company will make a specialty of electric street railway repairs of all descriptions, as well as do a constructing business They will also manufacture electric street railway specialties of various kinds. While they will give especial attention to railway work they expect also to construct lighting plants, either arc or incandescent. Mr. C. M. Barclay, general manager of the company, was for several years the western representative of the Sprague Electric Equipment Company, and is well known in electrical circles, as also are his associates. Mr. W. A. Kreidler will act as secretary. Mr. W. Sharpe will have charge of the construction department, and the repair department will be under the management of Mr. J. G. Hart.

F. M. I.

UNDERGROUND WORK IN CINCINNATI.—After a long fight in the courts, the Edison General Electric Company finally got permission to lay conduits in the streets of Cincinnati. Work however, was stopped by a resolution of the City Council, appealing to the Attorney General of Ohio, to bring *quo warrant* proceedings against the Edison Company. The object is to secure the right for all electric companies to construct and use a common conduit.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED OCTOBER 28TH, 1890.

439,047. Electric Lamp Socket with Regulating Attachment. William F. Wollin and Elmer H. Werline, York, Pa. Filed Jan. 28, 1890.

439,055. Electrically-Controlled Lock for Fire-Arms. Albert von Dérschau, Emden, Germany. Filed Nov. 5, 1888.

439,069. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor by mesne assignments to the Thomson-Houston Electric Company, Boston, Mass. Original application filed July 14, 1885. Divided and this application filed Mar. 12, 1889

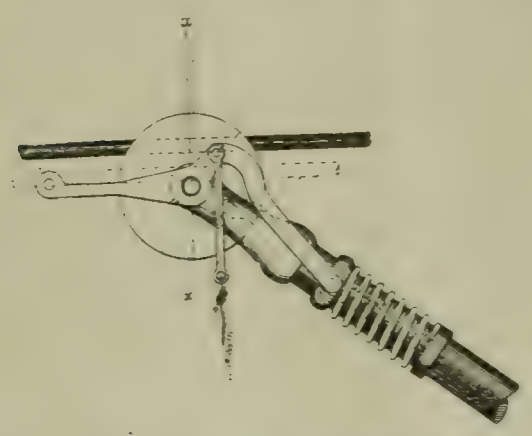
439,070. Electric Railways. Rudolph M. Hunter, Phi'adelphia, Pa., assignor to the Electric Car Company, of America, same place. Original application filed June 9, 1886. Divided and this application filed July 10, 1890.

439,092. Guide for Trolley-Arms. Arthur F. Bardwell, Boston, assignor of one-half to Herbert H. Brooks, Cambridge, Mass. Filed May 15, 1890.

439,102. Electric Motor. Charles S. Bradley, Yonkers, N. Y. Filed July 5, 1890.

439,151. Dry Battery. Wilhelm F. L. Hellesen, Copenhagen, Denmark. Filed March 2, 1889. Patented in Germany, France, Belgium, England, Switzerland and Austria-Hungary.

439,178. Method of Repairing Incandescent Electric Lamps. Casimir Pauthonier, Paris,



NO. 439,092.—GUIDE FOR TROLLEY ARMS.

France, assignor to the Sociéty L'Incandescence Électrique, same place. Filed June 7, 1890. Patented in France.

439,180. Electric Elevator. Francis B. Perkins, Boston, Mass. Filed Feb. 5, 1890.

439,182. Trolley Pole. Louis Pfingst, Boston, Mass. Filed July 14, 1890.

439,192. Trolley Pole for Electric Cars. Benton C. Rowell and Francis E. Galloupe, Boston, Mass. Filed April 5, 1890.

439,213. Electro-Magnetic Clutch. Curtis H. Veeder, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed June 27, 1890.

439,237. Apparatus for Transferring Electric Car Batteries. Frederick G. Corning, New York, N. Y. Filed Aug. 5, 1890.

439,238 Electro Dental Heater. Luther A. Faught, Philadelphia, Pa., assignor to the Wilmington Dental Manufacturing Company, same place. Filed July 23, 1890.

439 240. Method of and Apparatus for Preparing Electrodes for Secondary Batteries. Charles D. P. Gibson, Jersey City, N. J. Filed Mar. 8, 1890.

439,262. Electric Railway. Laurence Westerland, Atlanta, Ga.; Mary C. G. Westerland, administratrix of said Laurence Westerland, deceased. Filed May 31, 1890.

439,295. Recording Signalling System. William J. Fraser, Milwaukee, Wis. Filed May 17, 1890.

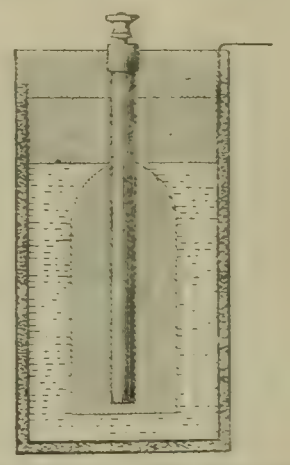
439,301. Secondary Electric Battery. Jacob F. Mehren, Chicago, Ill. Filed Jan. 20, 1890.

439,304. Electric Lamp Socket. John O. Phillips, New York, N. Y. Filed Feb. 5, 1890.

439,308. Automatic Wire Finder for Trolley Heads. George S. Slocum, Newport, R. I. Filed June 2, 1890.

439,324. Secondary Battery. Edward J. Mason, Waterford, Canada, assignor of three-fourths to Frank Brown Allan, Elias Edwy Slaght, and John William Thompson, all of same place. Filed Feb. 20, 1890.

439,345. Electric Locomotive. Francis W. Dean, Cambridge, Mass. Filed July 15, 1890.



NO. 439,151.—DRY BATTERY.

439,363. Electric Lamp Alfred Swan, Orange, N. J., assignor, by direct and mesne assignments to the Insulite Manufacturing Company, New York, N. Y. Filed Mar. 5, 1889.

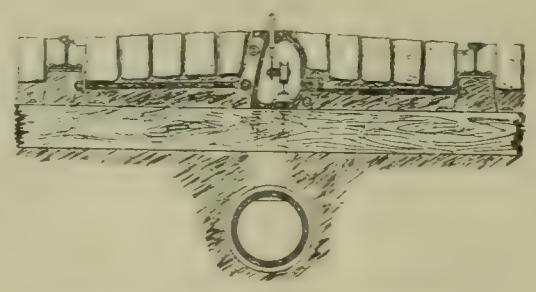
439,364. Incandescent Lamp Socket. Alfred Swan, Orange, N. J., assignor, by direct and mesne assignments to the Insulite Manufacturing Company, New York, N. Y. Filed Apr. 22, 1889.

439,365. Incandescent Lamp Socket. Alfred Swan, Orange, N. J., assignor, to the Insulite Manufacturing Company, New York, N. Y. Filed Nov. 27, 1889.

439,366. Incandescent Electric Lamp Socket. Alfred Swan, Orange, N. J., assignor to the Insulite Manufacturing Company, New York, N. Y. Filed June 6, 1890.

439,367. Incandescent Electric-Lamp Socket. Alfred Swan, Orange, N. J., assignor to the Insulite Manufacturing Company, New York, N. Y. Original application filed May 5, 1889. Divided and this application filed July 23, 1890. Patented in England.

439,381. Electric Meter. William H. Bristol, Hoboken, N. J. Filed Apr. 10, 1890.



NO. 439,262.—ELECTRIC RAILWAY.

439,389. Electric-Lighting System. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Aug. 30, 1881.

439,390. System of Electric Lighting. Thos. A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed June 26, 1882. Patented in England, France, Belgium and in Italy.

439,391. Junction Box for Electric Wires. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed August 7, 1882.

439,392. Electric-Lighting System. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed August 22, 1882. Patented in England.

439,393. Carbonizing Chamber. Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y. Filed Sept. 13, 1882.

439,398. Thermal Cut-Out. Calvin Goddard, New York, N. Y., assignor to the Edison Electric Light Company, same place. Filed Dec. 12, 1883.

439,409. Railway-Track Electrical Annunciator. Jacob W. Lattig, Easton, Pa., assignor to the National Switch and Signal Company, same place. Filed Aug. 21, 1890.

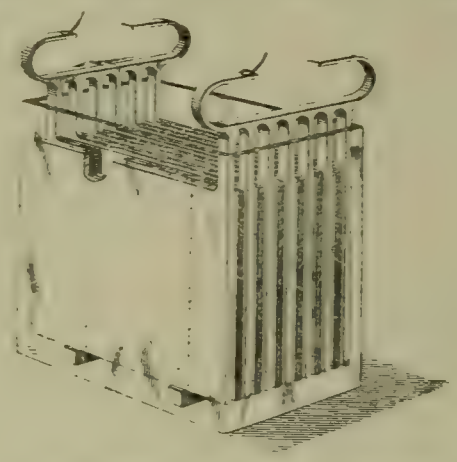
439,416. Method of Making Storage Battery Plates. William Morrison and Louis Schmidt, Des Moines, Iowa, assignors to the Hess Electric Storage Battery Company, same place. Filed Dec. 22, 1889.

439,417. Automatic Regulator for Electric Currents. Wm. Morrison, Des Moines, Iowa, assignor to the Hess Electric Storage Battery Company, same place. Filed Feb. 17, 1890.

439,428. Electric Railway. Chas. Richter. Camden, N. J., assignor to the Electric Construction Company of New Jersey. Filed Aug. 11, 1890.

439,459. Synchronous Alternating Current Electric Motor. Charles Zipernowsky, Maximilian Deri and Otto T. Blathy, Buda-Pesth, Austria-Hungary. Filed May 11, 1889.

439,516. Porous Cup for Galvanic Batteries. Charles A. Hussey, New York, N. Y., assignor



NO. 439,324.—SECONDARY BATTERY.

to the Crosby Electric Company, same place. Filed Aug. 29, 1890.

439,577. Electric Motion Transmitter. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed June 23, 1890.

439,584. Electric Railway Motor Car. Edmund Wagemann, Little Rock, Ark., assignor of six-sevenths to John D. Adams, Dean Adams, Oscar Davis, John W. Davis, Horace G. Allis, and John B. Jones, of same place. Filed Oct. 17, 1889.

439,594. Secondary Battery. Wm. B. Hollingshead, Bronxville, assignor of one-half to Sydney H. Carney, New York, N. Y. Filed May 29, 1890.

439,597. Conduit for Electric Raillways. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Thomson-Houston Electric Company of Connecticut. Original application filed June 9, 1886. Divided and this application filed July 28, 1890.

439,602. Electric Switch. John A. K. McGregor, New York, N. Y., assignor to himself, Herman Cohn, Edward Cohn, Henry Wallach and Solomon J. Wallach, trustees, all of same place. Filed May 6, 1890.

439,614. Bell. Benjamin E. Vaughn, Hill's Grove, R. I., assignor of one-half to Frank L. Harris, same place. Filed July 23, 1890.

TELEPHONY IN CLEVELAND.—In Cleveland, O., there are 650 miles of telephone wire underground.

GENERAL ELECTRICAL DIRECTORY.

BALTIMORE, MD.

Viaduct Manufacturing Co. District Telegraph Supplies.

BOSTON, MASS.

American Bell Telephone Co., 95 Milk Street.
American Circular Loom Co., Insulated Wires and Cables, 620 Atlantic Avenue.
American Conduit and Construction Co., Clement Conduits, Jamaica Plain.
American Electric Register Company, Electric Registers for Street Cars, 620 Atlantic Avenue.
American Fire Alarm Co., Thermostats and Fire Alarms, 71 Kilby Street.
The Holtzer-Cabot Electric Co., General Electrical Supplies, 111 Arch Street.
Wilson, R D. and Co., 113 Devonshire, W. Electric Securities.
Zeigler Bros., Annunciators, etc., 73 Pearl Street.
Duralite Company, 85 Water Street.

BROOKLYN, N. Y.

Elektron Manufacturing Co., 79-81 Washington Street.
Mason, J. H., Primary Batteries, 114-120 Park Avenue

CAMDEN, N. J.

Applegates Electric Floor Mat Manufacturing Co., Electric Mats, 37 Market Street.

CHICAGO, ILL.

Central Electric Co, General Electrical Supplies, 118 Franklin Street.
Bain, Foree, Electrical Expert, 84 Market Street.
Pumpelly Storage Battery Co., 229 La Salle Street.
Electrical Supply Co., Annunciators, etc., 171 Randolph Street.
Bleckert & Nelson, Electric Light and Combination Fixtures, 83-87 Fifth Avenue.
Electric Merchandise Co., Electric Railway Supplies, 11 Adams Street.
Adams, Waldo P., Electrical Constructor, 144 Adams Street.

CLEVELAND, O.

Fletcher & Fletcher Electric Co., Annunciators, 13 South Water Street.
Forest City Electric Works; Switches and Cut Outs.
Lyman, A. B., Electrical Instruments, 34-36 South Water Street.

CONCORD, N. H.

Page Belting Co., Link Belts.

DETROIT, MICH.

Detroit Electrical Works, Woodward Avenue and Railroad Crossing
Detroit Motor Co., Motors, 212 Griswold Street.
Fisher Electric Co., Dynamos and General Supplies, 187 Larned Street.
Brownlee & Co., Poles,
Commercial Electric Co., 55 and 57 Gratiot Avenue.
Lockwood Instrument Co., Electrical Measuring Instruments, 61 Buhl Block.

FITCHBURG, MASS.

Colburn, I. W., & Co., Dynamos.

HARTFORD, CONN.

Ahearn, James, Electric Light Fixtures and Supplies, 280 Asylum Street.
The American Writing Machine Co., Typewriters.

MONTREAL, QUE.

Ness, T. W., Electrical Supplies, 644 Craig Street.

NEW YORK CITY.

Alexander, Barney & Chapin, General Electrical Supplies, 20 Cortland Street.
Aluminum Brass and Bronze Co., 52 Chambers Street.
Anglo-American Electric Light Manufacturing Co, "Times" Building, Park Row.
Ansonia Brass and Copper Co, 19 Cliff Street.
A. B. C. Motor Co., 44 Gold Street.
Bergmann Electric and Gas Fixture Co., 527-537 West 34th Street
Bishop Gutta-Percha Co., Wires and Cables, 420 426 E. 25th Street.
Bogart, A. L., Electrical Gas Lighting Apparatus, 22 Union Square.
Bunnell, J. H. & Co., General Electrical Supplies, 76 Cortlandt Street.
C. & C. Electric Motor Co., Electric Motors, 402 and 404 Greenwich Street.
Clark Electric Company, Arc Dynamo, 192 Broadway.
Crocker-Wheeler Motor Co., 14th and Washington Sts.
Charles A. Schieren & Co., Leather Belting, 45-51 Ferry Street.
Cary & Moen Co., Springs, 234 West 29th Street.
Crosby Electric Co., Batteries, 89 South Fifth Avenue.
D. Van Nostrand Co., Electrical Books, 23 Murray St.
Desant Electric Co., Electric Signals, 45 Broadway.
Edison General Electric Co., 44 Broad Street.
Edison Manufacturing Co., Batteries 19 Dey Street.
The Electric Construction and Supply Co., 16 Cortland Street.
Empire City Electric Co., General Electrical Supplies, 17 Dey Street.
E. S. Greeley & Co., Electrical Supplies, 5 and 7 Dey Street.
Freeman, Walter K, Transformer System, 150 Nassau Street.
Hall Signal Co., Railway Automatic Signals, 50 Broadway.
Interior Conduit and Insulation Co, Electrical Conduits, 16 and 18 Broad Street.
John Stephenson Co., Tram Car Builders, 47 East 27th Street.
Kintner, Charles J., Patent Expert, 45 Broadway.
Lynch. Eugene T., Jr., Electrical Engineer, 120 Broadway.
Law Telephone Co, Batteries, 85 John Street.
Leclanche Battery Co., Batteries, 149 West 18th Street.
National Electrical Manufacturing Co, Electrical Supplies, 14 and 16 Vesey Street.
New York Insulated Wire Co., wires of all descriptions, 649-651 Broadway.
Okonite Co., Insulated Wires and Cables, 13 Park Row.
Prescott, George B., Jr., Wires, 16 Dey Street.
Paillard Non-Magnetic Watches, 192 Broadway.
River and Rail Electric Light Co., Storage Batteries, 45 Broadway.
Reese, S. W., & Co., Stencils, Stamps, etc., 182 Fulton Street.
Sabine. J. B., Patent Attorney, 181 Broadway.
Sawyer-Man Electric Co., 510-534 West 23d Street.
Shaver Corporation, Molecular Telephones, 207 Broadway.
The S. T. Smith Co., Typewriter Supplies, 14 Park Place.
Wyckoff, Seamans and Benedict, Typewriters, 327 Broadway.
W. H. Gordon & Co, Wires, Electric Light and Power Supplies, 115 Broadway.

NEWARK, N. J.

Weston Electrical Instrument Co., 114 William Street
McIntyre Co., The C., Connectors and Terminals. 13-15 Franklin Street.

NORTH EAST, Pa.

Eureka Tempered Copper Co., Manufacturers of pure tempered copper for commutator bars and brushes.

PHILADELPHIA.

Novelty Electric Co., Manufacturers and dealers in Electrical Supplies, 50, 52 and 54 N. 4th St.
Queen, J. W & Co., 924 Chestnut Street.
Partrick & Carter, Gen'l Electrical Supplies, 114 S. 2d Street.

PITTSBURGH, PA.

Standard Underground Cable Co., Wires.

PIQUA, O.

Cincinnati Corrugating Co., Metallic Lath.

PROVIDENCE, R. I.

Alarm Box Controller Co.

ST. LOUIS, MO.

Aloe & Son, Electrical Instruments, 415 Broadway.
Heisler Electric Light Co., Incandescent Electric Lights, 809-817 South 7th Street.

ST. PAUL, MINN.

Acme Electric Co., Manufacturers Dynamos and Motors, Gilfillan Block.
Ames, Wright & Co., Agents Western Electric Co., 51 East 4th Street.

SYRACUSE, N. Y.

Pass & Seymour, Toughened China Insulators.

TORONTO, ONT.

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In order to meet a demand for an electrical trades directory in a weekly electrical paper we have decided to establish such a feature in the ELECTRIC AGE.

The above is the beginning of this new and valuable feature and orders to have names and addresses inserted are beginning to come in at a rapid rate.

One important feature of this directory will be readily noticed and appreciated, and that is the arrangement of the names in alphabetical order under the heads of the proper cities and town, the name of the places being also arranged in like manner. This arrangement makes it extremely easy to find a name in any city or town.

The importance and value of this directory to those engaged in electrical business cannot be over estimated.

It is important that all persons firms or corporations engaged in any line of electrical industry should be represented therein and to all these we would say that any desiring to get your address will consult the directory, and you will do likewise when you want the address of others.

The importance of being represented in our directory is therefore obvious. The entire country will be covered, and wepo pose to make the electrical directory a reliable one and as complete as possible.

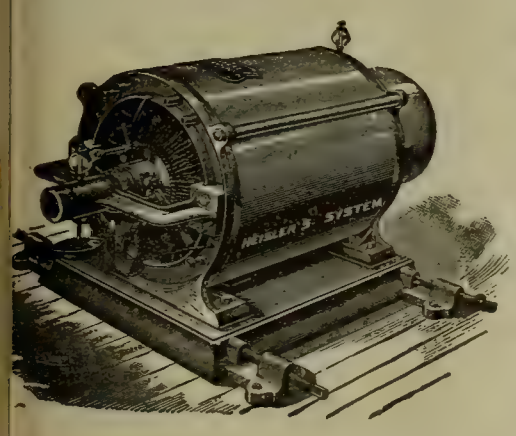
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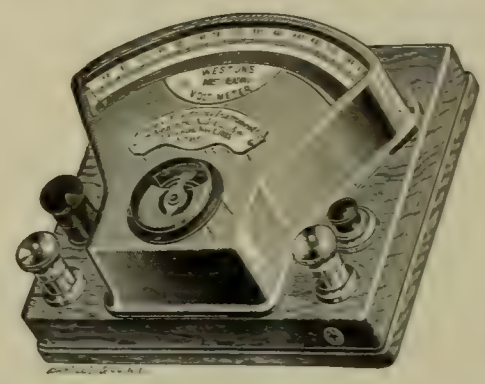
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2 No. 9 Cells at $1.50	$3.00	4 No. 9 Cells at $1.25	$5.00	6 No. 9 Cells at $1.25	$7.5[illegible]
1 1-C.P. Incandescent Lamp (large bulb)	.85	1 3-C.P. Incandescent Lamp (large bulb)	.85	1 6-C.P. Incandescent Lamp (large bulb)	[illegible]
1 Key Socket	1.20	1 Key Socket	1.20	1 Key Socket	1.2[illegible]
1 Shade and Holder	.50	1 Shade and Holder	.50	1 Shade and Holder	.5[illegible]
50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.5[illegible]
4 Charges of Depolarizer (will run 80 hours)	.40	2 Charges of Depolarizer (will run 40 hours)	.40	3 Charges of Depolarizer (will run 72 hours)	[illegible]
	$6.45		$8.15		$11.[illegible]

*This plant will be found useful for lighting small rooms, dining tables, desks, and for reading purposes. It will also properly light two stalls in a stable.
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NEW YORK, NOVEMBER 15, 1890.

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OUR ELECTRICAL DIRECTORY.

We call the attention of all electrical houses to our general electrical directory in every issue of the ELECTRIC AGE. It is a permanent feature, and will be found of great value and importance to everyone engaged in the electrical trade. It is constantly growing, and every electrical house in the United States should be represented therein. It is being constantly referred to by thousands of our readers who desire to ascertain the address of electrical houses in the various cities and towns. Every concern, therefore, should be represented. The directory will be found elsewhere in this paper, with a general sketch of its aims and purposes. We emphasize the importance and value to every concern in the electrical or kindred trades of being represented in this directory. No other weekly electrical paper has such an important feature, and that it is greatly appreciated by the business community is evident from the fact that little argument is necessary to secure names. Our object here is to simply call attention to the fact that there is such a directory, and that we propose to make it a special and permanent feature. It will be thoroughly reliable.

RENDERING HIGH-PRESSURE CURRENTS HARMLESS.

We describe and illustrate elsewhere in this issue a most efficient device, which, in its practical operation, entirely removes from overhead electric light and electric railway wires all of their terrors, imaginary and real. Mr. F. W. Jones, the well-known electrician of this city, has given considerable thought to the subject of the dangers of overhead wires carrying currents of high pressure, with the result of the evolution of the device above referred to.

The apparatus is as efficient as it is simple, and any high pressure electric conductors, properly equipped with this device, is rendered as harmless as any inert substance in case the wire breaks and falls into the street.

High-pressure currents on overhead wires are unquestionably a constant menace to life and property, as has been exemplified too frequently.

Mr. Jones' invention is extremely simple and can be attached to any existing line. The moment a wire breaks the tension on the device is removed and the broken wire is grounded at the points of support nearest the break. The dangling ends, therefore, are rendered perfectly harmless and can be handled by a child with perfect impunity.

The great value of this invention lies in the fact that while broken wires are instantly rendered harmless to life and property, much smaller wire and higher pressures may be used with perfect safety. Thus a great saving in copper is effected, which item is a most important one in electric light and electric railway operations. The consideration of prime importance is, of course, safety to life and property. With these dangers entirely rendered null, the next point for consideration is the question of expense and cost of plant. The dangerous element having been removed, the item of cost and expense appeals first to the capitalist and operator. Here is something that at once removes all danger from broken wires and makes it possible to effect a large saving in copper.

It seems to be one of the most valuable and efficient inventions in this line that has ever been produced, and by its use all of the terrors of the so-called "deadly wire" are effectually removed.

Another important point in connection with the use of this device is the fact that, in case of a break on a trolley wire the operation of the cars is not necessarily interfered with. The circuit being grounded on both sides of the break, cars continue to run just the same. Usually a car could be carried by the break by its own momentum and the circuit re-established on the other side. Under the present method all traffic ceases when the trolley wire breaks, and cannot be re-established until the break is repaired.

We refer our readers to the descriptive article on this invention. The illustrations show the device in detail and its application in practice. From these illustrations and accompanying description the value and efficiency of the invention will be readily understood.

SAVAGES AND TELEGRAPH LINES.—Telegraph lines are the objects of peculiar attacks in newly settled countries. On the western plains of our own country the buffalo used to find the poles very convenient back-scratchers. The Indians, too, found the material used on the lines very handy for various purposes; so the wire, poles, etc, were appropriated as occasion required. These times have all passed away, however—at least as far as this country is concerned—and telegraph lines are so familiar that they are seldom interfered with. In our Australian letter, on another page, our correspondent incidentally relates similar experiences in that country when the telegraph was first strung inland. There the uncivilized natives used to steal the glass insulators for the pupose of making, or fashioning, spear heads. They were spared the trouble of climbing poles and breaking their necks by the distribution of a plentiful supply of broken bottles and insulators on the ground along the route. By this strategy the lines were to a great extent preserved from molestation.

ELECTRO-THERAPEUTICS.—Electro-medical apparatus is as important to the modern practicing physician as drugs are. The electric current as applied by the physician is, in a certain sense, a medicine, since it effects the cure of certain ailments. If it is a medicine it is important that it should be as easily measured and prescribed as any other medicine. We describe, on page 9, an electro-medical apparatus which will interest physicians generally. There are some important improvements in this apparatus over the old method of applying Galvanic and Faradic currents.

ELECTRICITY AS A SCIENCE.

The development of scientific knowledge of electricity in late years is one of the features of the times. Not many years ago exact knowledge of this wonderful force was very imperfect indeed, and the determination of a simple fact necessarily involved a good deal of guess work. To the birth and development of electric lighting is due the wonderful enlargement of our electrical knowledge, although previous to this period electricity had already risen to the dignity of an exact science.

In his recent address before the Chicago Electric Club, on "Underground Electrical Work," Mr. F. E. Degenhardt refers in a practical way to the high scientific development electricity has attained. "The telephone manager," he says, "tells you that he must have a cable with an electro-static capacity that must not exceed a given number of microfarads and that it must contain so and so many conductors, and that its insulation must be so high and no higher, that all the conditions must be delivered within a given space and the wires must be twisted in pairs, so that they can be formed into a metallic circuit if they wish, and your manufacturer goes at once to work and evolves a cable that meets these most exacting requirements."

Everything pertaining to electricity is planned on a strictly scientific basis these days, and we are now beginning to learn how to get the most from the least.

TELEPHONE NOTES.

The *News Letter* of the National Telephone Exchange Association, covering the month of October is out.

Gen'l Barney, the secretary of the Association, announces that the Executive Committee of the Association has decided that it is undesirable to continue the publication of the *News Letter*, and that the current number will be the last one.

Among the other items contained in the *News Letter*, we find the following:

The Erie Telephone Company will this season complete the laying of underground cables and the erection of new multiple switchboards in St. Paul, Minneapolis and Cleveland, at a cost of $150,000. These improvements have been provided for by an increase of the capital stock of the sub-companies, the Erie and American Bell Companies taking and paying for their respective proportions of the increase.

The extension of underground work in this city goes on steadily, and a new branch of electrical engineering, so far as New York city is concerned, has been developed in the watching and testing of the wires and cables that now ramify all over Manhattan Island. Electric lighting and power companies have an extensive mileage in use, and are obtaining very fair results, even with the high-tension and alternating currents. This is due in a measure to the superior quality of the cables that are being manufactured and employed for the work, and also the experience that has been acquired during the past two or three years.

Any person having a spare copy of the proceedings of the Association at its Cincinnati and Providence meetings, will confer a favor by corresponding with the Secretary, who will be glad to exchange for copies of the proceedings of any other meeting, or to pay cash for the extra copies.

It is said that there are about 25,000 telephones in use in Canada, of which more than 20,000 belong to the Bell Telephone Company.

CABLE CHARTS.—We publish a letter, by request, signed "A Well-Posted Cabler," relating to the notice made by us of a Cable Chart lately issued by the Direct United States Cable Company. We do not offer any opinion ourselves as to the similarity of the two pictures but reproduce them elsewhere and give our readers the opportunity of judging for themselves.

THE NEW HOME OF THE ELECTRIC AGE.

The accompanying illustration is of the new *World* building, New York City, in which are located the offices of the ELECTRIC AGE. The building is on the corner of Park Row and Frankfort street, and in the heart of the great newspaper section. The New York terminus of the Brooklyn Bridge abuts the building on the eastern side, and is seen at the left in our illustration.

As to the building, it is a marvel of engineering skill. It is the highest structure in New York City, and one of the most imposing edifices on the American Continent. The architecture is of Romanesque style with some modifications, the whole giving an imposing and massive appearance.

The extreme height of the huge structure is its most prominent feature, the distance from the sidewalk to the base of the flag pole being no less than 318 feet. The flag pole itself is 32 feet in height, making the height from the sidewalk to the top of the pole 350 feet. This is many feet above the next highest structure in the city. Trinity Church spire and the Brooklyn Bridge towers are looked down upon from the top, and over and beyond Brooklyn can be seen the Atlantic Ocean. Looking westward, the second range of mountains in New Jersey, beyond the famous Orange Mountains can be distinctly seen in clear weather—in fact the scene is a perfect birdseye view of the great city and its suburbs and surrounding country, within a radius of at least 25 miles.

The building is 18 stories high above the ground, including those in the dome, which is 50 feet in diameter—quite a building in itself. There are two stories below the ground, making 20 stories in all.

From an electrical point of view there is much of interest in this great building. The electric lighting plant will be an enormous one. It is rapidly approaching completion, and when finished, we hope to be able to give our readers a detailed description of the plant with illustrations. The installation consists of four United States dynamos, each with a capacity of 800 16-candle power lights. The machines are compound wound, and will be driven by two New York Safety Engines. There will be 4,000 incandescent lamps distributed throughout the building. The plant is so arranged that in case of accident to the Safety engines, the dynamos can be driven by the great Corliss engine, which furnishes the power for the presses, etc.

There will be a large installation of electric motors for ventilating purposes and power.

The tubing of the Interior Conduit and Insulation Company is used throughout the building, no less than 20 miles of it. The wire used, is the well-known Grimshaw White Core, made by the N. Y. Safety Insulated Wire Co., and the enormous length of sixty miles of it were necessary. The United States Electric Lighting Company did the wiring, as well as putting in the plant, and the work was most successfully performed.

The offices of the ELECTRIC AGE are most conveniently situated on the first floor, and are but a step from the elevators, and the head of the main stairs. Our friends are, therefore, to a very great extent spared the bewilderment which is very liable to come over one when entering a great building of this class for the first time in search of some particular office or person.

The electrical plant will include an extensive annunciator and telephone system, installed by the Complete Electrical Construction Company of this city. The annunciator plant will be unique, and presents some very interesting features, all of which have been carefully and successfully developed by the company named. In the press room will be push buttons arranged on a handsome frame, and in the stereotyping rooms will be the annunciator. On the push button frame there is arranged on the top row, ten pushes, numbered from one to ten successively. These represent editions of the paper. Below this row are five others of ten buttons on a line, making 50 in all. These represent stereotype plate numbers, and below this is another row of six buttons, representing the Brooklyn, New Jersey, Harlem, Connecticut and New York editions respectively, there being two buttons for the New York edition. The plan of operation is as follows: In case the press is ready for, say, plates 2, 3, 4 and 5 for the second edition of the Harlem issue of the paper, the proper buttons are pushed, which indicates on the annunciator in the stereotyping room the corresponding numbers, etc., and the foreman of the stereotyping department knows at once which plates to send up, and which not. This system of communication between the two departments, will save a great deal of time.



THE NEW HOME OF THE ELECTRIC AGE—WORLD BUILDING.

There will be a complete bureau of information which will include a central telephone station, communicating with the various departments of the paper. The switchboard has 24 circuits and the station will occupy a room all by itself.

For the public telephone service there are a pair of metallic circuits run into each office in the building, and connected in the cellar with the underground wire syetem.

Thirty-five miles of wire was used for wiring the building for the telephone service alone. District loops and Gold and Stock wires are also run into each office.

In the wiring for these installations the well-known goods of the Okonite and New York Safety Insulated Wire Company were used.

The Complete Electrical Construction Company also installed a motor and generator plant, the motor being supplied by power from the electric light plant. This motor will run the generator, which is to be used in the telephone and annunciator service, for calling, etc.

The electrical plant of the *World* building will be, when complete, the most extensive of any private building in the country, and will be full of interest to electricians.

GEISSLER'S TUBES.*

It has been observed by E. Warburg, that whilst in a Geissler tube filled with slightly moist nitrogen the difference of potential between the cathode and a point in the extreme visible limit of the negative glow remained constant, yet when the nitrogen is quite dry a considerable increase of fall takes place as the current passes [*vide* Gilbert's "Annalen der Physik und Chemie," series [2] Vol. XXI., page 545].

This observation has recently been under investigation again, and Warburg now attributes the phenomena to the presence of minute quantities of oxygen in the nitrogen, and shows in a paper in Gilbert's "Annalen," &c., series [2], Vol. XL., page 1, how these traces of oxygen may be removed. Sodium had previously been used for this purpose, but a difficulty was experienced in obtaining this metal in a state of sufficient purity.

Warburg now liberates his sodium within the closed tube in a nascent state by electrolysis through the glass, a portion of the tube being immersed in half per cent. sodium amalgam connected with the negative pole of a battery and heated to 300° C., the cathode of the tube being connected with the positive pole. When the last trace of oxygen has been removed a deep yellow light appears in the part of the tube where the sodium is liberated.

Nitrogen at 2.3 mm. pressure was freed from oxygen in 20 minutes with a current from three Bunsen cells connected with an induction coil capable of giving a 25 mm. spark in air, and making 390 contacts per minute. The excess of sodium was afterwards distilled into a remote portion of the tube. From his experiments, Warburg gets the following mean numbers for the fall of the cathode in volts:—

Platinum cathode in	nitrogen	= 232	volts.
" "	hydrogen	= 300	"
Magnesium "	nitrogen	= 205	"
" "	hydrogen	= 168	"

Variations of a few per cent. still remain, but the author is of the opinion that in perfectly pure gases the fall is independent of the current strength and of the pressure, being determined only by the chemical nature of the gas and of the cathode, and by the physical condition of the latter.

Experiments with the Andrews electrical fog signal have recently taken place at Bowes Park on the Great Northern Railway, in the presence of a large number of railway engineers and directors. In this system an insulated rail is laid down parallel with the ordinary rails; and the current is conveyed to the engine by means of a metallic brush affixed to the footboard. There is an illuminated dial fixed on the weather-board of the engine, with a miniature signal and a gong to direct the attention of the driver to the signal given on the engine. In the signal-box are other miniature signals showing the signalman that the driver has received correctly the signal. The signal may be brought into action by the signalman immediately upon a fog coming on simply by moving a switch.

London *Electrical Review*.

A VALUABLE SAFETY DEVICE FOR HIGH-PRESSURE OVERHEAD ELECTRIC CONDUCTORS.

The danger of dangling electric conductors, charged with high pressure currents, has been demonstrated so often and so seriously, that any practical invention relieving overhead conductors of their deadly menace to life should be heartily welcomed by both the proprietors of the wires and by the public. The accompanying illustrations show an ingenious safety device and its practical application, on which letters patent are being taken out in the United States and Canada, by Mr. F. W. Jones, the well-known

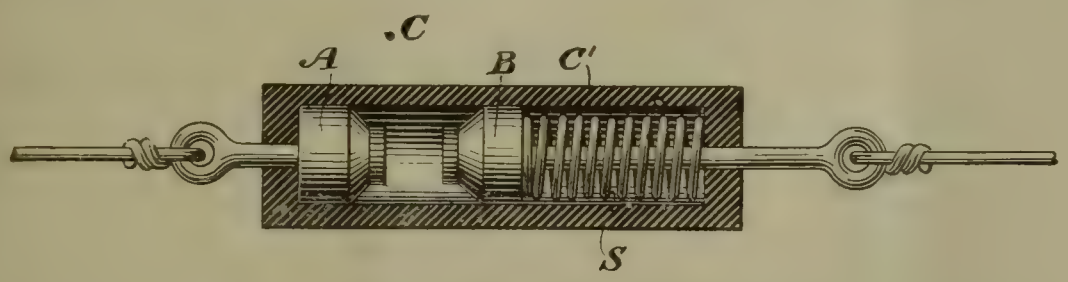


FIG. 1.—JONES SAFETY DEVICE.

electrical expert of New York. The object of the invention is to automatically divert the heavy currents to the earth at the points of support, should a trolley wire or a conductor of electricity for light or power be accidentally displaced or broken. In conjunction with the device is a plan for permanently grounding the guard wire, so that any foreign wire falling across it may be reduced to zero and its dangling end be perfectly harmless, whether it was previously carrying a dangerous current or was accidently crossed with a trolley wire. In Boston, not long ago, the instantaneous killing of two horses in a crowded street by a falling trolley wire arrested public attention to the terrible possibilities of such accidents in the case of human beings. It is true that the extreme watchfulness of the companies operating the trolley street car systems may render breakages less frequent. The companies are thoroughly alive to the great danger lurking in the network of wires covering so many busy streets, and no effort is spared to repair the defects as fast as they appear. With all this precaution, however, the wires are daily growing older and weaker from the incessant pounding and wear of the trolleys and the time must arrive when they will snap at points quite unsuspected, and their deadly ends may embrace many persons walking or riding beneath them. The storms and sleet of winter are also more than likely to bring these death-dealing wires down upon the heads of the people in the streets when the snow and rains have produced the very best conditions for fatal shocks. That an exceedingly simple, practical, and inexpensive device has been proposed by Mr. Jones for entirely removing all danger to life and property from overhead electric conductors of all kinds, will become apparent from an inspection of the diagram and perusal of the description following. It will also become obvious to capitalists and electricians that once the danger is removed the electric pressures can be increased and with twice the voltage of current four times the work can be done. Or, the amount of copper can be reduced seventy-five per cent., making it possible to run cars four times farther from the power station, or of reducing the amount of copper in the wires to one-fourth. It will be found on actual trial that the device does not wait until the wires have fallen to the ground before diverting the current of electricity, but long before the wires have reached a position of danger. Even a fall of an inch or two below their normal plane of suspension, they have been entirely deprived of their charge of the deadly fluid, and consequently are nothing more than simple uncharged wires when they arrive within reach of persons or animals, and may be handled with perfect safety by a little child.

Figures 1 and 2 show two safety devices, C and D, applied respectively to a power wire, G W, and a trolley wire, T W, as shown in fig. 3. The grounded guard wire is not shown. Between the two insulated sections of the trolley wire and the power wire two feeder wires are seen, each including a suitable fuse, F, to be blown out in case either section of T W becomes grounded.

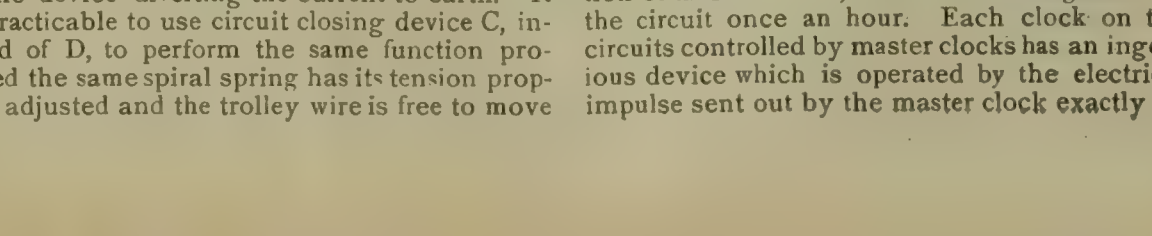


FIG. 3.—APPLICATION OF JONES'S SAFETY DEVICE.

The automatic circuit closing device C (fig. 1) is attached to G W on both sides of each support (fig. 3) and the tension of spring S is overcome by the tension of the branch wires attached to G W and the support to hold the device in position, so that no current can escape from G W to earth via the device. Should G W drop slightly from its normal position the spring S will act, instantly closing the earth circuit via the dotted line down the pole and divert all of the current from the main conductor beyond. The automatic current opening device, D (fig. 2), is attached *above* the trolley wire in such a way that the strain of the branch wires attached thereto to hold it in the position shown in fig. 3 is not great enough to overcome the spring S and allow the points to close. Should the trolley wire break, it is obvious that the weight of the falling wire would instantly close the circuit in the device diverting the current to earth. It is practicable to use circuit closing device C, instead of D, to perform the same function provided the same spiral spring has its tension properly adjusted and the trolley wire is free to move slightly in the direction of its length. As the springs are not likely to be called on for action very frequently, they can readily be rendered proof against oxidation from the weather and the determination of the proper size of the electrodes of the devices, their best construction to meet the various conditions under which they may be used, together with other details involved in their practical application will meet with a ready solution at the hands of an expert of ordinary intelligence.

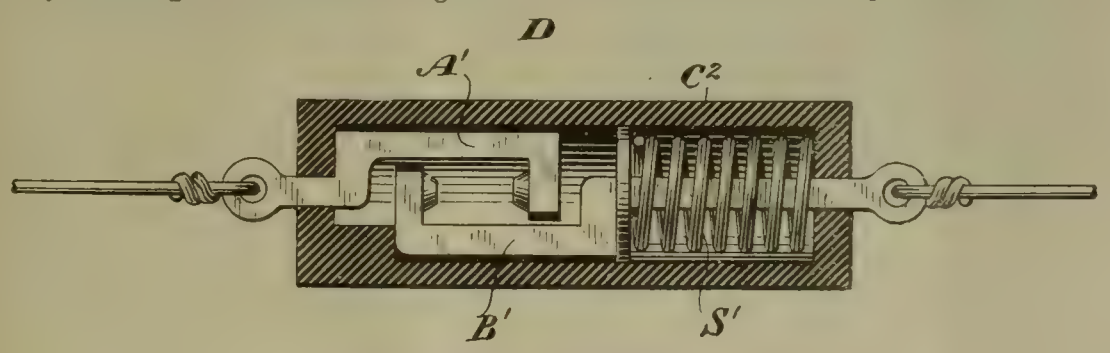


FIG 2.—JONES SAFETY DEVICE.

In fig. 1, A and B represent the contact points of the electrodes, and in Fig. 2 the corresponding points are represented by A' and B'. The cases of the device, C^1 and C^2, are made of some insulating substance, preferably hard rubber. G, in fig. 3, represents the generator of electricity.

DISTRIBUTION OF TIME BY ELECTRICITY.

On Friday night, Nov. 7th, Mr. James Hamblet, manager of the time service of the Western Union Telegraph Company, delivered before the Electrical Department of the Brooklyn Institute a lecture on the Method of Distribution of Time by Electricity.

Mr. Hamblet illustrated many of the important points of his lecture by lantern projection and blackboard diagrams. There were also on exhibition two very fine self-winding clocks, the self-winding features of which that gentleman gave a general description.

Mr. Hamblet opened his lecture with a brief historical sketch of the various methods of distribution of time from the earliest days down to the present time. He exhibited a sun dial, over 300 years old, as showing the ancient method of telling the time.

In 1837 the first suggestion of time distribution by telegraph was made, and the general plan did not differ much from that in use at the present time. The first time ball ever constructed was at the Greenwich Observatory, a picture of which was projected on the screen.

Among the slides used was one showing the method of taking time by a star passing across the field of a telescope. The field is divided by spider lines, the distance between which correspond with a certain length of time, and as the star passes across these lines signals are tapped upon a key by the observer.

Another slide showed the relative position of the sun and planets and the relative motions of the latter bodies.

Various clock escapements, in practical operation, were also shown on the screen.

On the blackboard were diagrams showing the method of distributing time from Washington, and the Western Union building, and also the method of synchronizing clocks. One relay at the Washington observatory, at which institution the sun time is taken every day at noon, transmits the solar time to the Western Union building, New York, and from there it is distributed throughout the country. In this way about 5,000 clocks are synchronized daily.

The lecturer also described the important function of master clocks, which send a signal over the circuit once an hour. Each clock on the circuits controlled by master clocks has an ingenious device which is operated by the electrical impulse sent out by the master clock exactly on

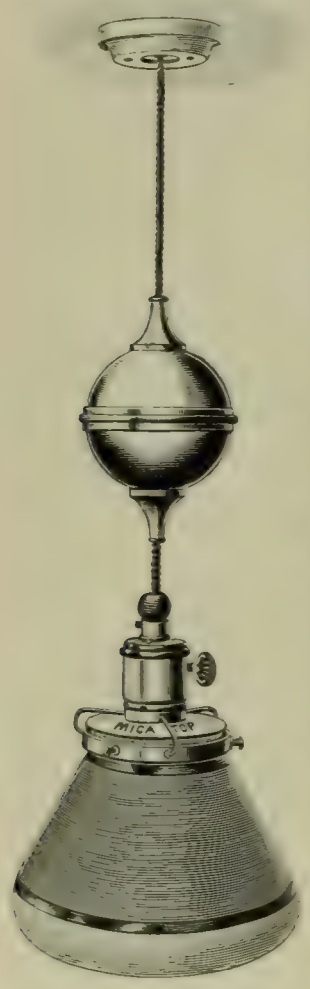
the hour. If any clock has gained or lost a few seconds during the hour the operation of that device sets the hour and minute hands exactly to the hour; thus every clock starts from each hour exactly correct.

In describing the winding mechanism of self-winding clocks, Mr. Hamblet stated that these clocks are wound once every hour by the operation of a small electric motor. How long they will run without being touched depends altogether upon the battery. They will run, however, for two or three years without any necessary attention. The batteries are usually inspected once a year. Appropriate mechanism in the clock movement closes the electrical circuit every hour, and in this way the winding machinery is operated. "These clocks," said the lecturer, "are having remarkably good success in railroad use."

A letter was read from the Secretary of the New York Electrical Society suggesting that the electrical department of the Brooklyn Institute take some action in the matter outlined in the recent lecture of Lieutenant Bradley A. Fiske, on the subject of establishing an electrical corps in the army and navy. A committee will be appointed to take the matter into consideration.

THE BRADNER ADJUSTABLE HANGER.

The method at present in vogue of raising or lowering pendant electric lights is at best clumsy and the appearance of a loop of flexible cord dangling in mid-air, somewhere between the ceiling and the lamp is hardly in accordance with aesthetic taste. We describe and illustrate herewith an improvement in this direction which will be appreciated, and all those users of electric light who are as particular about the looks of the light and its adjuncts as they are about other things will find in this new device something that will meet the objection to the old plan of raising and lowering lamps.



THE BRADNER ADJUSTABLE HANGER.

The Bradner Adjustable Hanger, of which an illustration is here given consists of a suspended differential pulley enclosed in a neat brass shell. The flexible cord is wound several times around the large drum, passed through an opening and around the small drum, the lamp and shade being perfectly balanced by the weight of the pulley. The lamp will remain in any position between ceiling and floor. Should the lamp and fixture be heavier than the pulley alone there are small weights provided with each pulley, that fit a recess in the large end of the pulley, and by inserting one or more of these weights the balance can easily be made perfect.

The device is quite simple, there being no springs, or anything else in the mechanism that can get out of order. The balance is perfect, and the adjustment to any elevation is a very easy accomplishment. The flexible cord,—that part of it exposed to view—is always taut, and the unsightly knot or loop is done away with entirely. Three sizes of this hanger are made, viz:

SIZE A. Especially adapted for all single light pendants in offices, stores, libraries, etc.

SIZE B. Are for engravers, printers, factory and mill lights, the pulley being held in a stout wire cage.

SIZE C. Extra heavy for chandeliers, umbrella and cluster lights of all kinds

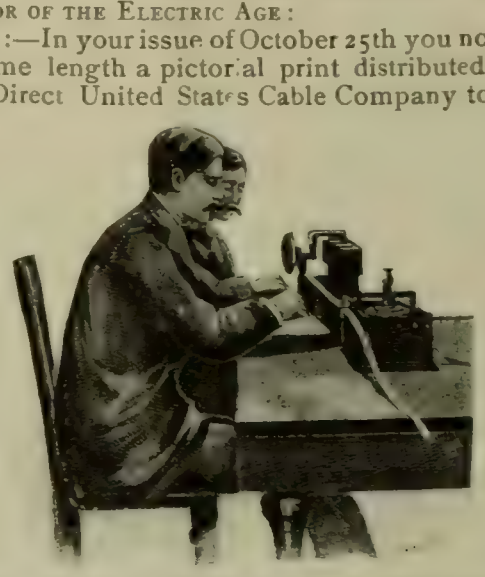
The McCreary Electrical Specialty Company, of 18 and 20 Cortlandt street, this city, are the sole agents for this improved hanger in the eastern and most of the southern states, and are licensed to sell in foreign countries.

CABLE CHARTS.

NEW YORK, October 27, 1890.

EDITOR OF THE ELECTRIC AGE:

SIR:—In your issue of October 25th you notice at some length a pictorial print distributed by the Direct United States Cable Company to remind the American public of the company's existence and purposes.



PICTURE USED ON DIRECT UNITED CABLE COMPANY'S CHART.

On looking over the print I find on the left hand side a scene of an interior, and a legend on the window proclaims it to be the New York office of "The Direct United States Cable Company, forwarding cablegrams to Great Britain, Germany and all parts of the world."

I thought I had seen this picture before and recollected that the same view appeared in *Scribner's Magazine* for July, 1889, where it was said to represent the working of the Siphon Recorder in the office of the Commercial Cable Co.,



PICTURE PUBLISHED IN *Scribner's*.

No. 1 Broad street. It therefore appears that the Direct United States Cable Company has not only appropriated a copyright picture, but represents itself as working an instrument which it is well known it does not use in New York nor at any other office on its system.

It would be interesting to know what Messrs. Scribner and Co., think of the plagiarism of their picture and what the Commercial Cable Company thinks of its property as an adornment of its rival's showcard, and how the public will judge this honorable (?) proceeding.

May I ask you to publish this letter as a matter of justice, and oblige a

WELL POSTED CABLER.

The town of Magdeburg will devote $375,000 for the erection of a central electric light station.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part XIII.—Converters.

243—What is a converter?

A converter is a device used in connection with alternating current systems for the purpose of converting or transforming into low pressure the current generated by the dynamo, which is usually of high potential or pressure.

244—How are alternating currents converted from high to low pressure by the aid of the converter?

By the inductive effect of one coil of the converter upon the other.

245—What is the difference between an alternating current converter and an ordinary induction coil?

A converter is really an inverted induction coil.

246—What is meant by an inverted induction coil?

In an induction coil the primary coil, or the one in which the battery or inducing current flows, is wound with much coarser wire than that used for the secondary coil. An inverted induction coil means one in which the primary coil is wound with much finer wire than that used for the secondary coil; in other words

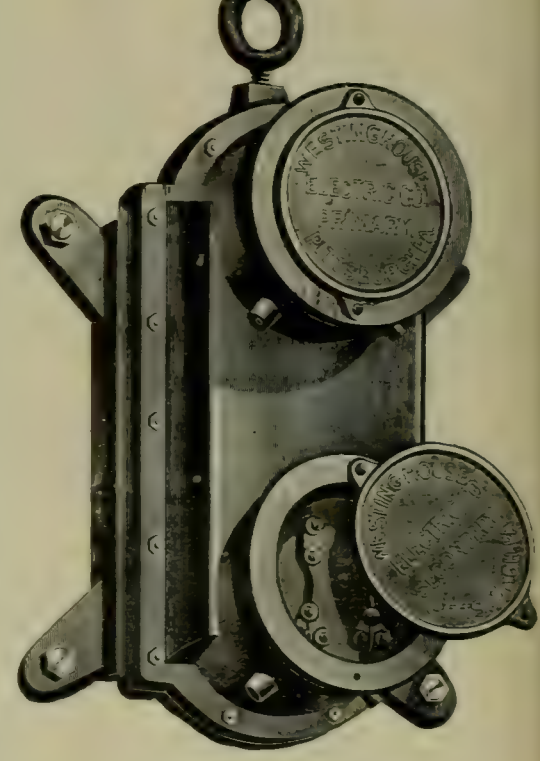


FIG. 1.—CONVERTER.

in the converter the thick wire is on the secondary coil and the thin is on the primary, while in the induction coil the thick wire is on the primary and the thin on the secondary.

247—What is the form of the converter?

One form is shown in fig. 1. This represents the Westinghouse converter.

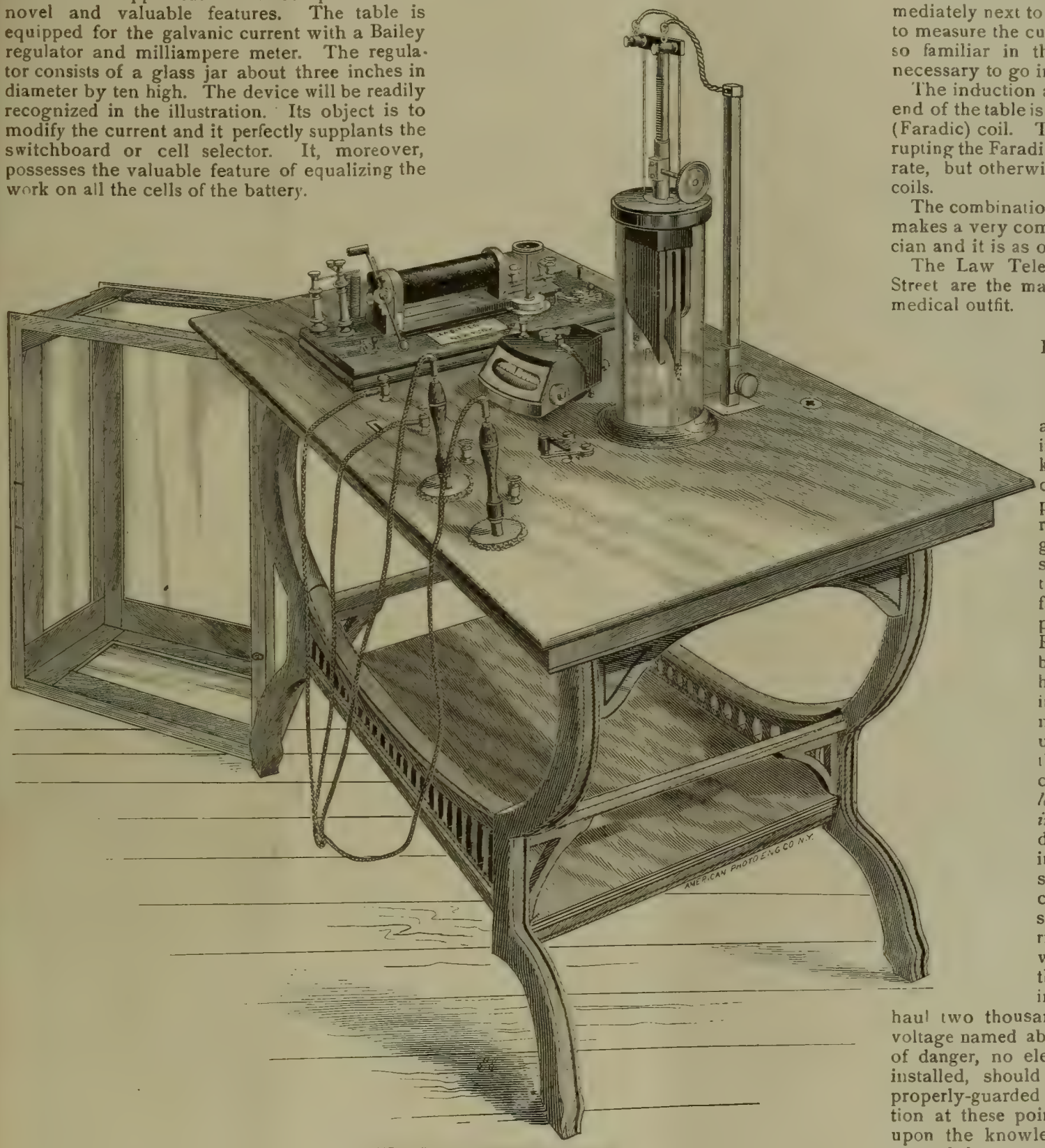
(To be continued.)

PANIC.—On the night of Nov. 1st a panic occurred among the patrons of the Grande Café, Rue Scribe, Paris, which is traceable to electricity. The press despatch giving the details of the affair was rather vague, but it seems probable that the overheating of a wire started a fire. When the flames were discovered consternation seized those present in the café, and in the mad rush everything breakable was demolished. The despatch states that the flames constantly increased "in volume and intensity owing to the continuance of the electric current," which could not be shut off.

* Copyrighted.

A NEW ELECTRO-MEDICAL TABLE.

At the exhibition given at the Brooklyn Institute, of the various batteries now in use, the electro-medical table, comprising part of the exhibit of the Law Telephone Company of New York, attracted considerable attention. The table itself was of antique oak and of beautiful design, while the instruments were remarkably well finished. We give below an illustration of this useful apparatus which comprises some novel and valuable features. The table is equipped for the galvanic current with a Bailey regulator and milliampere meter. The regulator consists of a glass jar about three inches in diameter by ten high. The device will be readily recognized in the illustration. Its object is to modify the current and it perfectly supplants the switchboard or cell selector. It, moreover, possesses the valuable feature of equalizing the work on all the cells of the battery.



A NEW ELECTRO-MEDICAL TABLE.

This regulator is simply a new and improved form of water rheostat and differs from all its predecessors in that it is capable of fully giving the extremes and, too, with a uniform increasing and decreasing effect. It will be noticed in the illustration that there are four plates of carbon within the jar with their lower ends pointed alternately to the right and left. To two of these points are attached small pieces of sponge which extend below the level of the points.

The first and third carbon plates are connected with one side of the circuit, while the second and fourth are connected with the other side. By means of the thumb screw, which is shown in the illustration, the plates may be slowly lowered into the water, or withdrawn therefrom. In lowering the plates, when the sponge tips touch the water current equivalent to that from a single cell or battery flows through the circuit, and as the plates are lowered more of their surfaces are submerged, consequently the resistance to the flow of the current is reduced and the current correspondingly increased. When the plates are fully submerged all the resistance in the current regulator is removed and the effect of the entire battery as a result is obtained.

The current regulator and the milliampere meter are connected in a single metallic circuit with from forty to eighty cells of Law battery. The regulator is non corrodable in any of its parts, hence there is no expense to maintain it. To prepare it for use all that is necessary is to half fill the jar with water, so that when the plates and sponge tips are elevated into the upper portion of the cell neither will be in contact with the water.

The value of this device may be appreciated when it is stated that in the switchboard heretofore used each cell of battery required a terminal on the board and a wire leading to the battery. With a battery of forty to eighty cells this means as many wires to connect with the switchboard. The switchboard itself is therefore necessarily a cumbersome affair, having, as it does, a system of levers and keys for throwing in and out of circuit any one or number of cells. One of the great objections to the switchboard system in addition to the one above named is, that part of the battery is overworked while the other part has little or nothing to do, and the patient receives a succession of slight shocks instead of a gradual increase or decrease in the current.

The meter, which is shown on the table immediately next to the current regulator, is simply to measure the current, and as such devices are so familiar in their construction it is hardly necessary to go into details here.

The induction apparatus shown at the further end of the table is known as the Dubois-Raymond (Faradic) coil. The coil has a device for interrupting the Faradic current at almost any required rate, but otherwise is similar to other induction coils.

The combination as shown in our illustration makes a very complete office outfit for the physician and it is as ornamental as it is useful.

The Law Telephone Company, of 85 John Street are the makers of this improved electro-medical outfit.

ELECTRICITY IN MINING OPERATIONS.*

The danger of accident from any class of electric machinery in mining operations, is of three kinds: first, physical injury from contact with conductors or apparatus, through which a current is passing; secondly, danger of fire or explosion from a spark in some part of the electrical apparatus; and, thirdly, failure of the apparatus to work properly at critical moments. Regarding the first point, it may be said that a limit of 250 volts has been fixed by many experts in mining and electrical engineering for all apparatus to be used below the surface; and that *permanent injury* from a current of this tension, *regardless of its amount*, is *absolutely impossible*, the only liability to danger lying in secondary and indirect accidents, owing to the surprise and momentary discomfort due to an accidental shock. A hot steam-pipe carries more danger for the man who unexpectedly touches it than a bare copper wire carrying enough current to cut and haul two thousand tons of coal a day, at the voltage named above. As to the second source of danger, no electrical apparatus, if properly installed, should ever spark at known and properly-guarded points; the amount of protection at these points being entirely dependent upon the knowledge of the designer, faithfulness of the operator and common sense of the purchaser, in spending sufficient money on safeguards. As to the third point, no class of apparatus ever designed is free from the possibility of accidental derangement, and at critical moments. But of electrical apparatus, it may be said that no type of machinery will answer more quickly to sudden demands upon its capacity, or give a plainer indication of continued abuse; while, on the other hand, no system of power transmission is capable of more rapid repair in case of temporary derangement.

EDISON'S FIRST PATENT.—The first patent taken out by Mr. Edison was on a vote recorder.

* Abstract from paper of H. C. Spaulding, read before American Institute of Mining Engineers, New York.

HIGH VACUA.

At the September meeting in Leeds, of the British Association for the Advancement of Science, Mr. J. Swinburne read the following notes on high vacua:

In a series of papers on "Incandescent Lamp Manufacture," I called attention to the great superiority of the Geissler to the Sprengel form of mercury pump. Several kinds of Sprengel pump were successively connected to a Geissler, and both were worked at the same time. The Sprengel invariably stopped taking air down before the Geissler; in fact, the Geissler never stops. It acts as its own McLeod gauge, and never indicates a perfect vacuum. The probable reason why the merits of the Geissler have been so underrated is that it needs the greatest care in securing perfect dryness of the bulb and valve. Not only will traces of water vapor condense under the floating valve instead of lifting it and going through, but it is probable air does it too. About a century ago, Davy showed that if the mercury were allowed to run up gently in an imperfect Torricellian vacuum, a bubble was left; but if allowed to rise suddenly, it indicated a perfect vacuum, the air being condensed against the glass. In the lamp papers I described a form of pump which avoids difficulties due to small condensations. The main bulb discharges into a small chamber sealed by a little V tube, so that a pressure of 1/100 A would move the mercury. This chamber exhausts into a larger globe, exhausted mechanically, and sealed by a floating valve. The small chamber is thus as thoroughly exhausted as an ordinary pump can pump it; but the pump proper, exhausting into high vacuum, can thus work better. The condensed air and water cannot expand back into it. It is thus really a double pump, or two mercury pumps in series. The only drawback is that it needs some pressure to open the first valve or sealing, so that there might, after all, be some condensation under it. I have lately devised and used a pump made as follows:—A, is the body or chamber of the pump proper. This exhausts into the small chamber, B, sealed by the valve, C, and this exhausts into the chamber, G, sealed by the floating valve, H. G is connected to a reservoir and mechanical air pump. The valve, C, has a long thin glass rod passing down through A into the lower tube, which acts as a guide. A loose sleeve, F, is strung on this rod. There is a swelling at E which fits the lower end of the sleeve, and is small enough to pass through the neck in putting the pump together. When the mercury rises in the globe, A, it lifts the sleeve till the lower end catches on E, which closes it. The mercury rises, and floats the sleeve, thus lifting the valve, C. The mercury that sealed C, then runs out, and there is a clear passage through into B; so no condensation takes place in A. The mercury rises till it floats H. When it falls, the valve, C, acts again, for the mercury has filled the sleeve, F, over the top, and C is heavy enough to sink the sleeve and rod when the sleeve is full of mercury. I have tried electromagnetic and other arrangements; but this is the best, as far as I have gone.

When using a pump it is best not to let air, and perhaps moisture, run through it more than can be helped. By the use of a sort of syphon it is possible to seal on new work to be exhausted without letting the air pressure into the pump.

The point, K, is the barometric height at which the mercury normally stands in the tube, R. There is then a clear passage between L, which is connected to the tubes to be exhausted, and M, which goes to the drying tubes and pump. When a tube has been sealed off, and a new one is to be put on, the mercury reservoir at the foot of the arrangement is raised so that bulb, N, is filled. A tap at the end of the tube, R, is closed, and the vacuum in L is broken. The mercury then runs up to the new barometric height, P. The new tube is then sealed on and exhausted by a mechanical pump, the connection being then sealed off. The mercury in the long tube then stands only half an inch or so above that in N, and on opening the tap at the foot of R, the communication is made again to the pump. The small bulb, O, and the trap at the top are to prevent a plug of mercury from going round into the phosphoric tubes.

The pump is driven by water so as to be self-acting, and can be left running for any length of time. Those who have worked much with mercury pumps will realize the value of this. Nothing makes one feel the futility of life more than to exhaust something by hand which cracks at the last stage, when five hours of life have been ticked off.

In the same papers on lamp making I urged that the methods of measuring high vacua were inaccurate and completely misleading. The McLeod gauge and the induction coil are usually relied on for testing vacua. In incandescent lamp work the induction coil is almost exclusively used. With the test by induction sparks, I have, at present, nothing new to add, and will confine myself to the McLeod gauge. In measuring vacua with this gauge it is assumed that the mercury itself has no vapor tension. The vapor tension of mercury has been given by Regnault as about 50 millionths of an atmos-

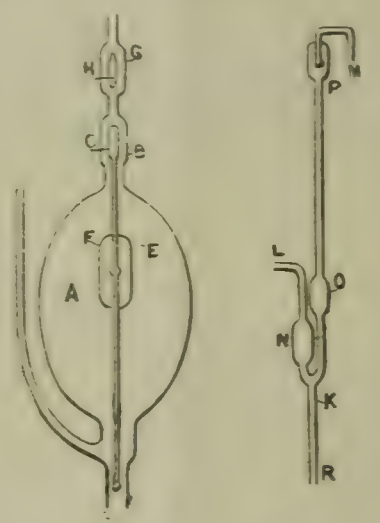


FIG. 1.

FIG. 2.

phere. If it is anything like this, of course a vacuum of one millionth, or of .005 millionth, as some experimenters profess to have reached, is absurd. When discussing this subject at the Society of Arts after Dr. S. P. Thompson's well-known paper on "Mercury Pumps," Prof. Ramsay gave .25 millionth of an atmosphere, or, as I shall write it, shortly, .25 m., as the vapor tension of mercury at ordinary temperatures.

The whole action of a pump is consistent with a vapor tension of from 25 m. to 50 m. A Geissler does not reduce the pressure in geometrical progression; but when it gets a good vacuum it takes out very little air each stroke, worked fast, and much more if worked slowly. This looks as if when the tension of mercury vapor was reached, the air taken out at each stroke was what diffused into the mercury vapor. This would also explain why a Geissler, which goes on long after Sprengel stops, does not so readily make a sparkling tube. A Sprengel stirs up the mercury, and gives the tube being exhausted more chances of getting filled with mercury vapor, which is a non-conductor. This also explains why so many experimenters get better vacua with hot mercury. Of course a new pump should be heated to get the moisture off the glass, but not when it is in ordinary use.

To test this more directly, I attached two McLeod gauges to the same pump. They communicated till a fair vacuum was reached. One was then sealed by raising the mercury past the elbow tube. The gauges were allowed to communicate by lowering the mercury every now and then, and it was always lowered before taking a reading. By this arrangement, when the pressure was reduced nearly to the vapor pressure of mercury, one gauge might have little but mercury vapor, and show a good vacuum; while the other had air at the same pressure, and showed a pressure equal to the vapor tension of mercury, or nearly so. The gauges are graduated by finding $p\,v$ corresponding to one millionth of an atmosphere, and graduating accordingly. The pressure in millionths is then the product of the reading on the closed tube and the difference in the column. Each reading is thus readily taken at several pressures to make sure there is no condensation of any vapors or gases. The readings obtained varied in an extraordinary way. When the exhaustion was carried so far that the open gauge registered 2 m. or 3 m., the closed registered from 20 m. to 60 m. The least difference in temperature seems to make a large difference in the readings. In some cases, when the vacuum was still low, the open gauge was heated till the mercury sputtered and condensed about the bulb. The bulb was then warmed to evaporate the mercury and drive all the air out, and the elbow tube sealed by raising the mercury. When the gauge was cool both were unsealed and readings taken. The gauge that had been warmed sometimes gave 1 m. against no less than 230 m. in the other. Ten minutes' connection generally brought the readings equal. Obviously the movement of the air need not depend on diffusion only; for a very small difference of temperature would cause mercury to evaporate in one gauge and condense in the other, driving the air with it.

I made a gauge with an alloy at about equal parts of potassium and sodium, which is liquid at ordinary temperatures. It would, of course, absorb any mercury vapor, and has probably a low-vapor tension. It was very troublesome, for it could not be exposed to the air for a moment, and heavy hydrocarbons would prevent the pump's working. The alloy always gets moisture, and gets coated with a thin film of oxide which prevents drops from uniting, and they can only be run together by heating under a hydrocarbon of low boiling point. I eventually got the gauge fitted up, but the alloy acted on the film of moisture on the glass, and the bubbles formed seemed to drive plugs of it about. It has a very low specific gravity, and pistons of it began to stray about inside the pump, and I was afraid they might get to the mercury, and by combining explosively, smash the pump, so the experiment was abandoned. In one experiment a plug did wander into the tube, R, and cracked it.

Fusible alloy was next tried. It worked better, but the vapors of some sulphur that was used to trap any mercury vapor blackened the surface, and only two readings were obtained. These gave a pressure of only 13.5 m. as the vapor tension of mercury.

Whether it is really 13 m. or 50 m., is of comparatively little importance; but there seems to be quite enough evidence that the readings of .01 m., and higher vacua that have been given, are inaccurate to the extent of some hundreds of thousands per cent. This is important in many investigations pursued by means of mercury pumps, for instance, experiments on the "Fourth State of Matter." The question is also important in lamp making, as it shows that better vacua are possible, and they may be an advantage. I do not know whether pumps worked with alloy of sodium and potassium will come into commercial use.

ACCIDENT.—An unfortunate accident occurred at the Sansom street station of the Edison Electric Light Company in Philadelphia, on the night of Nov. 5th. The wire rope of an elevator broke, and the car was precipitated from the third story to the cellar. Three employés were in the car, and two of them were probably fatally injured.

ELECTRICITY'S GREATEST ENEMY.—Moisture is and always has been the worst enemy of electric transmission, particularly in underground work.

ELECTRICITY IN NEW SOUTH WALES.

We are in receipt of some interesting news from our correspondent in Sydney, N. S. W. In the matter of electric lighting our friends at the Antipodes are making good progress as may be judged from what our correspondent states. "In this colony," he says, "electric lighting is making great strides.

"In Sydney the majority of public buildings have been installed with the electric light, but the city itself has not yet availed of its advantages. There is no doubt, however, but that it will do so before long.

"In the lighting of railway trains some experiments have been made with considerable success. Trains running to and from the Victorian Border have been lighted by electricity and the experiments are continued with a view to make a permanency of the light.

"It would be interesting to note that the lighting of the Macquarie Lighthouse, situate six miles from Sidney, on a rocky eminence between 200 and 300 feet above the sea level, is illumined with what is said to be one of the most powerful electric lights in the world. Some shipmasters claim that they have seen this light a distance of forty miles at sea, and although this is doubted by some, many others think that it is quite possible.

"Outside of this city five or six of the country towns have installed electric light plants, and from all reports the best of satisfaction is being derived in their operation."

The telegraph, of course, was the pioneer of electricity in that colony, and our correspondent gives a brief but interesting bit of history thereof, as follows:

"In the year 1858 the electric telegraph was introduced into New South Wales, by Captain Martendale, under an engagement to the government of the colony; our present superintendent, Mr. E. C. Cracknell, being his coadjutor. For years after this event the white population continued sparse and it took some time for the wires to run to the far country districts. The present system (Morse) was then in use but operators trusted solely to the tape embossed by the register for receiving business, sound taking being an unknown accomplishment This clumsy and by no means distinct method gave way to the ink recording registers, and, up to a little over three years ago, were still in force throughout the colony. They have been, however, superseded in the Sydney office alone by the sounder, the country offices still using the registers, the tapes of which are supposed to be running both on sending and receiving business, this arrangement being used for record purposes in event of mistakes happening.

The Wheatstone automatic was also introduced here some fourteen years ago, and lady operators were employed at the same time. The automatic, from some unexplained cause, was abandoned after a few months' trial, the ladies being drafted into suburban offices. Up to the end of 1889, 22,606 miles of wire have been erected at an outlay to the colony of £713,663. The number of stations connected by wire numbering 485 during the year 1889, the number of messages transmitted amounted to 3,433,562, representing a sum of £213,775, and the number of messages issued 3.435,389, representing £211,644, this from a population of a little over one million souls. The rates of charges are, for ten words one shilling, and one penny each additional word, suburban or offices within a radius of 15 miles, for ten words, six pence and one penny each additional word; press rates for 100 words or any portion thereof, one shilling and six pence and six pence for every additional 50 words or portion thereof.

New South Wales is connected with the Colony of New Zealand (some 1,300 miles distant) by cable, which has been working the last twelve years, a duplicate having been laid within the last twelve months. This service is conducted and officered by the Eastern Extension Cable Company, and subsidized by the Colonial Governments of Australasia. The charges are nine shillings for ten words and one shilling each additional word. These colonies are also in communication with the old world by cable, the starting point being Port Darwin in North Australia, a distance of 1,970 miles from Adelaide, these being connected by what is termed the overland line stretching across the most uninhabited and wildest portion of this continent. There are some dozen telegraph stations on this route where reside an officer in charge, and a couple of linemen—a lonely and dreary occupation. After this line was first erected the interruptions were numerous, the linemen in most cases finding the line on the ground and the insulators missing. A happy idea occurred to one of the officials and several broken insulators and bottles were distributed along the line. From that time on the interruptions ceased to a certain extent, proving that the blacks had removed the original insulators and broken them to sharpen or form their spears, arrows, etc.

ON A MERCURY ELEMENT IN RELATION TO TEMPERATURE.*

The combination $Ag/AgSO_4/Hg_2SO_4/Hg$, which exhibits a marked change under different temperatures, seemed to the author peculiarly adapted for the study of Helmholtz's theory, that the difference between the electrical and the chemical energy of an element is equivalent to the product of the absolute temperature and the differential coefficient of the difference of potential between the poles. If the chemical energy overcomes the electrical energy, in which case a current is generated, the coefficient is negative; if the reverse is the case, it is positive. The elements used consisted of two glass vessels, 6.5 cm. high and 2.5 cm wide, connected by a capillary tube. In both vessels was placed mercury, into which in the second vessel was plunged a platinum wire. On the mercury in the first vessel was placed a layer of paste of mercurous sulphate and silver sulphate, and on this the silver sulphate solution was carefully poured. In the silver sulphate solution a silver wire spiral and a thermometer were immersed. The whole was put into a copper vessel containing water.

The changes in the E.M.F. varied considerably with the time. The first reading was .0295 volt at 13.8°C. The tests at various temperatures give rise to the assumption that the E.M.F. is a linear function of the temperature. The results show that the agreement between the theory and the experiments is complete in cases of actions of a reversible nature. It would also seem that even with actions not belonging to this class the theory would lead to the correct conclusion.

NOTES FROM CORNELL UNIVERSITY.

Lee H. Parker, '85, is engaged with the Short Electric Company, at Cincinnati.

E. C. Sickles, '90, is with the Wenstrom Dynamo and Motor Co., Baltimore, Md.

F. F. Goodwin, '90, is settled at the Thomson Welding Co.'s works, at Lynn, Mass.

Mr. Walter C. Kerr, of the firm Westinghouse, Church, Kerr & Co., has been elected Alumnus trustee of the university.

Mosscrop, '88, is the engineer in charge of the construction of the Amsterdam Electric Street Railway, at Amsterdam, N. Y.

At the last meeting of the Board of Trustees of the University the sum of $50,000 was appropriated for new apparatus and machinery. Among other things a mammoth engine, costing about $13,000, is to be purchased.

* F. Steinitz, in the *Wiener Berichter*.

At the last meeting of the Senior Electrical Society, Mr. Thompson, R.G., gave an illustrated lecture on electric meters. The history of the development of the electric meter was traced and views of all kinds now on the market shown.

The Sibley non-resident lecturers elected for the ensuing year are as follows: Alexander Graham Bell, William A. Anthony, Elihu Thomson, Professor Mendenhall, Captain R. H. Hunt, Professor S P. Langley, Mr. J. M. Allen, Mr. Holloway, Eckley B. Coxe, Charles E. Emery, Dr. C. B. Dudley, F. J. Sprague, Mr. E. D. Leavitt and Mr. Rothwell.

THE ELECTRICAL EXECUTION LAW.

The test of constitutionality is to be applied to the New York electrical execution law by the United States Supreme Court. The first step in this direction was taken on October 27th when the case was presented to the court and a motion made that the case be advanced and set down for a speedy hearing. The point raised in the case is that the Kemmler execution demonstrated that killing by electricity is a cruel and unusual punishment, and, as such, prohibited by the Constitution of the United States.

The case in which the motion to advance was made is that of the Japanese, Shibuya Jugiro, against A. A. Brush, agent and warden of the New York State Prison. Jugiro is under sentence of death for the crime of murder, and it is proposed to kill him by means of electricity, as is provided by the law of the State of New York. Counsel, both for the State and for the prisoner, concur in the motion to advance. There have been several stays of execution already in Jugiro's case, and another will undoubtedly be necessary, as the case can hardly be decided before the time last fixed for his death.

WESTINGHOUSE DYNAMOS IN ENGLAND.—The dynamo equipment of the Sardinia street station of the Metropolitan Electric Supply Co., London, consists of ten Westinghouse alternate-current dynamos, of 125 kilowatts output each, providing, therefore, for a total output of 1,250,000 watts, or for a supply of 20,000 50-watt lamps, all burning at one time. These dynamos are respectively driven by the belting coming up from the associated engine on the floor below. The belts and pulleys are covered in with belt shields. Each dynamo generates an alternating current at a pressure of about 1,050 volts when running at its normal speed of 1,030 revolutions per minute. These dynamos are technically known as the "No. 3" size. The dynamos are bolted down on strong wooden frames, and have the usual belt tighteners and screws. All moving parts of the dynamos are supplied with oil from sight-feed lubricators, which are themselves fed from an oil tank placed at a higher level. From this oil tank proceed a system of oil pipes to each dynamo. The waste oil runs away down stairs by waste pipes; is cleaned, filtered, and pumped up again to the oil tank by a small pump.

PLATINUM.—In each 16-candle power lamp there are from four to eight grains of platinum. Assuming an average of six grains per lamp, an ounce will be sufficient for 80 lamps. Estimating the demand for 16-candle power lamps for the year 1891, based upon reliable data, ten million 16-candle power lamps, or their equivalent, would not be in excess of the amount. This would give a demand for 125,000 ounces of platinum, which, at present price ($14 to $17 per ounce), would amount to about $2,000,000. The probable income from these lamps will not amount to more than $6,000,000, while the cost of one item alone is one-third the total income. If some substitute for platinum is not found it seems that the cost of the incandescent lamp will advance rather than decrease.

ON THE CONDUCTIVITY OF SOLID AND FUSED SALTS *

The data hitherto published on the conductivity of solid and fused salts differ for each salt when determined by different observers. The author was extremely careful to keep the salts at constant and accurately measured temperatures. The salts were fused in a small porcelain crucible 2.8 cm. high and 2.2 cm. diam., heated equally in a sand bath. In the salt were placed stout, square, platinum electrodes of 2.25 square cm. surface. The electrodes were freshly platinized before each test. To prevent cooling of the electrodes by conduction of heat through the connecting wires, about 20 cm. of the latter were also put in the same bath. The resistance of the salt was measured by the alternate current and an electro dynamometer. The capacity of the crucible was determined by a solution of magnesium sulphate. All readings were taken with decreasing temperatures.

In spite of the fact that many of the salts on solidifying showed porosity, a general agreement was found between the results for the same salt in the solid and fused state. With some salts, just at the point of fusion, a remarkable change occurs in the volume or in their conductivity; with others, the conductivity alters rapidly at a temperature below the fusing point; and with a third group, a steady change only is observed. It appears, therefore, that the only difference between salts in the solid and fused state is due to an action of an electrolytic nature, as Warburg has already proved in the case of glass and crystal. Clausius' theory, therefore, that in solid bodies the molecules oscillate about a position of equilibrium, but cannot separate from their own group, cannot be accepted. The idea of a sharply-defined difference between solids and liquids must also be abandoned, as it seems to have no existence in nature. Liquid molecules exist in every solid, even when the latter show no approach to the softened state.

SECONDARY CELLS.†

The author in this paper limited himself to a description of his own experiences in regard to secondary cells, primarily with a view to provoke discussion on the subject. Soon after the introduction of M. Faure's cells his attention was drawn to the hard film of sulphate of lead formed on the plates, which materially interfered with their efficiency; and, as a result of experiments, he ascertained that the addition of a small quantity of carbonate of soda to the dilute acid served to remedy this evil, even when the cells were allowed to remain idle for a considerable time. Subsequently, in the case of a small installation of 22 E.P.S., 350 ampere-hour cells, the plates of which showed signs of sulphating, carbonate of soda (ordinary washing soda), was added in small quantities, and on proceeding with the charging the plates were restored to their original condition. The cells thus treated have since been in use for a period of five years, and are now in perfect condition. The subsequent experiments on this subject by Mr. Preece were then alluded to. The author advised that large cells be used for stationary work, and that they be both charged and discharged at low rates. Various details in regard to the management of cells were discussed, the practice of packing the plates in a solid though porous mass formed by mixing plaster of Paris and sawdust being specially recommended.

The paper concluded with the expression of a hope that a thoroughly practical cell for traction purposes might be introduced—one which will stand rough usage and be free from the defects which characterize those at present in use

*L. Gratz, in Wiedemann's Annalen.

†Abstract of a Paper read by W. J. S. Barbour-Starkey, before the British Association in Section G, Leeds, September, 1890

WESTINGHOUSE EQUIPMENT IN LONDON.—The Sardinia-street station of the Metropolitan Electric Supply Company, London, is equipped with Westinghouse dynamos and engines. In referring to this equipment the *London Electrician* says: It will be interesting to see how, with imported machinery, the Westinghouse Company, after showing by this excellently arranged station what they can do, will be able to compete with our home manufacturers. One of the solitary advantages to us of American Protection is, that the cost of their labor and material is so high that they cannot compete on the same grounds, nor will their labor saving devices help them permanently, unless they are continually improved more rapidly than they are adopted in our workshops. But the American manufacturer has an immense advantage in the limitation of his standard sizes. Our dynamo builders are fully alive to the fact, but they continue to offer a very much larger choice of standard sizes, and they generally need but little inducement to build machines to suit the special requirements of an order. The magnificent catalogue of the Westinghouse Company relating to "incandescent apparatus" offers only five sizes of alternating-current dynamos for 1,000 or 2,000 volts. In the latest price list of English manufacture that we have received we find five sheets of continuous current dynamos at five different voltages, with twelve different sizes on each sheet. These may be shunt, series, or compound wound, making no less than 180 varieties. Few makers of dynamos offer less than a dozen or fifteen sizes, and in most cases they denote them by mysterious combinations of letters and figures. It is difficult to explain why our manufacturers cannot rid themselves of a fashion which must necessarily increase the cost of production, and one that greatly reduces the immense usefulness of the interchangeable system, which is by no means uniformly adopted even among our best firms.

COST OF ELECTRIC LIGHT TO THE CONSUMER.

Mr. C. W. Naylor, on Oct. 23d, read an interesting paper before Illinois Branch, No. 28, of the National Association of Stationary Engineers, on the subject of the electric light in its relation to the consumer. The following extracts therefrom will be of interest to our readers:

It must perforce be admitted that the electric light is a plain everyday matter of fact illuminant, and as a practical thing has come to stay with us. As such, it is to be gauged and measured by that worldly standard—the almighty dollar.

The question is, "Does it pay?" The answer involves an intricate problem.

What does it cost to make the electric light? To anticipate somewhat, it will be found that it is proportionately cheaper to generate it on a large scale. This fact is not surprising, for it holds true in the operation of most commercial apparatus.

For very small generating plants, the costs as compared with those of medium sized or large stations are utterly disproportionate. To operate a very few lamps only, by means of machinery, would be many times more expensive than any of the other ordinary means of lighting.

It will not be necessary here to claim everything for the electric light and insist that it is a necessity and that everybody must sooner or later adopt it. It will be only a matter of a few years at most when the claim will make itself good.

In a very short time—we shall live to see the day—the electric light will reign supreme where people live thickly congregated and depend for existence upon their industry. As present users enlarge their plants, as new converts augment the demand for it, production will be cheapened, and thereby its field of usefulness will be increased.

How much will it cost to put in and operate an electric-light equipment?

Assume for the time being that there is no machinery in an establishment and that it becomes necessary to rent lights, the place in question being a small store or salesroom. The charge for one arc lamp to burn all day, say for ten hours, will be 50 cents per day. This can be compared with the price that would be paid for gaslight. Assume as a basis of comparison ten gas jets. This comparison, however, is hardly fair to the electric light, as the illumination given by the latter is vastly superior to that of the gas.

Ten gas jets at an average consumption of 5 cubic feet of gas per hour per burner at $1.25 per thousand feet will cost for ten hours, 62½ cents. The electric light, as will be readily seen, is much the cheaper; is more powerful and penetrating, is cleaner and vastly safer, so far as fire risk is concerned. It is switched on at once and off again just as quickly; it does not overheat the room; it will not ruin ceilings and walls with soot and grease, nor damage fabrics with deleterious, sulphurous and other gases. Gas cannot be obtained at a price much cheaper than that mentioned. Even at $1 per thousand, the cost figured as before will reach 50 cents per day, which is fully as expensive as an electric arc.

This is the limit of economy in gas lighting. Should it become desirable to light a large room or a number of rooms, gas cannot be had cheaper. On the other hand, electric lights are rated by a graded price list. If five, or ten, or twenty electric lights are needed they are to be had for 40 cents per day, which is 20 per cent. less than the charge for gas. In fact they can be contracted for at the low rate of 33 cents per day, almost 40 per cent. cheaper than the gas method of lighting. Gas light varies with the season and output, now weak, now strong. Sometimes it can hardly be coaxed out of the burners, at other times it flames to the ceiling. Now it is yellow and now red; it is often blue, but very seldom white. In winter so sluggish is it that it is with difficulty cajoled into leaving its natural lair under the ground.

The electric light assures to the consumer at all times the full measure of an almost perfect illumination. With all its drawbacks it is wonderfully superior to any and all other known means of artificial lighting. There are numerous objections to the use of this light, most of them, however, are trivial.

Mr. Naylor discusses very fully the cost of operating electric light plants under various conditions and concludes his paper as follows:

The light has come to stay, and has taken its place with elevators and lifts as a necessary part of the machinery of an establishment that is forced to carry on its business in tall, deep buildings, hemmed in on both sides by other buildings fronting on narrow streets and shut off from the light of day. It then becomes our duty as intelligent, progressive engineers to seek at once for a better acquaintance with this method of illumination.

It will be found a most simple mechanical problem on a par with the other machinery intrusted to our care, and no more difficult to manage than the ordinary elevators and engines. It is not at all mysterious. The atmosphere in the immediate vicinity of dynamos, converters and electric circuits is commonly supposed to be full of flying and flurrying volts, watts, amperes and other hidden subtleties.

This need, however, occasion no alarm. They keep themselves in the background, and are not nearly so troublesome as hot-boxes. The thoughts of them need deter no one from undertaking a study of them.

We have no more to fear from a volt than we have from a latent heat unit. Who ever saw the engineer that was afraid of a latent unit of heat? Do not, then, fear the electric terms. They are but the hidden elements of the forces with which we will have to deal. Master them.

FOREIGN NOTES OF INTEREST.

In the beautiful but notorious sea bathing and gambling town, Monte Carlo, a central station for the electric lighting of the town is in course of erection, and is to be shortly brought into play.

The authorities of Brussels have opened a competition for a model of the Venetian masts intended to support the electric lighting apparatus in the Grande Place.

It is stated that Mr. Lane-Fox and his associates are contemplating taking action against a number of people with regard to their using their dynamos, accumulators, and incandescent lamps in conjunction with each other.

The steamship "Westmeath," chartered for the laying of the new cables which are to connect certain of the West India islands with various points on the continent of South America, left Messrs. Henley's works at North Woolwich on October 15th.

The five-wire central station at Königsberg, the first of its kind in Germany, will shortly come into operation. The total capacity of this station is at present 600 horse power. There are two groups of engines and dynamos, each comprising two triple expansion engines, and four dynamos.

How far workable platinum ores are distributed over the globe, says the London *Electrical Review*, appears yet to be very imperfectly known, but a recent discovery at Colac, Australia, appears to show that there is hope that a fairly abundant supply of the metal may yet be forthcoming. It is stated in the *Ballarat Courier* that samples of the ore taken from the Otunz Ranges give a return of 1,120 oz. per ton, and that great excitement reigns in the district.

An application now before the Municipal Council of Paris is full of interest to electricians. It is proposed to secure permission to erect an electric central station in order to utilize the power of a new artesian well situated in the Herbert place, La Chapelle. The well, which is 750 yards deep, gives 215,000 cubic feet of water in twenty-four hours, and throws the water up to a height of 38 yards. La Chapelle is the centre of a large industrial population, and it is intended to use several turbines in driving the dynamos, which will supply current for light and power to the surrounding districts.

Great interest is taken in French naval circles on the possibilities of the application of electricity to naval uses. The government has taken the matter up and proposes to institute a series of lectures for the benefit of naval officers on the theory and use of electricity. These lectures will be given by recognized experts and will extend over a period of four months. Particular attention will be paid to the various systems of electric lighting, which four working electricians from each naval port will carefully study under the government.

The funicular electric tramway between Pazzalo and Lugano has lately come into operation. The line, which is of one metre guage, is close upon a mile long, and runs along the shore of the Lake of Lugano and up to Mont Salvatore. Power is obtained from a waterfall which actuates two Girard turbines, each of which drives a dynamo. One of these machines is an alternator, and supplies lights at Lugano and Pazzalo. The second dynamo is a continuous current machine, and gives 1,800 volts and 22 amperes at 700 revolutions; the motor at Pazzalo develops 40 horse power at the same speed. The maximum gradient is one of 38 per cent. The track being double, a car is attached to either end of the cable, so that the tractive effort required is considerably reduced. Each car weighs 4½ tons, and can carry 32 passengers. A 50 horse power steam engine is kept in reserve at Pazzalo.

AN EXCELLENT OPPORTUNITY TO PROCURE ELECTRICAL BOOKS FREE.

It is not necessary to give prizes with the ELECTRIC AGE for new subscriptions, but we desire to make a sensible business offer to our patrons to pay for their securing us new business among their friends. For one new subscription accompanied by $3.00, to cover the same for one year, we will send free to any address, one copy of any one of the following named books: Atkinson's Electric Lighting, Bottone's Electrical Instrument Making for Amateurs, Cumming's Electricity, Terry & Finn's Description of Telegraphic Apparatus, Maver & Davis's Quadruplex, Lockwood's Measurements, or any other book which costs $1.50.

For two yearly subscriptions accompanied by $6.00, we will send one copy of Houston's Dictionary of Electrical Words Terms and Phrases, or any other book costing $2.50.

For four yearly subscriptions ($12.00), we will send one copy of Culley's Hand-Book which costs $5.50.

All books to be sent postage prepaid.

We will also send for one yearly subscription accompanied by $3.00, one copy of A B C of Electricity, one copy of Bottone's Electric Bells, and one copy of Day's Electric Light Arithmetic, or any other three books that aggregate in cost $1.50.

We name below a few books and prices, for the purpose of allowing our friends the opportunity to make a selection more in line with their requirements:

Elementary Principles of Electric Lighting, by P. H. Atkinson. Illustrated. Price	$1.50
Incandescent Wiring Hand Book, by F. B. Badt	1.00
Winding Magnets for Dynamos, by Carl Hering	1.25
Electric Transmission of Energy and its Transformation, by G. Kapp	3.00
Electrical Engineering, by Slingo and Brooker	3.00
The Electric Railway to To-day, by H. B. Prindle, (paper)	.50
Same in cloth	1.00
The Electric Motor and its Application, by Martin & Wetzler, 316 illustrations.	3.00
Evolution of the Electric Incandescent Lamp, by F. L. Pope	1.00
The Modern Practice of the Electric Telegraph, by F. L. Pope	1.50
The Quadruplex, by Maver & Davis	1.50
Illustrations and Descriptions of Telegraphic Apparatus, by Terry & Finn	1.50
Practical Information for Telephonists, by T. D. Lockwood	1.50
Electrical Measurements and the Galvanometer, by T. D. Lockwood	1.50
Dictionary of Electrical Words, Terms and Phrases, by Edwin J. Houston	2.50
Principles of Dynamo Electric Machines, by Carl Hering	2.50
Wrinkles in Electric Lighting, by Stephen.	$1.00
The Principles and Practice of Electric Lighting, by Swinton	1.50
The Dynamo Tender's Hand Book, by Badt, with 70 illustrations	1.0
Practical Directions for Winding Magnets for Dynamos, by Badt	1.00
The Dynamo, How Made and How Used, by Bottone. A book for amateurs, 39 illustrations	1.00
Dynamo-Electric Machinery, by Thompson. A series of lecturers. Numerous illustrations	.50
Dynamo-Electricity, by Prescott. Its generation, application, transmission, storage and measurement, with 545 illustrations	5.00
Practical Electricity, by Ayrton. A laboratory and lecture course for first year of students of electrical engineering, based on the practical definitions of the electrical units, with numerous illustrations.	2.50
The A B C of Electricity, by W. H. Meadowcroft	.50
Dymanic Electricity, by Hopkinson. Its modern use and measurement, chiefly in its application to electric lighting and telegraphy, including (I.) some points in electric lighting. (II.) On the measurement of electricity for commercial purposes. (III.) Electric Light arithmetic	.50

For sale by the ELECTRIC AGE PUBLISHING COMPANY, *World* Building, New York.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Nov. 6, 1890.

An electric storage battery car was tried on the tracks of the Lowell Street Railway last Friday.

A party of thirty-five members of the British Iron and Steel Institute visited the Thomson-Houston Works on Nov. 5th.

The electric motors that are to run the pulp mill of the S. D. Warren Co., at Cumberland Mills, are about done and will be started soon. They will make a large saving of water and steam.

The Belt Line Electric Railroad Company, at Lynn, are to build a new car house for the housing of their electric cars. The new power house is approaching completion. The engine to be used will be of 400 horse power.

The new electric railway from Whittin's station to Whittinsville, about 1½ miles, is well under way, and a large number of workmen are employed. Both passengers and freight will be carried. The overhead trolley system will be used. Cars will be running before December.

Some of the armature winders of the Thomson-Houston Electric Company, on Nov. 3d, struck to resist a reduction in wages. This is the first strike of importance in the works. After being out two days the men returned to work, an agreement having been arrived at between the men and the superintendent of the works.

Electric motors bid fair to come into general use in Waltham, where light work is done, and it was with the end in view of furnishing power for small shops, that the electric light company decided to put in a larger engine and dynamo, when it made the contract with the Newton Street Railway Co.

A five horse-power motor has been set up in Stark's machine shops, Waltham. A two horse-power motor has been ordered by D. D. Palmer, and smaller motors will be introduced for running sewing machines, ice cream freezers, and work requiring less than two horse-power, while a number of printers are considering the introduction of electric power in their establishments.

Curtis H. Veeder, of Lynn, has patented an electro-magnetic friction clutch or brake, consisting of two electro-magnetic members mounted upon a shaft, one of said members being fast to the shaft, while the other is free to rotate thereon, each member having an energizing coil whereby they may be independently magnetized so as to either attract or repel.

The great 250 horse-power generator in the testing house of the Thomson-Houston Co., is now furnishing power to run the several lines of the L. & B. R. R., the Highland circuit, Wyoma and Walnut sts., which were deprived of power by an explosion last Sunday. The generator was ready before the wiring was. The big machine just played with the load carried by the cars on the several routes. They require 100 amperes, while its capacity is 400. It will be run until the Gas and Electric Co. are ready to resume their contracts.

R. M. Hunter has designed and patented an electric railway conduit, consisting of a stationary source of electric supply, a bared electric working conductor arranged along the railway, a separate supply conductor electrically connected at intervals with said bared working conductor, and a slotted conduit inclosing it.

The great traveling crane in Factory K, at the Thomson-Houston Works, Lynn, is nearly ready for use. In appearance it is like two heavy walking beams extending the width of the factory. These trusses are made of iron, and are fitted with trucks at either end resting on heavy iron tracks and are arranged along the wall at the upper part of the room. There are three motors on the crane, one a three-horse power, to move the hoist laterally, another a ten-horse power, to move it lengthwise of the building, and a third to work the hoist. An iron platform is attached to the crane on which is the rheostat which works it. It adds one more item to the wonders of the works.

At the Mechanics' Fair, the American Magnetic Electric Co. exhibits a novel system of electric bells, requiring no battery, and being of especial interest to electricians because it involves a very important new departure in the principles of construction of electric bells. The generator works on the same principle as that of the ordinary telephone call, but instead of a polarized bell, such as has been used hitherto with such generators, this company shows bells of radically novel construction, of surprising simplicity and efficiency, and of practically unlimited power. The hammer of one of the bells is a solid brass ball of one inch diameter, and a moderate sized generator suffices to swing this hammer vigorously through a stroke of $2\frac{1}{2}$ inches.

W. J P.

TRADE NOTES.

The firm of J. M. Lane & Co., 90 Court street, Brooklyn, who have been pushing the Himmer and Anderson dry battery in that city, are doing a good trade. The members of the firm are enterprising and capable young fellows and deserve the success they are meeting with.

The Wheelock Engine Company of Worcester, Mass., are having an exceedingly busy season. Moving to new works early in the past spring to gain capacity to handle their increasing business they find, almost before getting settled, that the new facilities, though two or three times the old, are crowded to the utmost, and they have been running nights for the larger part of the time. Extensive additions to the plant will be imperatively demanded for next year's business by the natural increase and the amount already in sight. There is every indication of a still greater pressure of business for the coming year.

The McCreary Electrical Specialty Company has just issued, under date of Nov. 1st, an illustrated price list of electrical specialties for incandescent and arc electric lights. It includes some new things including the Bradner Adjustable Lamp Hanger, which is described and illustrated on another page in this issue.

A Westinghouse Electric Road.—Four miles of electric railway are being equipped with the Westinghouse electric motor system, at Findlay, Ohio.

No Income.—Many people suppose that the Edison laboratory is the source of a fabulous revenue. To such it will be a surprise to know that nothing is manufactured there for sale. Experimental work only is carried on and the result is, there is no direct income, as there is nothing made nor sold.

Contract Awarded.—The National Electric Manufacturing Company, of Eau Claire, Wis., have secured the contract to establish an electric light plant in Glasgow, Va.

ELECTRICAL PATENTS ISSUED NOVEMBER 4TH, 1890.

439,662. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Original application filed Sept. 23, 1886. Divided and this application filed June 1, 1887.

439,675. Guide for Machines for Covering Wires. John McCahey, Providence, R. I., assignor to the New England Butt Company. Filed May 7, 1890.

439,724. Electric Heater. Charles W. Drew and Edwd. M. Francis, Minneapolis, Minn. Filed Feb. 20, 1890.

439,737. Standard Galvanic Cell. Edward Weston, Newark, N. J. Filed May 12, 1890.

439,746. Trolley-Line Switch for overhead Electric Conductors. William L. R. Emmett, East Rockaway, N. Y. Filed May 7, 1890.

439,775. Electric Motor and Generator. Alfred Gartner, Newark, N. J., assignor, by mesne assignments, to Albert A. Schmidt, same place. Filed Aug. 16, 1889.

439,792. Fluid-Pump. Imle E. Storey, Brooklyn, N. Y. Filed Jan. 16, 1890.

439,796. Insulating Composition. Turner D. Bottome, Hoosick, N. Y., assignor to John B. Tibbits, same place. Filed Jan. 2, 1890.

439,838. Electric Actuating Device for Pendulum Clocks. John H. Dyson, Mazomanie, Wis., assignor of one-half to Herman O. Wetherell, same place. Filed June 2, 1890.

439,840. Electric Log. William P. Granville, Stroud Green, County of Middlesex, England. Filed June 17, 1890. Patented in England.

439,850. Secondary-Battery Plate. Albert E. Woolf, New York, N. Y. Filed Feb. 13, 1890.

439,859. Magazine Fuse-Box for Electric Circuits. William Fr. Bossert, Ilion, N. Y. Filed July 30, 1890.

439,867. Electric Railway. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed June 30, 1890.

439,882. Incandescent Gaslight. Charles M. Lungren, Brooklyn, N. Y. Filed April 9, 1889.

439,904. Electric-Arc Lamp. Harold C. Shubert, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Aug. 30.

439,906. Automatic Car-Register. William B. Sprague and Charles W. Kellogg, Chicago, Ill. Filed June 20, 1890.

439,916. Device for applying a coating to Electric Conductors. Jas. T. Whittlesey, Lynn, Mass. Filed Dec. 20, 1889.

439,929. Method of and Apparatus for connecting Dynamos. Charles T. Child, Brooklyn, N. Y. Filed Mar. 19, 1890.

439,959. Telegraph Key. William A. J. Kohrn, San Francisco, Cal. Filed May 10, 1890.

439,974. Electrical Generator. Frederick L. McGahan, Indianapolis, Ind. Filed Sept. 8, 1890.

440,013. Electric Indicator. Leston O. Chatfield, Benton Harbor, Mich. Filed Dec. 12, 1889.

440,016. Automatic Regulator for Dynamos and Motors. Fremont J. Cleaver and George Fassold, Pittsburg, Pa. Filed Apr. 11, 1890.

440,023. Electrode for Secondary Batteries. Justus B. Entz, New York, and William A. Phillips, Schenectady, assignors to the Waddell-Entz Electric Company, New York, N. Y. Filed Feb. 20, 1890.

440,042. Insulator for Electric Conductors. William Kessler, Lafayette, Ind. Filed Aug. 8, 1890.

440,070. Magnetic Separator for Grain. Ewald von Syo, Augsburg, Germany, assignor to Philipp Adam Tafel. Filed May 14, 1890.

440,071. Electric Heater. Charles H. Talmage, Kansas City, Mo. Filed Nov. 23, 1889

440,096. Telephone. Sigmund Bergmann, New York, N. Y. Filed Feb. 28, 1884.

440,106. Adjustable Trolley and Guard for Electric Wires. Lewis S. Hoyt, Boston, Mass. Filed June 25, 1890.

440,115. Electrical Burglar Alarm. Francis Pierce, Philadelphia, Pa., assignor of one-half to William J. Phillips, same place, Filed May 8, 1889.

440 118. Automatic Toll System for Telephone Pay-Stations. Howard C. Root, Brooklyn, N.Y. Filed May 20, 1890.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Ill., Nov. 7, 1890.

Mr. R. S. Waring, of the Fowler-Waring Underground Cable Company, of London, Eng., has been in Chicago for some days.

The plant placed in the Erie flats in this city by the Pumpelly Storage Battery Company, and which was described in our columns some weeks since, has given such satisfaction, that Dr. Clark has decided to put in a similar plant of about 120-light capacity in his handsome apartment building, the Cambridge, located at the corner of 39th street and Ellis avenue.

The Seattle Electric Railway and Power Company, of Seattle, Washington, are operating a very successful street railway line in that city, and the following items regarding their plant may be of interest. The power station is a two-story building 265 x 60 feet, the second floor having a capacity for 32 cars. The power plant and machine shop are on the first floor. Two Corliss single non-condensing engines of 250 horse-power each drive the generators, of which there are five, having a capacity of 80 horse-power each. Sixteen motor cars are now in operation upon twenty miles of track, and ten cars are in course of construction. The system used is the Thomson-Houston. The average run, per car, per day, is 103 miles, and the average number of passengers carried on the line, per month, is 307,979. The officers of the company are as follows: L. H. Griffith, president; D. T. Denny, vice-president; E. C. Kilbourne, treasurer; V. Hugo Smith, secretary; James G. McCarty, manager; A. Dunn, auditor.

Prof. F. B. Badt, who recently severed his connection with the Edison General Electric Company, has accepted a position with the Thomson-Houston Electrtc Company, as Manager of the Power and Mining Department.

The Central Electric Company are to be congratulated upon the acquisition of Mr. George W. Vernor, who takes charge of their bookkeeping department. Mr. Vernor has been secretary of the Electrical Supply Company at St. Louis for the past year and is already well known to the electrical trade.

F. M. I.

Second Century of the Patent System.—A movement is on foot in Washington to celebrate the inauguration of the second century of the American patent system on the 15th of next April, on a grand scale. The affair is to be made national, and Commissioner of Patents Mitchell has promised his co-operation and support.

Gas Engines in Electric Lighting.—The use of gas engines for isolated electric light plants is becoming very extensive in Philadelphia. This is on account of the difficulty in getting service from the electric light companies, owing to the overhead wire restrictions by the municipality.

A Great Improvement.—The electric railways on the overhead system already introduced in many places, have so far improved upon the horse and mule, that the public once given rapid transit, would not go back to slower methods, and are clamoring everywhere for such facilities.

Electric Lighting by Gas Companies.—From March 1889 to March 1890, the gas companies increased their ownership in electric lights, to the extent of almost 50 per cent.

LIFE OF INCANDESCENT LAMPS.

Experience has shown says the *Bulletin International de l'Electricite*, that the life of incandescent lamps is greatly diminished if the current supplying them is irregular, as happens when the dynamo is driven by an engine whose flywheel is too tight. The strength of the current will vary periodically, and the temperature of the filament, and therefore also its brilliancy, follows the same variations. From this result a disintegration of the carbon, which results in rupture of the filament after a small number of hours of service. The question has been asked if the lighting of incandescent lamps by alternate currents does not lead to the same result. Under this supposition, M. Rodet has calculated the variation of temperature in the filament, and after a series of calculations represents this variation by the formula : $d\,T = \frac{R\,I^2}{2\,\pi\,C\,P\,Z}$

where $d\,T$ is the variation of temperature sought in function of : R I2 the number of watts furnished to the lamp, and Z, the number of reversals of current per second ; P is the weight of the filament in grammes, and C the specific heat of the filament corresponding to the volt coulomb. This equation, which does not include the mean temperature of the filament, shows that for a given lamp, and consuming a given number of watts, the amplitude of temperature variation of the filament is in inverse ratio to the number of reversals of the current, and that for different kinds of lamps requiring the same electrical energy $d\,T$ is in inverse ratio to the weight of the filament. Applying this formula to the case of a 16 c. p. lamp, using 60 watts at 105 volts, and supplied by a current whose frequency is 42, it is found for a filament of carbon of 0.005 grammes, and that $d\,T = 12$ deg. Assigning to Z the values of 10 and 73, it is found that $d\,T = 70$ and $d\,T = 100$ deg. respectively. It is seen that for the second of these frequencies the variation attains 100 deg., and ceases to be negligible.

It results from this that users of lamps do better to take machines having the higher number of reversals. Experiments have been made previously to these researches of M. Rodet, to determine if the alternate current uses up the lamps more rapidly than the continuous current, and these have gone to show that the duration is very nearly the same in both cases.

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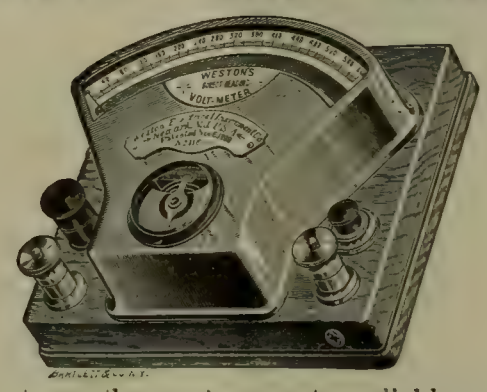
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1 1-C.P. Incandescent Lamp (large bulb)	.85	1 3-C.P. Incandescent Lamp (large bulb)	.85	1 6-C.P. Incandescent Lamp (large bulb)	.85
1 Key Socket	1.20	1 Key Socket	1.20	1 Key Socket	1.20
1 Shade and Holder	.50	1 Shade and Holder	.50	1 Shade and Holder	.50
50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.50
4 Charges of Depolarizer (will run 80 hours)	.40	2 Charges of Depolarizer (will run 40 hours)	.40	3 Charges of Depolarizer (will run 70 hours)	.90
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"The question of the absorption into the skin of solutions by means of electric currents has been," says Dr. S. Ehrmann, of Vienna, "the subject of many experiments with me since Prof. Wagner first started the discussion by his researches on the cataphoresis of cocaine; and I have at last hit upon a very simple experiment. Take two similar glass vessels, with zinc electrodes at the bottom, and filled with a very weak solution of methyl-blue; and if an individual places one of his hands in each vessel then when a constant current of from 10 to 20 milliamperes is allowed to pass for five or ten minutes, the hand in the anode vessel becomes covered with blue spots, whilst the other is not marked. The spots appear most on the back of the hand, where the hair and fatty glands are situated. In the palm and round the nails they do not occur."

The recent explosion of accumulators on the yacht "Pathfinder," in Portsmouth (England) harbor, is the subject of considerable discussion in English electrical circles. The daily press refer to the affair as though accumulators were really infernal machines. It seems to be generally admitted that the explosion was probably due to the accumulation of hydrogen gas, but how the accumulation was affected is yet a mystery.

Electrical Commission Appointed.—The President has appointed an electrical commission for the District of Columbia. The members are Prof. Henry A. Rowland, of Johns Hopkins University, Andrew Rosewater, of Omaha, and Lieut. Francis R. Shunk, U. S. A.

The telephone network at Stuttgart has reached such proportions that a further extension of overhead wires has been forbidden by the authorities, who have, accordingly, ordered that in future the lines must be laid underground.

Early Underground Conduits.—In 1832, Prof. Morse first conceived the idea of underground transmission of electricity, and among his earliest plans the conduits of to-day were suggested.

The London *Electrician* refers to the charge of $1,000 a mile for the use of subway ducts in New York as preposterous.

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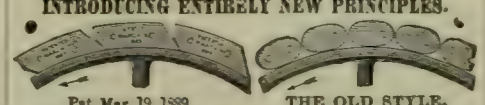
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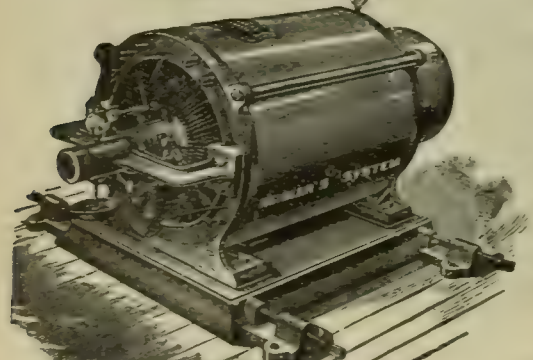
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NEW YORK, NOVEMBER 22, 1890.

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THE WESTINGHOUSE SYSTEM IN BALTIMORE.—Since the Brush Company of Baltimore passed into the hands of the Westinghouse Electric and Manufacturing Company great improvements have been made in the plant, and many more are contemplated. It is the object of the company to make this plant the largest alternating current central station in the country. Under the new management the Westinghouse Alternating system has gained many friends in Baltimore, and the result of this is a great demand for the light. In order to satisfy this extraordinary demand a number of new alternating current apparatus will be installed shortly. When these are placed in the station the plant will have a capacity of 20,000 incandescent and 1,500 arc lamps. As an evidence of the favor with which the system is held in Maryland's greatest city it is interesting to note that the company furnishes the illumination for the Johns Hopkins Hospital in Baltimore.

IN THE EAST.—Our Eastern letter this week is full of live and interesting news. Things about Lynn are particularly active, and electricity at the great factory in that town is being developed in every line. Taking the East as a whole, it looks as though they were as much interested in electricity as any other section of the country. There is one commendable quality among the people in the East, that should be noted here. They are going into electricity by themselves, and finding out all about it themselves, not waiting to profit by the experience of others. The result of this is they are pretty well to the front in experience. In Lynn, electricity pervades everything and everybody. We hear of brass bands, base ball clubs, and all sorts of organizations with the word "electric" attached to their distinctive names. Truly, electricity is life in the East.

SHOCKED WITH A 500 VOLT CURRENT.—Another man has received a 500 volt shock and lives to tell the story. An inspector of motors of the Thompson-Houston Electric Company, received a shock from a 500 volt current, in Beverly, Mass., recently, and, according to our information, was paralyzed for half an hour. He then was able to return to his home. It has been abundantly proved that a 500 volt current is not necessarily fatal to human life. It is, of course, a decidedly unpleasant thing to take, but if it is taken accidentally it is safe to assume that the unfortunate person will not receive any lasting injury.

ELECTRIC LIGHT IN MASONRY.—Our Masonic friends will pause in admiration when they come to page 5, of this paper. That page contains an illustration that bristles with Masonic emblems, and the effect of this arrangement of the electric lights must have been very effective indeed. It was a happy idea of the Masonic brethren of Baltimore to utilize the electric light for the purpose of making their fair attractive, and, according to all reports, their object—*i. e.*, pleasure—and profit, was fully realized.

ELECTRICIANS AT BANQUET.—Members of the Boston Electric Club met at the festive board one night last week and had a good time. Prof. Elihu Thomson was there, and did his part in making the evening pleasant and profitable. Our report does not state to what extent New England's favorite dish—pork and beans—was indulged in at the feast, but whether that classic dish was included in the menu or not, all hands evidently had a good time.

EXPONENT OF ELECTRICITY IN CONGRESS.—Mr. Allan C. Durborow, Jr., business manager of our Western contemporary, the *Western Electrician*, has been elected to Congress from the third Illinois district. Mr. Durborow is a very popular gentleman in and outside of electrical journalism, and the electrical interests of this country have cause for congratulation in having so worthy an exponent of their cause at the national capital.

LECTURE.—On Friday evening, Nov. 21st, Dr. Schuyler S. Wheeler will lecture before the Brooklyn Institute, on "Some Application of Electricity." The lecture will be illustrated by experimental demonstrations. The meeting will be held in the lecture room of the Y. M. C. A. building, Fulton street, Brooklyn.

MR. EDISON A VERY BUSY MAN.—A notice posted in the waiting room of the Edison Laboratory reads: "Mr Edison is, in justice to his work, compelled to deny absolutely all personal interviews except when appointment has been previously arranged by letter." Mr. A. O. Tate conducts all business matters.

ANTIQUITY OF THE MAGNET.—Although the names of the discoverers of most of the important inventions and the locality where they were discovered is known, yet no doubt all the world would be very glad to do honor to the discoverer of the magnet and the inventor of the magnetic needle or mariner's compass. But the history of these is unknown. It is said that in the record of the Chinese, some 2,600 years before Christ, that they knew and made use of the magnet (the natural magnet or loadstone), and the fact is noted in their histories that their armies were led across the large plains in the interior by a combination of loadstones which is represented by the figure of a man. They carried him along in a wagon and his extended arm always pointed toward the South, which is opposite to the direction in which we consider the needle as pointing—toward the North. It is also known to have been in use in a similar manner in Japan. The Greeks and Romans knew of the attractive power of the loadstone or the natural magnet, but were entirely ignorant of its polarity.

SUBMARINE TELEPHONY.

We are in receipt of the following communication from Mr. T. D. Lockwood, the Electrician of the American Bell Telephone Co., which gives some interesting facts concerning submarine telephony:

BOSTON, MASS., NOV. 13, 1890.

Editor of the ELECTRIC AGE:

I observe, on page 5 of your issue of Nov. 8, 1890, a notice, evidently editorial, entitled "Submarine Telephony," which intimates that somebody has said or written that "submarine telephony may be classed as one of the accomplishments which theory said was impossible." The remarks in question are stated to be german to the abstract on page 7 of Mr. Preece's British Association paper entitled "Cable for Long-Distance Submarine Telephony."

Since your comment seems rather far-reaching in its conclusions and is, I fear, rather misleading, you will, I hope, excuse me for saying a word or two thereon.

I do not think that any one whose opinion on the subject is of value, has ever said or thought that submarine telephony, broadly stated, was impossible.

The question from the beginning of telephony has always been understood to be mainly one of electrostatic capacity; and thus practically a question of the length of the submarine cable.

The fact that conversation can be transmitted through 25 or 30 miles of sea cable is not new, and need not be considered astonishing.

As early as 1878 and 1879 a good deal of cable telephony was performed.

Articulate speech only a little indistinct was transmitted between Guernsey and Dartmouth, a distance of sixty miles, *vide*.

The "Telephone," Du Moncel, Trans., London, 1879, page 250, and "The Bell Telephone," Prescott, page 81. Also over the cable between Dublin and Holyhead a distance of 67 miles. Du Moncel, page 251.

Prescott's work, pages 87 and 88 gives a graphic account of the transmission of speech between Dover and Calais.

All of these instances are notable, when it is remembered that there was no other transmitter than the regular Bell magnet telephone at the disposal of the experimenters.

The interest of the new Anglo-French cable transmission lies, I apprehend, not so much in the cable as in the fact that a pretty long land line is in circuit at both ends of the cable,

While the construction and operation of such a line is not a problem of tremendous magnitude, that of telephonic transmission through a *long* submarine cable (say the Atlantic cable) is quite another matter. I do not object to joining the prophets myself when such a cable is being considered.

We must not undervalue theory; theory is not the less theory because it can be made the basis of practice; it is then an embodied or realized theory, and that is all.

Were it not for theory we should not have had instruments to-day to work our Atlantic cables telegraphically. The conditions stated by theory were not too onerous to be met by practice. Practice being made acquainted by theory with the conditions, went to work to construct instruments adapted for such conditions, and met them.

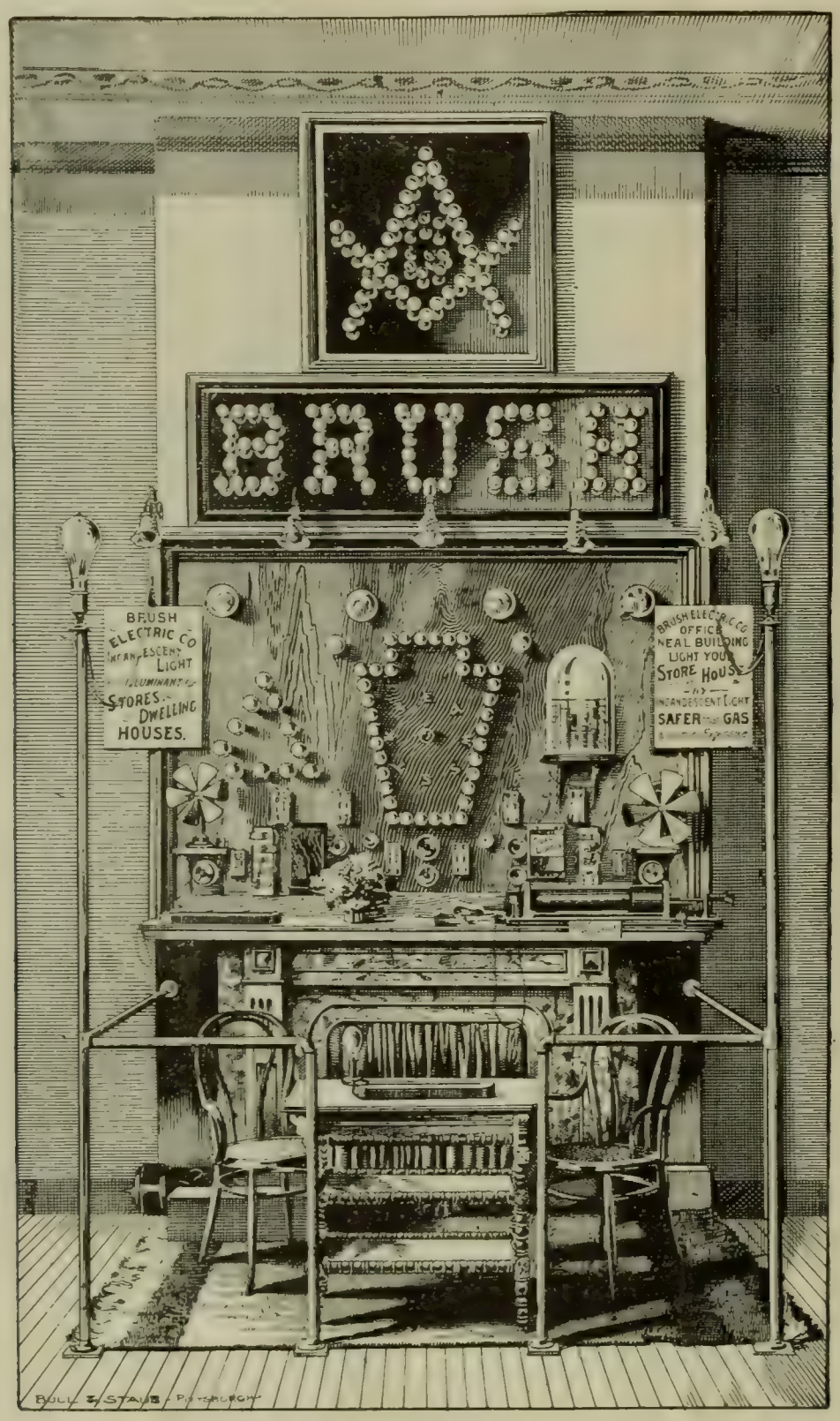
Yours truly, THOS. D. LOCKWOOD.

ELECTRICAL SOCIETY.—The programme of the Buffalo Electrical Society for the coming season is an extremely interesting one. A very large field will be covered by the various papers booked to be read, and the authors of these papers are prominent in the electrical field. Each of these gentlemen will undoubtedly have something of value and interest to tell the members of this thriving society.

AN INTERESTING BRUSH EXHIBIT.

The management of the Brush Electric Company, of Baltimore, has just completed a very beautiful electrical exhibit in that city, which attracted a good deal of attention. The display was on exhibition at the Masonic Temple, the occasion being a "Bazaar," which had been gotten up by the Masonic fraternity of Baltimore for the purpose of obtaining funds to pay the expenses of a new temple.

The hall in the temple was beautifully decorated for the occasion, and a number of were burned in the hall, the exhibit consisted of a stage regulator, the Shallenberger Alternating Current Meter, the electric cigar lighter, which attracted especial attention; on the table in the front, two coils, representing the converters, and showing that the system is perfectly safe and harmless. The two lamps on the top of the rails, as noticed in the cut, are of 250 candle power. The exhibit also contained several batteries and an induction coil, from which the attendant gave some of the guests electric shocks, to the delight of the onlookers. Some lettering and a few of the Masonic emblems were repre-



BRUSH EXHIBIT IN BALTIMORE.

booths were put up in the place, where ample opportunity was afforded all the friends of the Masons to spend their money freely in the interest of the order. However, it very soon developed that the electrical display of the Brush Company was the principal attraction in the hall, for a similar display had never been made in the city. Since the exhibit had been put up at the solicitation of the Masons the management of the Brush company deserves especial credit.

The exhibit contained all the principal features of the Westinghouse Alternating Current system, because it is this system which the Baltimore company operates. Besides the seventeen arc lights and about 200 incandescent lamps, which sented by numerous incandescent lamps of vari-colored globes. It is stated that during the first four weeks of the electrical display, over 50,000 people witnessed it.

Since the reorganization of the Brush Company of Baltimore the management has made a good many improvements and even now many are contemplated. In fact it is the object to make the Baltimore plant the largest Alternating Current Central Station for electric lighting in the country.

The power house has already a boiler capacity of 2,800 horse-power. The company has now 16 engines ranging from 75 to 300 horse-power and the foundations for two additional Westinghouse Compound engines of 250-horse power are awaiting the machines. As the company is controlled by the Westinghouse Electric and Manufacturing Company the apparatus of that firm is mostly used, and in order to satisfy the great demand which has of late been made upon the capacity of the plant a number of new alternating current apparatus will be installed shortly.

Among them are two 250-light Westinghouse Alternating Current Arc Machines, and two No. Alternating Current incandescent dynamos.

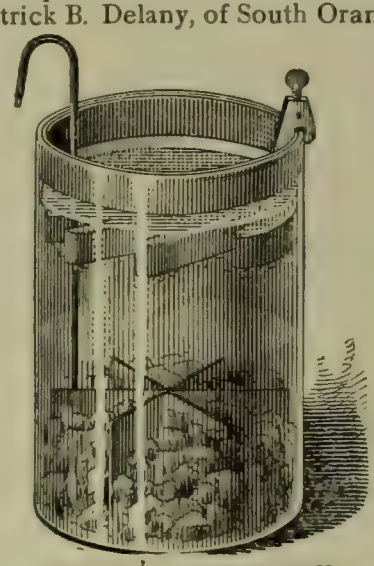
When these are placed in the station the company will have a capacity of 20,000 incandescent and 1,500 arc lamps.

The Brush company furnishes the illumination for the Johns Hopkins Hospital of Baltimore, lights up the majority of the theatres and also supplies most of the principal buildings in the city with electric lighting.

THE DELANY PATENT BATTERY STRIP.

The creeping of salts in the Gravity, Le Clanche and other types of cells is the one disagreeable feature of these batteries. There are several methods which are supposed to prevent this creeping but they do not work in practice. Paraffine, vaseline, glycerine, etc., are recommended as "sure cures" for this evil. The salts however, do not mind these supposed hindrances but creep over them and over the edge of the jar much to the disgust of the tidy batteryman or housekeeper.

Mr. Patrick B. Delany, of South Orange, N. J.



DELANY'S BATTERY STRIP.

the well-known inventor, has just brought out what he calls a "Battery Strip," of which we give an illustration. It is said to be an absolute and permanent preventive of creeping salts.

The strip is made of rubber cloth. One side is covered with a sticky compound. When properly applied it will never come off the jar. It offers a mechanical obstruction to the creeping salt, which masses underneath the strip and is redissolved in the battery fluid each time the water is added to the solution to make up for evaporation. All waste and exhaustion of batteries by local action is prevented, and shelves are kept perfectly clean and dry.

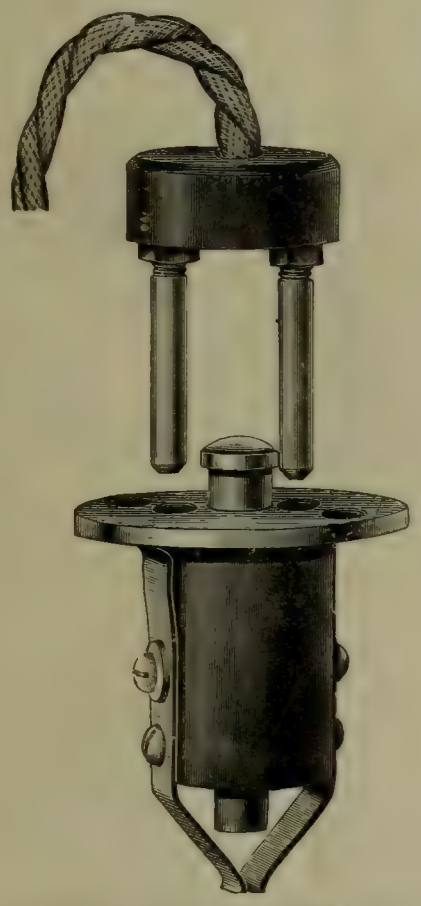
Before putting this strip on the market a thorough test, covering one year, has been made. At the end of that time both Gravity and Le Clanche jars were as clean and dry on the outside as when first set up.

Batteries may now be placed in wardrobe closets, telephones, cabinets or on carpets with perfect safety.

PERSONAL NOTES.—Mr. J. E. Zeublin, assistant general superintendent of the Central United Telephone Company at Columbus, Ohio, has gone to Chicago to relieve Mr. F. G. Beach, general superintendent of the same company. Mr. Beach has been given an indefinite leave of absence to recuperate his health. During the absence of Assistant General Superintendent Zeublin from Columbus, his duties will be performed by M. J. Carney, superintendent, and F. P. Ross, assistant superintendent.

COMBINED FLOOR AND BUTTON PUSH.

The floor push shown in the accompanying illustration has just been brought out by the Manhattan Electrical Supply Company, of 36 Cortlandt street, this city. Indeed, it is more than a floor push. The terminal device shown in connection with the flexible cord may be pushed in the holes in the plates of the floor push, and the call bell can then be rung by pushing the button attached to the other end of the flexible cord. This push button can be placed at



COMBINED FLOOR AND BUTTON PUSH.

any convenient point, on the top of the table for instance, or held in the lap. It is not always convenient to use the floor push, but by the insertion of this extension device the ringing of the call bell can always be made a matter of convenience.

This improvement commends itself for its simplicity and convenience, and ought to find a large and ready market.

THE BUFFALO ELECTRICAL SOCIETY.

The programme of the Buffalo Electrical Society for the season of 1890–91, is just out. It comprises some very interesting subjects, as follows :

Nov. 17—Conception, Development and Future of the Storage Battery. Wm. H. McDonald.

Dec. 1—Electro Therapeutics. Dr. Roswell Park.

Dec. 15—Advance of Electric Traction. Frank Kitton.

Jan. 5—Phenomena of Earth Currents. William Finn.

Jan. 19—The Chemistry of Electrolysis. Wm. H. Dopp.

Feb. 2—Informal Talk on Telegraphic Subjects. A. C. Terry.

Feb. 16—Electricity in the Household. F. P. Jones.

Mar. 2—Effects of Electric Light on the Eye. Dr. Lucien Howe.

Mar. 16—The Telephone. M. Beecher Marvin.

Apr. 2—Present Status of the Transmission of Electrical Energy by Water Power. Madison Buell.

Apr. 16—Arc and Incandescent Electric Lighting. J. P. Chapin.

May 6—On the Efficiency of the Alternating Current Motors. Edward F. Wilson.

May 20—Electrical Measurement. Cuyler C. Smith.

June 3—Observations on the Effects of Static and Dynamic Induction. Astley C. Terry.

This society is a branch of the Society of Natural Sciences, and its meetings are held on the first and third Monday evenings of each month, in the rooms of the Society, Buffalo Library Building. The officers are : President, W. H McDonald ; Vice-President, F. P. Jones ; Secretary, Astley C. Terry ; Treasurer, Samuel Stewart ; Librarian, Wm. C. Lewin.

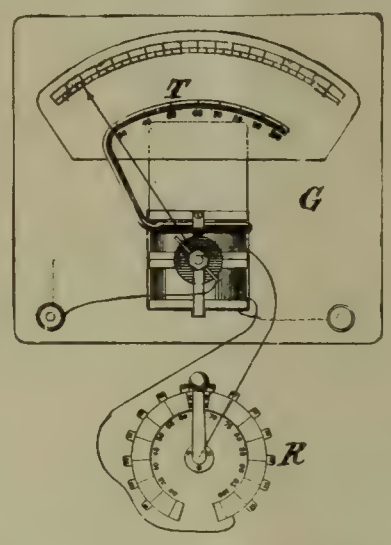
HEAT ERROR IN MEASURING APPARATUS.

As is well known, variation in the temperature of electric circuits renders it difficult to obtain accurate results in electrical measurements. Mr. Edward Weston, of Newark, N. J., has devised an instrument for the purpose of correcting these differences due to the changes of temperature in the wire of the instrument during the passage of a current.

The apparatus consists of the combination of any electrical measuring instrument, G, with a thermometer, T, and a rheostat, R, the latter being in circuit with the coil of the instrument.

With this introduction the operation of the apparatus will be readily understood by reference to the accompanying illustration of the combination device.

The resistance coils or rheostat, R, which are arranged in series are cut in and out with a radial switch arm as shown in the illustration.



WESTON'S METHOD OF CORRECTING THE HEAT ERROR.

By the variation of this resistance it is evident that the temperature, which is indicated by the thermometer, may be maintained steady, so that accurate results may be obtained in measurements. The variation in the temperature in the circuit, due to the heating effect of the electric current, is recorded in the usual way on the thermometer. By watching these variations, the temperature error may be entirely eliminated by a corresponding variation in the resistance. The combination works upon the well-known principle of heat development by electricity. The more resistance there is in the circuit through which the electric current is required to pass the greater will be the consequent heat, and the heat itself increases the electrical resistance. The difficulty in obtaining accurate electrical measurements lies in the fact that the resistance of the circuit is made variable by the heat developed therein. Hence any device for the purpose of correcting this error would be of much value, and that is the object of the apparatus just described.

BOSTON ELECTRIC CLUB.

The first dinner of the season of the Boston Electric Club was held at Young's Hotel, Boston, on the evening of Nov. 10th. Prof. Elihu Thomson was the guest and speaker of the evening. He sat at the president's right at the dining table, while Capt. Eugene Griffin, manager of the street railway department, was at his left. The other special guests of the evening were Mr. C. L. Gates of the Boston Electric Light Company, and Mr. E. Meinze of Lynn.

After the menu had been discussed, Professor Thomson, gave an address on "The Properties of Alternating Currents," illustrating the subject with practical experiments. A colored spread was thrown across the tablecloth and the apparatus for the experiment placed in position upon it.

"We are all of us familiar with the fact," said Prof. Thomson, "that until quite recently the continuous current was considered the only one of any utility. A continuous current is one that flows steadily in one direction, while an alternating current changes its direction according to the speed with which it was driven. In ordinary apparatus the current is made to change its direction 200 or 250 times per second. I have, however, experimented successfully with a current that alternated 8,000 times per second, and, if there were any demand for machinery that required alternations three times as fast as that, I have no doubt that it could be produced."

The speaker went on to say that the principal difference between the continuous and the alternating currents was in the magnetic field which the latter produced. The alternating current had a wonderful inducive power and could excite in other conductors, not in contact with it, currents like its own, only moving in opposite directions.

On a chest before him Professor Thomson placed a copper coil charged with an alternating current that changed from north to south 250 times a second. He slipped over this upright coil a copper ring, which became charged by induction and the ring was thrown off the coil with much force.

A copper disc, composed of a series of copper rings, converted the repulsive force shown by the single ring into a rotary motion, turning one way one side of the coil, and in the opposite the other. In this way two discs were made to turn in opposite directions simultaneously. But the copper plates could only move when held parallel to or inclined toward the current in the coil. Iron discs, however, by virtue of becoming magnetized, could revolve at right angles with the current in the coil.

Profossor Thomson was repeatedly applauded and given a rising vote of thanks. Few of the members had ever seen any of the phenomena exhibited.

FOREIGN NOTES OF INTEREST.

Experiments have been made in electric light signalling from Hindhead to Aldershot, a distance of 12 miles.

The municipal central station, which already supplies 7,500 lights, is about to extend the length of its mains by 2,000 metres, and it will then supply current to 2,000 more lamps.

The Fife Coal Company have arranged for the introduction of the electric light into their pits at Leven, in place of each miner carrying his own lamp. It is proposed to light the roads, the lamps to be 15 yards apart.

The London *Electrician* says : The supply from the Grosvenor Gallery will be discontinued after next week, and the machinery will be removed to Deptford. The pressure on the Deptford mains will probably be raised to 10,000 volts in order to avoid overloading the dynamos with current. The armatures, though designed for 100 amperes, are found to carry 160 without overheating.

The Telegraph Construction and Maintenance Company are about to make and lay for the Eastern Telegraph Company a quadruplicate cable from Suez to Perim and Aden.

ELECTROMOTIVE FORCE OF DYNAMOS.

Experiment shows that the greater the current flowing through the armature of a dynamo the smaller is the electromotive force. The reduction is greater than that which corresponds to the product of resistance and current, and thus we are forced to the conclusion that, apart from the passive electrical resistance of the wire, there is some other element tending to lower the electromotive force.

The reason is not far to seek. When a dynamo is at work each coil in the armature is alternately traversed by currents in one and the other direction, the change taking place each time the coil passes under one or the other brush. When a coil passes under one of the brushes it is for the time being short circuited in itself, and since a moment before it was traversed by half the total current, its self-induction will cause a gradually diminishing current to flow in after it has been short circuited by the brush. By the time the coil emerges on the other side of the brush that current may not yet have died out, and will cause a spark, especially since at that moment half the total current is forced through it in an opposite direction.

To avoid the spark we are forced to shift the brushes forward a certain distance beyond the neutral diameter, and it is well known to all who have to do with dynamos that the advance must be the greater the greater the current. The immediate result of shifting the brushes forward is to bring the coil in its short circuited state into a part of the field where there are lines already tending to produce an opposite current. In consequence of this the current circulating by self-induction will not only be extinguished the sooner, but the opposite current will be started, and if the brushes are properly placed it will have grown to half the strength of the total armature current by the time the coil emerges from under the brush. In that case there will be absolutely no spark, but those lines which were instrumental in toning down the violence of the change in the direction of the current are lost for the production of electro-motive force, and it is easy to see that this loss must be felt the more the greater the current.

The next result of the shifting of the brushes is to bring the poles induced by the armature current, in the core of the latter, somewhat nearer to the field magnet poles of the same sign, thus pushing the magnet forward and distorting the field, and thus the electromotive force is again reduced. In good dynamos the total reduction of electromotive force due to these two causes should not be more than about five per cent., but in badly designed machines, especially in those with weak field magnets, the reduction is often considerable.

UNDERGROUND ELECTRIC CABLES IN CHICAGO.*

The cables laid underground in the city of Chicago are placed in conduits of various kinds, viz., iron pipe laid in the earth without other protection; iron pipe laid in concrete; iron pipe, cement lined, laid in concrete and multitubular blocks of bituminous concrete about four feet long.

Manholes in many cases are built circular in form, and in other cases rectangular shaped, the latter averaging 46 inches in lengtn by 40 inches in width, and are from four and one-half to nine feet deep, with double iron covers, one of which is set below the grade and made water tight by packing, the other set on a level with the street.

The iron pipe used for conduit is thoroughly reamed at the ends, thus removing the burr. Conduit is laid with a pitch of difference of grade from six inches to one foot, so as to draw into the manholes, thus disposing of all drip from condensed moisture.

The usual specifications for underground conductors for the purpose of arc lighting may, perhaps, not be out of place, and I give them herewith:

The insulation resistance should not be less than 500 megohms per mile, and the insulation should not materially deteriorate for the space of two years after being in service on an electric light circuit having a voltage of from 2,500 to 3,000 volts, and a current of from 9 to 12 amperes, or a voltage of from 900 to 1,200 volts and a current of from 18 to 20 amperes.

* Abstract from paper read before Chicago Electric Club by F. E. Degenhardt.

ELECTRIC POWER IN MINING.—As a special class of distribution, no more extended or promising field can be found for the profitable and economical transmission of power by electricity, nor in none is there a greater necessity than that represented by the various mining industries. Water power, fuel, transportation facilities and rich mining locations do not ordinarily fall together. Oftentimes water is not available at all, the use of steam power is unprofitable, and the cost of transportation is prohibitory. Even when water power is in close proximity to mining locations, intervening mountains or other obstacles are often in the way, and expensive canals, tunneling, or insurmountable grades prevent its transmission. The lack of a practical and economical method for a long distance transmission of power, insuring efficiency and reliability, that is, commercial success, has led to the abandonment of many mines of great promise and the temporary suspension of work on properties of great intrinsic value. It may be safely said that mining properties to the value of $100,000,000 now lie idle chiefly from these causes, a large proportion of which could be profitably worked by power electrically transmitted from steam or water sources.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

At a meeting of the Executive Committee held at the Electric Club, New York City, Nov. 7, the following business was transacted:

1. The date for holding the Thirteenth Convention was fixed for February 17, 18, and 19, 1891.

2. Eugene F. Phillips, of Providence, was appointed chairman of a Committee of Five, on Reception and Arrangements, he to appoint the other members of the committee.

3. Gen. C. H. Barney, of New York, was appointed Chairman of a Committee of Three on Electrical Exhibits and Transportation, he to appoint the other members of the committee.

4. The Committee on Papers reported the following as promised, and stated that the prospects of securing two or three more important papers are most excellent. Announcements of these will be made later. The committee has not only secured the promise of these papers, but has gone a step further, and named a person to open the discusssion on each paper. This must inevitably tend to bring out the best points of the topic, and to greatly add to the interest in and value of the proceedings.

LIST OF PAPERS.

(*a.*) How can the National Light Association best serve the Central Station Interests? By C. R. Huntley. Discussion by A. M. Young.

(*b.*) Distribution of Steam from a Central Station. By F. H. Prentiss. Discussion by Geo. H. Babcock.

(*c.*) Distribution and Care of Alternating Currents. By T. Carpenter Smith. Discussion by G. H. Blaxter.

(*d.*) The Ferranti System. By C. B. Haskins. Discussion by C. L. Edgar.

5. The resignation of Mr. James English, as a member of the Executive Committee, was accepted, and Mr. Edward A. Leslie, Manager of the Manhattan Electric Light Company of New York City, was elected to fill the vacancy.

INSTALLATION RULES.*

The following is a brief summary of the rules usually given for the regulation of an electric light installation.

1. The dynamo should have a dry location; should not be exposed to dust or flyings; should be kept clean and well oiled, and its internal insulation should be practically perfect.

2. All conductors in the dynamo room should be properly supported, insulated, numbered, and conveniently arranged for inspection.

3. The construction of switches or commutators for opening or closing circuits, should be such that when moved or left there shall be no liability of heating or the formation of an arc.

4. The gauge of the wire on every part of the circuit should be proportioned to the current, and all junctions between conductors of different size would be fitted with fuses, so that the temperature of a conductor at any point cannot exceed 150° F.

5. All joints should be soldered and made mechanically and electrically perfect.

6. Complete metallic circuits should be used, and all connection with gas or water pipes as conductors avoided.

7. Bare wires, passing over buildings, should be at least seven feet from every part of the building; and those crossing thoroughfares should be high enough to allow free passage for all vehicles and fire apparatus.

8. Underground wires should be thoroughly insulated, easily accessible, and their position clearly indicated.

9. The insulation of indoor wires should receive special care, so as to protect the building and its occupants against dangerous currents, and to prevent electric waste, particularly where the wires pass through walls or floors, or in close proximity to metallic masses, and they should be incased in hard insulating material where the ordinary wrapping is liable to abrasion or the depredation of rats and mice; and, when placed beneath floors, they should be protected against mechanical injury and their position clearly indicated. Covered wires should have the preference for indoor work. Frequent electrical testing is exceedingly important, as the only safeguard against waste of current or injury to the conductors or insulation, since the ordinary indications of leakage by smell or otherwise, as in the case of gas or water, are absent.

10. All bare outdoor wire should be thoroughly insulated at its supports, and incased in insulating material for at least two feet on each side.

11. Arc lamps should be provided with globes as a protection against flying sparks from the carbons; and all parts which require handling should be insulated from the circuit.

* Atkinson's "Electric Lighting."

ELECTRIC RAILWAY STATISTICS.

New railroads put into operation by the Short Electric Railway Company, Cleveland, O., during the month of October, 1890:

Johnstown Passenger Railway Co., Johnstown, Pa., 10 miles, 20 motor cars; S. Covington and Cincinnati Street Railway Co., Cincinnati, O., miles, 20 motor cars.

Total number of lines in operation, Nov. 1st, Short system, 11; mileage, 1,123; number of motor cars, 193.

Number of former horse lines changed to Short Company's system, 8; mileage, 1,085.

TRANSMISSION OF POWER.—There are five prominent systems of long distance power transmission, some of them not very long; they are the hydraulic, pneumatic, steam, wire rope, and electric systems, and when the distance runs over a mile the general advantages of the electric system are most marked.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part XIV.—Converters (continued.)

248—How is a converter connected with the system?

One of the main wires leading from one brush of the dynamo is connected with one terminal of the primary coil and the wire leading from the other brush is connected with the other terminal of the primary coil. (See fig. 2.)

249—Then, are the converters placed in the lighting stations near the dynamos?

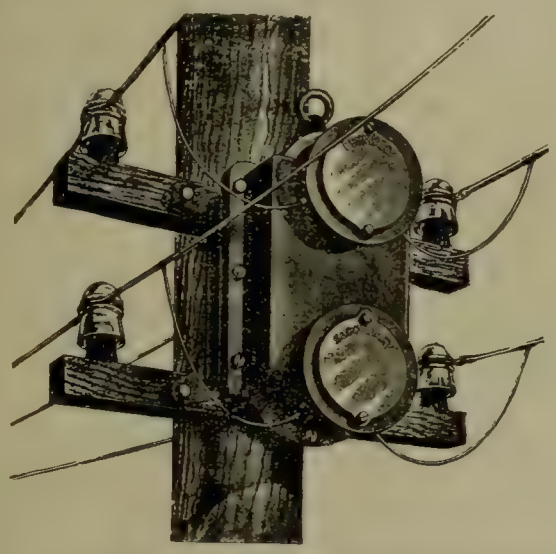


FIG. 1.—METHOD OF CONNECTING CONVERTER TO POLE.

No; they are placed in some convenient place near to where the lights are to be used.

250—Are converters placed outside or inside of buildings?

On the outside usually, sometimes on poles.

251—Why are the converters placed on the outside of buildings?

For safety. They are placed on the outside for the purpose of transforming or converting the high pressure main current (which may be of sufficient strength to be dangerous to human life in case of accidental contact with the main wires) into current of low pressure *before* entering the building; thus the dangerous currents are not admitted into the building. They are first rendered harmless, then carried into the building.

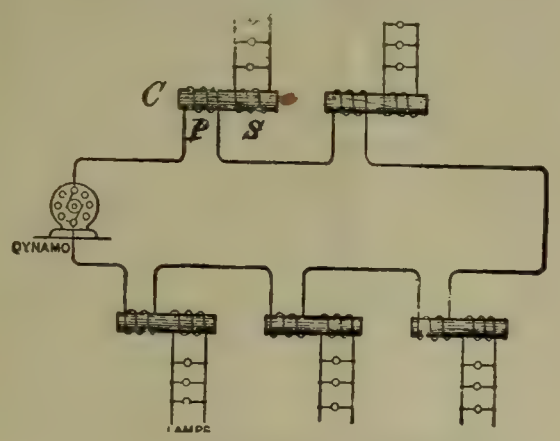


FIG. 2.—THEORETICAL CONNECTIONS.

251—After the primary coil of a converter has been connected with the dynamo through the main wires, what takes place?

The alternating currents generated in the dynamo pass over the main line through the primary coil of the converter. These alternating currents induce currents in the secondary coil, to which is connected the lamp circuit. Fig. 2 shows theoretically the relations of the various parts of an alternating current system C represents converters. P represents the primary coil in each and S the secondary coil. It must be remembered that this illustration does not show the actual form of the converters, but is merely to show, in as clear manner as possible, the relation of the various parts of the general system.

252—What is the name of the circuits in which the lamps are placed?

The secondary or lamp circuit.

253—Is the secondary circuit in electrical connection with the primary?

No; there is no connection whatever between the two coils, except that the insulation of adjacent wires touches. The action of the converter depends wholly on induction.

254—What class of lamps is used on secondary circuits?

Incandescent lamps.

255—Are arc lamps used on alternating current circuits?

Yes.

256—How are they connected?

They are connected directly in the main circuit, in series or multiple.

257—Are converters used in connection with arc lamps?

No; only for incandescent lamps.

258—Do converters have cores?

Yes.

259—Are converter cores made and disposed as the cores in induction coils are?

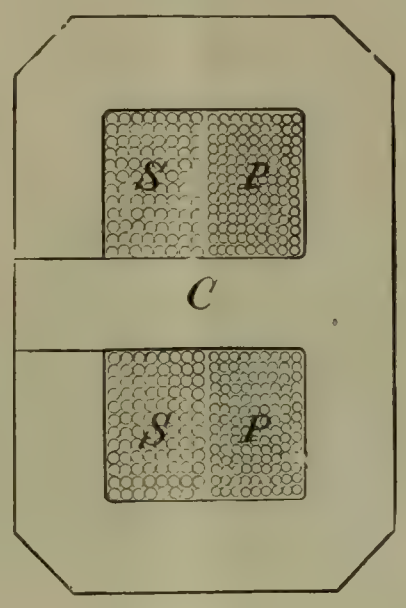


FIG. 3.—CROSS SECTION OF WESTINGHOUSE CONVERTER.

No; cores of converters usually surround the primary and secondary coils. In the induction coil the primary coil surrounds the core.

260—Are the two coils of a converter wound one on the other?

No; they are wound separately and placed together within the core, or envelope, side by side. Fig. 3 is a cross section of a Westinghouse converter. P represents the wire of the primary coil and S that of the secondary. It will be noticed that the wire in the primary is smaller in diameter than that in the secondary. C represents the core or envelope.

261—Of what material is the core of converters made?

Soft iron.

262—Why is soft iron used for converter cores?

To concentrate the magnetic lines of force.

263—Why is it necessary to concentrate the magnetic lines of force?

In order to get the greatest inductive effect in the secondary circuit.

264—If the lines of force were not concentrated, what would be the result?

Many of them would be widely scattered throughout the space surrounding the coils and little effect would be derived from them. They would represent waste energy.

(To be continued.)

* Copyrighted.

COMMUTATED FIELD COILS.—The railway motor of the Edison General Electric Company is the only one having commutated field coils, and has an efficiency of over 90 per cent.

BRIDGE TESTING SET.

The demand for accurate electrical measuring instruments has led to the production of some very fine pieces of apparatus. We describe and illustrate herewith a Wheatstone Bridge Testing Set combined with Battery, made by the E. S. Greeley & Co. of this city. This set has some features that are worth special mention. The instruments are made with great care and are finished in the very best manner. As to their accuracy, they are very carefully calibrated before leaving the laboratory. This testing set is known as Type "Y 2," and is a very complete and portable form of apparatus for measuring resistances. It consists of a sensitive galvanometer, a set of rheostat coils, forty in number, six bridge coils, a double successive contact key, and a chloride of silver dry battery of five cells. The case in which this apparatus is placed is made of mahogany, finely polished and lined with velvet. It is trimmed, in a very substantial manner, with brass, and is provided with lock and key, and a handle to facilitate carrying about.

The resistance coils are arranged in four rows



BRIDGE TESTING SET.

of ten coils each, the rows being designated "Units," "Tens," "Hundreds" and "Thousands." On each arm of the bridge there are three coils of 10, 100 and 1,000 ohms resistance. The extreme range of measurement by the use of these coils is from 1 100th to 1,111,000 ohms. The arrangement of these coils is such that only six plugs are necessary in this set—one in each arm of the bridge and one in each row of coils. This greatly facilitates the reading. For example: if with A = 100 and B = 10, to obtain a balance it is necessary to plug 5 in the "Thousands," 6 in the "Hundreds," 7 in the "Tens," and 2 in the "Units" row, the resistance measured is equal to 567.2. ohms.

The galvanometer is so arranged in the case that it can be revolved in either direction so that the needle will cover the zero point. This avoids the necessity of turning the case. A needle lifter is provided so that the needle may be raised from the centre pin, when not in use, to prevent injury to the delicate adjustment.

The whole outfit weighs but 12½ pounds, and the dimensions of the case are 9⅞ x 9⅞ x 5¾ inches.

INFLUENCE OF ELECTRIC PRESSURE ON INSULATION.*

With the increase in number and size of electric installations the question of insulation has assumed greater importance. It has already been pointed out by Uppenhorn that the insulation resistance is not independent of the pressure, but diminishes as the latter increases. The quantitative results that follow will, however, be of interest, especially as the tendency of late years has been towards a continual increase of the pressure in main conductors, and this interest will be increased owing to the bearing which the tests have on the question as to the durability of the insulation; for since the resistance falls with an increase of pressure, it seems likely that high volts cause a change in the nature of the insulating substance.

It is also to be remembered that these tests have a bearing on telegraph cables in which a high pressure is frequently employed.

Experiments were undertaken with lead-covered and with gutta-percha cables, and tests were also made with the field winding of a dynamo, and ordinary electric light wire attached to a wall, a bell wire and an aerial wire suspended on porcelain insulators. As will be seen, the the question as to whether the influence varies with the temperature was only investigated in one case, that of the dynamo winding. All the other tests were made at the ordinary temperature of the room.

After I had commenced these investigations, Forderreuther published his observations on "Insulation Measurements of Electric Light Conductors." I, however, continued the work which I had begun, the limit of pressure employed by him having been only 89 volts.

Material Tested.—For my tests on cables I had available two bare lead cables 1,000m. long, by different makers, and a gutta-percha cable 800m long. The dimensions of the lead cables were:

No. I.—Diameter of core, 1.4mm.; diameter of insulating sheath, 5.3mm.

No. II.—Diameter of core 1.1mm.: diameter of insulating sheath, 3.4mm.

Their capacities, as obtained by Thompson's compensation method, were:

No. I.—0.137 microfarad at 15.5° Cent.

No. II.—c.135 " 15.7° "

As will be seen from the dimensions, the insulations in two specimens were totally different. No II was in two pieces of 826mm. and 174mm. in length respectively. For such measurements as were taken it is clear that these cables were amply large enough. Also the absolute value of the insulation resistance agrees in all cases so long as the proportion between the diameter of the copper core and the insulating sheath remain constant. The gutta-percha covered cable had a core of seven wires of .7mm. diameter covered with two layers of gutta percha to the diameter of 5mm. This cable corresponds with the underground cables laid by the German Telegraph Department. The gutta percha was pure and the insulation free from faults. The capacity of the cable was .190 microfarads at 14 5° C.

Measurement.—The measurements were taken with a Thomson's astatic mirror galvanometer. Four shunts were used and a vulcanite commutator, also a rheostat of 100 000 ohms resistance. The galvanometer and shunts, etc., were carefully insulated from earth by means of vulcanite pedestals, and for every observation the leakage current was measured and allowed for. The sensibility of the galvanometer was adjusted by cutting out some of the electro-magnets, when it was made by a maximum 100 volts, though a resistance of 500,000 megohms gave a displacement of 1mm. on a scale 2 meters distant. The battery consisted of 330 small copper elements, to which could be added sixty accumulator cells, so that 460 to 470 cells were available. The Daniell cells were filled with a five per cent. solution of zinc sulphate, and in each about 15 grammes of copper sulphate were placed. It was found to remain very constant for three months, the volts in that period falling only from 1.06v. to 1.02v. per cell. The connections were so arranged that the primary cells could readily be switched in or out ten at a time, and the secondary cells in two equal halves.

Tests.—The observations could apparently be most simply carried out by taking a series of measurements of the insulation resistance either with increasing or decreasing pressures. Two points, however, have to be considered. On the one hand, any change of temperature, even if very slight, might utterly upset the results, owing to the high temperature coefficient of the insulation. Consequently, changes of temperature, are to be guarded against, and the observations ought therefore to be taken as rapidly after one another as possible. On the other hand, this condition can only be partly complied with, as if a certain time is not allowed to elapse, a residual charge is left in the cable depending in magnitude on the volts and duration of the previous charge, and which may practically operate either to increase or to decrease the apparent voltage.

To keep the temperature constant, the following precautions were taken: The gutta-percha cable was placed in a wooden barrel containing about 70 litres of water. This was enclosed in a wooden casing filled with sawdust, which formed a cover nowhere less than 8 or 10 cm. thick. The two cable ends, about 1 metre long, passed through an opening in the top closed with a cork, and a thermometer was placed in a gas tube lined with cork and passed through the sawdust, the lower end of the thermometer projecting into the centre of the coil of cable.

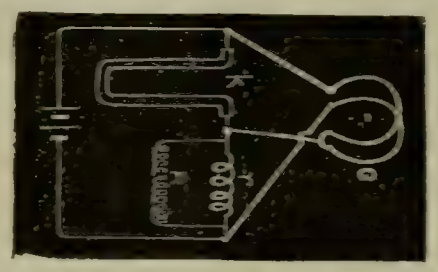


FIG. I.—CONNECTIONS FOR INSULATION TEST.

For the 2-lead cable, corks of sufficient size were not at hand. In their case the temperature was kept constant by wrapping them in a covering of straw 10cm. thick, which was enclosed in a layer of pasteboard. The cables were placed in a room where very little change in the temperature took place, the greatest variation during 24 hours not exceeding 1deg. For several weeks the temperature remained between 17deg. and 19deg. The ends of the cables were brought into the testing-room through a hole in the wall. During the course of a series of tests, lasting perhaps four or five hours, the thermometer belonging to the gutta-percha cable usually showed no change whatever, whilst that of the thinner of the lead cables was constant within .1deg. All the cable ends were provided with Frölich's insulating caps, 9cm. long. One end of each cable was brought to the measuring table, being connected to the instrument by a short length of wire passing through air.

A very exact check on the alterations of temperature in the cables may be obtained from the measurement of the alteration of the resistance of the copper core. This can be done as follows:—The cable K and a plug rheostat *r* of German silver wire are connected in series and coupled with a battery (Fig. 1). The cable K and the rheostat *r* are each put in shunt with one circuit of a differential galvanometer G (in my tests one of Wiedeman's was used). A current of about one-tenth ampere is allowed to flow through K and *r*. The resistance of *r* is made equal to that of K within one-tenth of an ohm. The resistance or this part of the circuit can then be made exactly equal to that of K by putting a high resistance R in parallel with *r*. From the readings taken we get the temperature of *r*, and thence that of K. The temperature coefficient of German silver being ten times lower than that of copper, an error of .1deg. in the determination of the temperature of the rheostat only produces one of .01deg. in that of the cable.

A large number of measurements of the insulation at various pressures have to be taken. At the end of any series of tests, and usually also after the measurement at an intermediate pressure, the insulation resistance is again measured at the low original pressure. From the difference between these two values a very slight alteration in temperature is easily detected, the method being very much more delicate than that of measuring the resistance of the copper core as above explained. This slight alteration having been determined, the correction it necessitates can easily be applied. The exact procedure is as follows:—The interval for discharge has to be suited to the pressure; thus, if the latter is 50 volts, the cable has both ends connected to earth for 45 minutes; if 460 volts, for two hours; 200 volts, for 1¼ hours; and so on. Consequently time of the measurement with high volts is nearer to the former than to the latter of those at lower tension; and this has to be taken into account in deducing the value of the insulation resistance at the low tension for comparison with that at the high tension. If more than two different pressures were tested, all readings were in the same way reduced to the time of one, usually the intermediate pressure.

In order to make the residual charge as small as possible, the time of connection to the battery must be short. I therefore took readings one and two minutes after closing the circuit. I did not consider that the former would be sufficient taken by itself, partly because it gave no control or safeguard against error, and partly because the length of time occupied by the swinging of the galvanometer mirror, together with the rapid change in the current passing, made it more difficult to take the reading after one minute than it was after two. It should be observed that the short-circuiting key of the galvanometer was not taken out until 10 seconds after the cable had been coupled to the battery.

In spite of the long time allowed for discharging the cables they showed signs of residual charge, especially after high volts had been used. Immediately before a fresh reading was taken, the cable was connected to earth through the galvanometer and the slight displacement was observed. If this exceeded ⅓ per cent. of that afterwards obtained. I added it to the latter, and calculated the insulation resistance from the sum. That this method was pretty correct is proved by the following:—In tests during which neither the thermometer nor the copper resistance showed any change of temperature, the insulation resistance at the low pressure at the end of the series of tests was found without the above correction, always to be lower than that found at the beginning; whereas if the correction was employed the two values agreed. Moreover, this process seems to be justified by the consideration that the residual charge, supposing that the same pole is used, acts as an opposing electromotive force, and that such residual charges, as Frölich observed, and I myself found, remain for a very long time in cables, and cannot be obliterated even by a short charge from the opposite pole.

For any series of tests on one cable the sensibility of the galvanometer was adjusted one hour before starting, and every correction for resistance in connecting wires, &c., was duly made.

In case of electric light cables and others carrying a current for a considerable length of time, the value of the insulation resistance after one or two minutes is not so important as that reached after a longer time. Frölich has concluded that in the case of a gutta-percha cable it approaches a constant value. I have made ex-

*C. Heim, in the *Elektrotechnische Zeitschrift*.

periments to ascertain if Frölich's results hold good for various temperatures, the cable for that purpose being connected to the battery for a quarter of an hour.

The experiments prove that a fall in the insulation resistance does undoubtedly take place as the pressure increases in the cases of the cables that I tested, but that within the limits of pressure I employed the variation is small. It is also clear that this rate of diminution varies for different dielectrics.

It is also interesting to note the influence of the time during which the circuit has been closed on the insulation resistance. The influence is far more noticeable in the 2-lead cables than in the gutta-percha cable.

Representing the value of the insulation resistance after one minute by unity, as is done by Frölich, the results for the gutta-percha cable are as follows:

Observer	Pressure Volts	1	2	3	5	10	15 min.
Frölich,	?	1.00	1.11	1.15	1.24	1.33	1.37
Heim,	53	1.00	1.13	1 20	1.27	1.35	1.40
	213	1.00	1.14	1.21	1.30	1.38	1.46
	270	1.00	1.13	1.19	1.28	1.36	1.42

My observations were taken at 16.5 deg. Frölich gives results for 16 deg. and 18 deg., from which those given above, under his name, are calculated. The slight difference is probably due to the nature of the gutta-percha.

For the two cables I got

	Pressure	1	2	3	5	10	15 m.
Lead Cable No 1.	21	1.00	1.25	1.54	1.96	2.83	3.59
	213	1.00	1.25	1.49	1.96	2.88	3.64
	470	1.00	1.25	1.47	1.92	2.80	3 52
Lead Cable No. 2	53	1.00	1.37	1.66	2.02	2.74	3.24
	213	1.00	1 42	1.72	2.16	2.82	3.26

It is therefore clear that for conductors supplying current continuously the insulation resistance should be measured not only one and two minutes after closing the circuit, but also say after the expiration of half an hour.

THE WORKING OF AN ELECTROLYTIC COPPER REFINERY.*

BY DR. G. GORE, F. R. S.

The entire economy of working depends essentially upon cheapness of motive power and minimum investment of capital, and nearly every attempt to improve the process, in the direction of such economy, involves a choice between two evils. For instance, if we try to save horse power by enlarging the electrodes and adding to the number and size of vats in series, we rapidly increase the loss of interest upon capital expended in stock of copper, solution, plant, working space, etc. If we increase the density of current with the intention of working more rapidly with the same stock of copper, solution, etc, we increase the loss of energy by causing polarization, and run a risk of depositing impure copper. And if we attempt to diminish the resistance by placing the electrodes nearer together, or by quickly stirring the solution, we get dirt upon the cathodes, or short circuiting occurs; and if we endeavor to decrease it by considerably heating the liquid, we rapidly increase the chemical corrosion of the deposited metal, and quickly alter the chemical composition of the liquid; or if we diminish resistance by large additions of acid, we promote chemical corrosion, polarization, and separation of gases.

Difference of potential required is a large element in economical deposition of copper. Whilst the same number of amperes of current passing through the ordinary solution deposits the same amount of copper in all cases, the necessary degree of difference of potential to overcome resistance, etc., varies in different cases; and the greater this difference the larger the cost; double the potential requires double the motive power. It is desirable, therefore, to lower the difference of potential as much as possible by diminishing the resistance throughout the circuit, and by avoiding all polarization and counter-electromotive force.

The degree of electromotive force required varies with every different kind of solution, and consequently of anode. It varies according as the anode is composed of pure copper, "black copper," or "copper matte," and whether the anode is clean, or covered with an adhesive badly conducting coating; it is also much greater when gas is evolved at either electrode.

Influence of Impure Anode upon the Liquid.—I will only speak of some of those substances which are more or less likely to be present in "black copper," "pimple copper," "Chili bars," "blister copper," containing from 89 to 98 per cent. of copper, and in cruder regulus of reduced pyrites of iron and copper. Those impurities include antimony, arsenic, bismuth, cadmium, carbon, cobalt, gold, iron, lead, manganese, platinum, silver, tin, zinc, suboxide of copper, sulphides of iron, copper and silver in the particles of unreduced pyrites of those metals, alumina, lime, magnesia, silica, and alkalies in the enclosed portions of slag. Black copper has been found to contain "1.23 per cent. of arsenic, 1.0 of iron, .54 of sulphur, .4 silver, and .011 of gold," (*Engineering*, 1885, p. 306).

In an acidulated solution of blue vitriol, the following of those substances, viz., cadmium, cobalt, iron, zinc, sulphide of iron, alumina, magnesia and alkalies of the slag dissolve readily; antimony, arsenic, bismuth, tin and silica dissolve imperfectly, and partly fall to the bottom; carbon, gold, platinum and sulphur from the pyrites are insoluble, and precipitate entirely; lead is converted into sulphate, which almost wholly precipitates; silver is changed into chloride, provided a soluble chloride is present, which is usually the case, and is entirely thrown down; suboxide of copper, and the sulphides of copper and of silver, also precipitate. The lime is all changed into sulphate, a small quantity only of which enters into solution, whilst the remainder subsides.

One effect of using an impure metal or an alloy as an anode is, that its different constituents are corroded unequally, both by the ordinary chemical action of the liquid and by the influence of the current By both these actions the most electro-positive metals are attacked first, and the others in succession, in accordance with the thermal law which governs such actions; and those which are not corroded at all, together with those which form insoluble compounds, either remain upon the surface as a coating, or fall to the bottom as mud. In consequence of this irregularity of action, the anodes are often corroded deeply in places, even while containing much metallic copper in their coatings, become rotten, and pieces of them fall to the bottom, and this occurs the most with very impure metal, and especially with cupreous matte. When the anodes are made by fusion of copper pyrites, they often swell on the sides towards the cathode after a few days of electrolytic action. If also the liquid is not kept homogeneous, impure ones are rapidly corroded, and sometimes cut through at the surface of the solution and fall to the bottom.

If arsenic is present it partly dissolves as arsenious or arsenic acid, and gradually unites with some of the constituents of the mud to form insoluble compounds: arsenious acid is sparingly, and arsenic acid freely soluble. It also partly forms arseniates upon the anode, which are non-conductors, and by adhering to that electrode offer resistance to the current.

Antimony partly dissolves, especially in acid solutions, and partly forms an insoluble basic salt, some of which adheres to the anode, oxidizes and increases in weight, and some falls to the bottom; any oxy-salt of antimony appears as a white cloudiness when the liquid is sufficiently dilute.

Bismuth behaves much like tin and antimony; it partly forms an insoluble basic salt, which precipitates, and partly dissolves as an acid salt, which ultimately also becomes basic and falls.

Tin behaves much like antimony; it forms a mixture of proto salt and basic salt, some of which adheres to the anode and some dissolves; the proto-salt is white when dry, and absorbs oxygen from the air rapidly to form persalt. The presence of dissolved tin in a neutral solution is said to greatly improve the quality of the separated copper, without the tin being deposited; this, however, probably only occurs under particular conditions, because in some experiments I made for the purpose, this effect did not take place. The presence of tin in the anode increases the electromotive force of the current, because tin is more electro-positive than copper in dilute sulphuric acid.

Lead, being also more electro-positive than copper, is attacked before it, and aids the electromotive force; but its sulphate, being very insoluble, falls nearly wholly to the bottom, and only a trace being dissolved. There is but little risk of lead being deposited with copper, not only because its sulphate is so very insoluble, but also because lead is electro-positive to that metal. Lead, by being electrolytically corroded in place of copper, and uniting with acid to form and insoluble salt, diminishes the amount of copper and of acid in solution.

If the anode contains metallic iron and manganese, those metals are dissolved before the copper, and being more electro-positive assist the current; they dissolve as proto-salts, and subsequently become oxidized to some extent, but not completely, to persalts by contact with the air. If, however, the current is very much stronger than that usually employed in refining copper, these proto-salts are also oxidized to persalts at the anode; and in any case their persalts are reduced to proto salts at the cathode by the current and cause great waste of power. The only way to prevent waste of energy in deoxidizing persalts at the cathode is to keep those salts out of the solution. Iron by dissolving in place of some of the copper at the anode, takes up some of the acid, forms green vitriol, and diminishes the solvent power of the water and the amount of copper in solution.

Any suboxide of copper in the anode, being a non-conductor, falls to the bottom, and is subsequently slowly oxidized and dissolved as cupric sulphate by the free acid. If the anode contains much cupreous sulphide, some of it is decomposed by the current, its metal dissolving whilst its sulphur separates and subsides. If its amount is small (as it usually is in "black copper"), being a very inferior conductor it is unaffected by the current, and falls to the bottom as fast as the metal around it is dissolved.

In an anode containing copper, copper oxides and sulphides, the current goes most by the path of least resistance, *i.e.*, very largely by the metal, very little by the sulphides, and much less by the oxides. If, therefore, the anode contains very little sulphide or oxide, the whole of the current travels through the copper, and the oxide and sulphide fall to the bottom; but if it contains much sulphide, some of the current passes through it. At the same time, independently of the action of the current, the liquid is always acting chemically upon each of these substances, whether they form part of the anode or of the sediment.

It is evident that when the anode contains a large variety of impurities the chemical actions going on at its surface must be numerous and exceedingly complex, and modify each other, and make it very difficult to accurately describe them. One effect of those numerous impurities is to cause an almost infinite number of local electric currents all over the anode, attended by corrosion and solution of all the more positive substances without the aid of the external current, thus gradually neutralizing the free acid, and saturating the water with metallic salts.

*Extract from "The Electrolytic Separation of Metals," from London *Electrician*.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Nov. 13, 1890.

The Jordan Train Lighting Company, are working night and day to keep up with their orders.

The pay-roll of the Thomson-Houston Company is one-fifth larger than it was six months ago.

The Thomson-Houston electric railway system is to be adopted by the Bridgeport, Conn. Horse Railroad Company.

The Dalton Shoe Co. has ordered a new electric dynamo, which will increase its lighting capacity about 50 per cent.

The Western Union Telegraph Company, are pushing the work on their underground system throughout Boston.

C. H. Page, a well-known Worcester electrician, fell from a twenty foot ladder the past week, and was severely injured.

The N. E. Printing Telegraph Company, have nearly completed their line between Boston and Donaldsonville, Conn,

The Johnston Electric Train Signal Company, have completed the equipment of their factory in Woburn, and are in constant receipt of large orders for goods of their manufacture.

The New England Telephone and Telegraph Company have petitioned for new locations for their works in Medford. There will be a hearing in the matter in the Selectmen's room, Tuesday evening, Nov. 18.

The Quincy and Boston Street Railway directors will hold a meeting, Nov. 15, to consider the advisability of increasing the capital stock to $100,000.

Mr. Howard Wheeler, who has been representing the railway department of the Thomson-Houston Electric Company, at 115 Broadway, New York, has been in Boston during the past week.

Two of Mr. Van Depoele's reciprocating electric drills—in fact, two entire plants, have been shipped to the Cape Ann granite quarries at Bay View, to be given a thorough trial on rough work.

The incandescent department of the Thomson-Houston Electric Company, is now turning out 28,000 lamps weekly. Four years ago, the weekly product was about 1,800.

The Schuyler Electric Company is going to build a new factory at Middletown, Conn., so great is the demand for its efficient system. Ground has already been broken and the undertaking is being pushed with all dispatch.

Work on the electric roads at Whittinsville is progressing rapidly, and it will soon be in operation. Another week of good weather will take them out of the highway. A large freight house has been built in the west yard of the Whitin machine works.

There was an adjourned town meeting at Danvers, Nov. 10. to act on the petition of the Naumkeag Street Railway for leave to extend their overhead electric system through that town, and after a hearing permission was refused.

The Selectmen of Weymouth gave a hearing at Town Hall, last Saturday, on the petition of the Weymouth and Hingham Street Railway Company for a location in this town. Each railway desires a similar location. A number of the citizens took part in the discussion. L. A. Cook appeared in the interest of South Weymouth and hoped the Selectmen would decide the matter for the best interest of that place. The Selectmen took the matter under consideration.

Paul Aborn, inspector of motors for the Thomson-Houston Company, received the full force of a 500-volt electric current at Allen's box factory, Beverly, Tuesday afternoon. Mr. Aborn was paralyzed for half an hour, when he was able to return home to Lynn.

Mr. H. C. Spaulding, formerly general manager of the Thomson-Houston Motor Company, has entered a new field of work, having recently been appointed manager of the mining department of the Thomson-Houston Electric Company, his former position now being filled by Mr. C. R. Wiggin.

The Gloucester Street Railway Company, have a large force of men at work digging up their road bed, and laying an underground wire, and making electrical connections for the single trolley system. The work is being pushed, and the workmen have reached that part of Prospect street, near Dale avenue.

A hearing was held in the Supreme Judicial Court, Salem, last Friday, upon a bill in equity by Williard Spaulding *vs.* the inhabitants of Peabody to restrain the town treasurer from paying out money, under a vote of the town, authorizing the establishment of an electric light plant.

Negotiations are pending for the purchase of the entire plant of the Union Street Railway Co. of New Bedford. The Standard Oil Co. is supposed to be conducting the negotiations through representatives who have recently been here and have held a conference with officials of the company. The contemplated change meets the approval of the public in general. It is stated that the change of management will wholly do away with the objectionable 3 cent transfer recently imposed, and that the electric system will be generally adopted. Cross-town lines will be built, and some of the remote sections of the city will be connected by electricity with the city proper.

Fully 1,500 people were present at town hall, Beverly, last Thursday evening, to hear the parties interested in the petition of the Naumkeag Street R. R. Co., to equip the road in Beverly with the overhead trolley system. D. A. Crowley and H. P. Moulton appeared for the Naumkeag road; S. P. Paine, of Boston, appeared for the Edison Co.; Austin Whitcom and L. Child, of Boston, represented the storage battery system, and A. T. Starkey, of Foxboro, told of the different places where it was in operation. A petition in remonstrance, several yards long, was in the possession of the selectmen. The meeting adjourned for one week.

The Thomson-Houston and Thomson Electric Welding Works were visited by another contingent of the British Steel and Iron Institute last week. The party came from Montreal, the Canadian Government furnishing free transportation. They were accompanied by J. F. Trench of the International Co., and were conveyed in electric cars to the works, where the work of showing them about was done by Electrician A. L. Rohrer and experts H. G. Martin, G. A. Whitmore, P. A. Draper, Jay Wiley and E. A. Bailey. The route was through the welding works factories H, F, C, E, A, B, D and K. The party left the factory at 5:30 o'clock.

An important suit has just been decided in the Superior Court by Judge Thompson. A man named Carlin sought to recover $10,000 from the West End road for injuries received while attempting to board an electric car in Cambridge. The plaintiff testified that he signalled the car to stop at a point between the stations where it regularly stopped; that the car slowed up, but started ahead with a jerk just as he was about getting on board. At the conclusion of the plantiff's testimony, Judge Thompson ordered the jury to find a verdict for the defendant. The ground taken by the court was that no one had a right to get on a car except when it had stopped at its regular stations, and that betwe stations the car was liable to start ahead with a jerk at any moment, the driver being justified in thinking that no one was getting on or off.

Messrs. Bird and Sloane who started an electrical construction business, something like a year ago, have been favored with so large a patronage, that in order to increase their facilities they have decided to form the Bird and Sloane Electric Construction Company. Their office and workroom will be located at 624 Atlantic ave. This company are now prepared to take contracts for any kind of construction work. W. J. P.

NEW YORK NOTES.

The Complete Electric Construction Company of this city, are wiring the O'Day & Rockefeller building, Buffalo, N. Y., for a 1,000 incandescent light installation.

Most of the power used in the jewelry establishment of Tiffany & Company, Union Square, is supplied by Thomson-Houston electric motors.

The new dynamo plant of the Western Union Telegraph Company will consist of between 50 and 60 generators. There will not be a cell of battery in the place. Seven-volt dynamos will be used for local work, such as operating the sounders, and the machines for the loops will give an electromotive force of 25 to 30 volts.

The United States Electric Lighting Company report an extensive demand for their generators and motors for power circuits. That company is putting in motor installations at the Altoona shops of the Pennsylvania Railroad, and the Baldwin Locomotive Works, Philadelphia. At each institution the aggregate power of the motors will be about 100 horse power. These motors are to be used for hoisting, pumping, travelling cranes, etc.

C. W. Bonynge, formerly of San Francisco but now of London, arrived on the Teutonic, Nov. 6th. It is understood that he is here to put into operation a scheme for the laying of a new cable across the Atlantic, to stretch from Valentia Bay, on the west coast of Ireland, to a point on the American coast as near New York as possible. It is thought that the ultimate object of the enterprise is to smash the present high rates.

The friends of Mr. James F. Kelly, the manager of the machine works of the Edison General Electric Company, will regret to learn that he sustained a painful injury recently. He was walking across a board in the new Edison building on Broad street, when the board broke. Mr. Kelly fell and sustained an injury in the side. He has been unable to attend to business for several days, but is on the mend.

Dr. J. Mount Bleyer, of this city, a noted specialist, has for the past year been carrying on experiments in the use of the phonograph for recording and preserving the voices of singers in the normal and abnormal states; also for teaching the students of medicine the characteristics of coughs, etc., produced by the different throat and lung diseases. As aids in teaching and object-lessons in diagnosis these illustrative records are said to have great scientific value.

Mr. Charles J. Kintner, the well-known electrical expert and patent solicitor, has recently added to his office at No. 45 Broadway, an electrical experimental laboratory. He is prepared to either make tests, or permit his clients to use the apparatus themselves. Mr. Kintner's laboratory is supplied with electrical currents of every character. These include the direct current from the Aldrich Court plant, either from the storage battery or direct circuit. He also has a series of Westinghouse converters in connection with the Westinghouse mains, so arranged that they can furnish a current of almost any amperage and voltage. R. J. G.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Ill., Nov. 14, 1890.

Negotiations are pending for the construction of an electric railway connecting St. Louis and St. Charles, Mo.

Mr. H. R. Hickson, assistant manager of the Great Western Electric Supply Company, has resigned his position with that company.

Albuquerque, N. M. will have an electric railway, a company formed for the purpose of constructing one having bought out the company now operating a horse car line in that place.

The Standard Oil Filter Company, has been formed at Chicago, to manufacture and sell oil filters; capital stock, $30,000; incorporators, G. A. Rollins, C. E. Gregory, and D. R. Ellis.

The Central Electric Company report an order for one hundred miles of improved Candee wire this week, orders in other lines in proportion. They have recently received an importation of all steel pliers which they are sending out under guarantee.

Mr. George Cutter, under whose efficient management the Great Western Electric Supply Company was organized and launched into business, has severed his connection with that company, and it is rumored has accepted a position with the Brush Electric Company.

The Great Western Electric Supply Company, of this city, has undergone some important changes within the past few days. Mr. Geo. Cutter has transferred his entire interest in the company to Mr. E. R. Gilman, who already owned considerable stock, and will now be the chief owner of the business. Mr. Gilman is president of the Northwestern Thomson-Houston Company, of Minneapolis. The business of the Chicago house will probably be under the management of Mr. Armstrong. The business of the Great Western will continue the same as heretofore, the company claiming to have all departments full of orders at present.

F. M. I.

QUEEN & CO.'S PORTABLE TESTING SETS.

That "nothing succeeds like success" is as true to-day as when first written. We must, therefore, judge from the following flattering testimonials that Queen & Co.'s Portable Testing Sets are appreciated quite as much by the public in general as by themselves.

Prof. T. C. Mendenhall. superintendent of the United States Coast and Geodetic Survey, says: "The set of resistance coils furnished by you some time since, has been used with great satisfaction. It possesses many advantages in the way of compactness and convenience of arrangement."

Secretary H. J. Davies, of the Brooklyn Street Railroad Company, writes: "We are very much pleased with the Portable Testing Set you sold us. We are using it constantly, and it is proving satisfactory."

Assistant Engineer R. Fleming, of the Edison General Electric Company, writes: "I would say that the Portable Testing Set I bought of you recently, has given every satisfaction, and for an instrument of its class surpasses anything I have ever seen for accuracy and reliability. I would heartily recommend it to electricians."

Superintendent H. A. Wagner, of the Missouri Electric Light and Power Co., says: "We are very much pleased with your new Portable Testing Set, which we have been using about two months, and have no hesitation in saying that it is the best instrument for the price which we have seen. We have had it compared with a Standard Elliot Bridge, and the readings when reduced to B. A. ohms, agreed with the former within one-tenth of one per cent. throughout the range tested."

The Schaefer Electric Manufacturing Co., writes: "So far as we have been able to test, the set has proven all we could wish for, and well adapted for our purposes."

Lieutenant McLean, of the Newport Naval Torpedo Station, says: "The arrangement of the bridge arms, coils and keys in the Portable Testing Set, $126, is very convenient and satisfactory." We are informed by Queen & Co. that, up to date, the orders for these sets have come so fast that it has been impossible to turn them out fast enough. They have employed additional force, however, and hope soon to be able to carry a supply equal to the demand.

RECENT INCORPORATIONS.

South Broadway Electric Railway, Denver, Colo., capital, $15,000.

South End Electric Railway Co., Chicago, Ill., capital, $100,000.

Spencer Electric Co., Spencer, Ia., for the purpose of supplying light and power. Capital, $3,000

Electric Mining and Reduction Co., Butte City, Mont., capital, $450,000.

Avoca Electric Light and Power Co., Avoca, Nebr., capital, $10,000.

Temple Electric Light Co., Temple, Texas, capital, $30,000.

Standard Lamp Co., Appleton, Wis., for the manufacture of incandescent lamps, etc. Capital, $25,000.

Berlin Electric Light Co., (Limited), Berlin, Wis., capital, $15,000.

American District Telegraph and Messenger Co., San Francisco, Cal., capital, $100,000.

Lake Meacham and Malone Telegraph Co. for the purpose of constructing a line of telegraph in Franklin County, New York State. Capital, $2,000.

ST. LOUIS ELECTRICAL SUPPLY COMPANY.—We have received from the Crocker-Wheeler Motor Company a copy of an excellent photograph of the display of the St. Louis Electrical Supply Company, at the exhibition in that city. The St. Louis Electrical Supply Company represent the Crocker-Wheeler interests in that section, and a prominent position is given in the exhibit to the Crocker-Wheeler Motors and fan outfits. These machines show very distinctly in the foreground of the picture.

Important experiments are to be made with the electric light and its efficacy in protecting the entrance of the River Thames. The experimental operations will be carried on at various points below Gravesend. Torpedo boats have been requisitioned to furnish a supposed enemy, and the operations are to be carried on with a view to determine the best positions at which electric search lights could be placed.

The French government has given permission for the laying of a new cable between France and Denmark in order to obviate the frequent interruptions with communication at present occurring between the two countries. It has also granted permission for the establishment of telegraphic communication between Marseilles and Tunis, and Marseilles and Oran.

AN EXCELLENT OPPORTUNITY TO PROCURE ELECTRICAL BOOKS FREE.

It is not necessary to give prizes with the ELECTRIC AGE for new subscriptions, but we desire to make a sensible business offer to our patrons to pay for their securing us new business among their friends. For one new subscription accompanied by $3.00, to cover the same for one year, we will send free to any address, one copy of any one of the following named books: Atkinson's Electric Lighting, Bottone's Electrical Instrument Making for Amateurs, Cumming's Electricity, Terry & Finn's Description of Telegraphic Apparatus, Maver & Davis's Quadruplex, Lockwood's Measurements, or any other book which costs $1.50.

For two yearly subscriptions accompanied by $6.00, we will send one copy of Houston's Dictionary of Electrical Words, Terms and Phrases, or any other book costing $2.50.

For four yearly subscriptions ($12.00), we will send one copy of Culley's Hand-Book which costs $5.50.

All books to be sent postage prepaid.

We will also send for one yearly subscription accompanied by $3.00, one copy of A B C of Electricity, one copy of Bottone's Electric Bells, and one copy of Day's Electric Light Arithmetic, or any other three books that aggregate in cost $1.50.

We name below a few books and prices, for the purpose of allowing our friends the opportunity to make a selection more in line with their requirements:

Elementary Principles of Electric Lighting, by P. H. Atkinson. Illustrated. Price	$1.50
Incandescent Wiring Hand Book, by F. B. Badt	1.00
Winding Magnets for Dynamos, by Carl Hering	1.25
Electric Transmission of Energy and its Transformation, by G. Kapp	3.00
Electrical Engineering, by Slingo and Brooker	3.00
The Electric Railway to To-day, by H. B. Prindle, (paper)	.50
Same in cloth	1.00
The Electric Motor and its Application, by Martin & Wetzler, 316 illustrations.	3.00
Evolution of the Electric Incandescent Lamp, by F. L. Pope	1.00
The Modern Practice of the Electric Telegraph, by F. L. Pope	1.50
The Quadruplex, by Maver & Davis	1.50
Illustrations and Descriptions of Telegraphic Apparatus, by Terry & Finn	1.50
Practical Information for Telephonists, by T. D. Lockwood	1.50
Electrical Measurements and the Galvanometer, by T. D. Lockwood	1.50
Dictionary of Electrical Words, Terms and Phrases, by Edwin J. Houston	2.50
Principles of Dynamo Electric Machines, by Carl Hering	2.50
Wrinkles in Electric Lighting, by Stephen.	$1.00
The Principles and Practice of Electric Lighting, by Swinton	1.50
The Dynamo Tender's Hand Book, by Badt, with 70 illustrations	1.00
Practical Directions for Winding Magnets for Dynamos, by Badt	1.00
The Dynamo, How Made and How Used, by Bottone. A book for amateurs, 39 illustrations	1.00
Dynamo-Electric Machinery, by Thompson. A series of lecturers. Numerous illustrations	.50
Dynamo-Electricity, by Prescott. Its generation, application, transmission, storage and measurement, with 545 illustrations	5.00
Practical Electricity, by Ayrton. A laboratory and lecture course for first year of students of electrical engineering, based on the practical definitions of the electrical units, with numerous illustrations.	2.50
The A B C of Electricity, by W. H. Meadowcroft	.50
Dymanic Electricity, by Hopkinson. Its modern use and measurement, chiefly in its application to electric lighting and telegraphy, including (I.) some points in electric lighting. (II.) On the measurement of electricity for commercial purposes. (III.) Electric Light arithmetic	.50

For sale by the ELECTRIC AGE PUBLISHING COMPANY, *World* Building, New York.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED NOVEMBER 11TH, 1890.

440,164. Telegraph Circuit. David H. Keeley, Ottawa, Canada. Filed Nov. 4, 1889.

440,165. Multiplex Telegraphy. David H. Keeley, Ottawa, Canada. Filed Nov. 4, 1889.

440,173. Battery Zinc. Archibald J. MacDonald, North Tiverton, R. I., assignor to Henry E. Townsend, trustee. Filed Feb. 20, 1890.

440,175. Secondary Battery. Friedrich Marx, Berlin, Germany. Filed Apr. 18, 1890. Patented in France, England, Belgium, Switzerland, Luxemburg, Italy and Spain.

440,184. Electric Motor Truck and Gear. Edgar Peckham, New York, N. Y. Filed May 29, 1890.

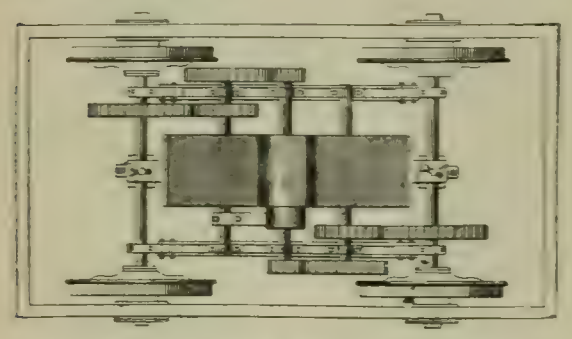
440,199. Induced Current Telegraph. Abner M. Rosebrugh, Toronto, Canada. Filed Feb. 3, 1886.

440,210. Electrode for Secondary Batteries. Edward B. Weed, Detroit, Mich., assignor to John E. Wiles, same place. Filed Feb. 8, 1890.

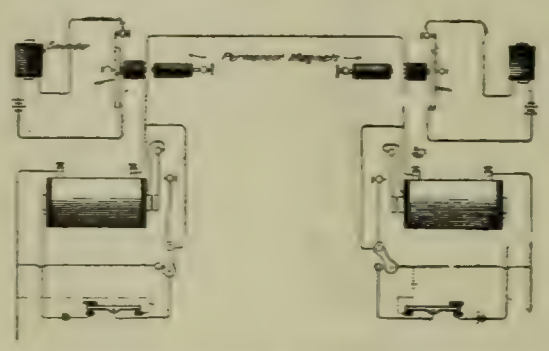
440,213. Electric Switch. Malone Wheless, Nashville, Tenn., assignor by direct and mesne assignments, to the Wheless Electric Railway Company, Alexandria, Va. Filed Sept. 24, 1889.

440,216. Secondary Battery Plate. Albert E. Woolf, New York, N. Y. Filed Feb. 10, 1890.

440,224. Distribution of Electric Energy. Sebastian Z. De Ferranti, Hampstead, England. Filed Feb. 19, 1889.



NO. 440,189.—ELECTRIC MOTOR TRUCK AND GEAR.



NO. 440,199.—INDUCED CURRENT TELEGRAPH.

440,241. Electric Actuating Mechanism for Clocks. Herman T. Schlegel, Akron, Ohio, assignor, by direct and mesne assignments, of three-fourths to Albert A. Schlegel and Michael J. Gilbo, both of same place. Filed Sept. 6, 1889.

440,267. Process of Producing Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed July 26, 1887.

440,268. Process of Producing Crystallized Metallic Lead Plates. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed Jan. 16, 1888.

440,269. Process of Producing Crystallized Lead Plates. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed Jan. 23, 1888.

440,270. Art of Producing Crystallized Metal Plates. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed May 12, 1888.

440,271. Porous Crystallized Metal Plate. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed Mar. 16, 1888.

440,272. Method of Making Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed June 16, 1888.

440,273. Process of Making Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed June 16, 1888.

440,274. Process of Producing Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed June 18, 1888.

440,275. Process of Producing Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester, City, N. J. Filed June 18, 1888.

440,276. Process of Producing Porous Crystallized Metal Plates. Clement Payen, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed June 20, 1888.

420,277. Process of Producing Porous Crystallized Metallic Plates. Clement Payer, Philadelphia, Pa., assignor to the Electric Storage Battery Company, Gloucester City, N. J. Filed Jan. 16, 1888. Renewed Apr. 4, 1889.

440,289. Dead-Beat Mechanism for Electrical Measuring Instruments. Edward Weston, Newark, N. J. Filed May 12, 1890.

440,290. Temperature-Regulator for Electrical Measuring Instruments. Edward Weston, Newark, N. J. Filed June 25, 1890.

440,291. Index-Controlling Device for Electrical Measuring Instruments. Edward Weston, Newark, N. J. Filed June 25, 1890.

440,303. Electric Switch. Arthur R. Bush, Boston, Mass., assignor to Paine & Francis, same place. Filed June 9, 1890.

440,326. System of Electrical Distribution. Walter S. Richards, Natick, assignor of one-half to George B. James, Boston, Mass. Filed May 2, 1890.

440,361. Combined Lightning-Arrester and Cut-Out. John A. McManman, Milwaukee, Wis. Filed Feb. 7, 1890.

440,362. Electric Railway. James K. P. Nourse, Boston, Mass., assignor to himself, Luther Daniels, same place, and John A. Fogg, South Weymouth, Mass. Filed Mar. 18, 1890.

440,375. Organ-Bellows. Fred S. Smith, Cincinnati, Ohio, assignor of one-half to D. H. Baldwin & Co., same place. Filed July 17, 1890.

440,384. Adjustable Resistance for Electrical Circuits. Charles Wirt, Orange, N. J. Filed Nov. 26, 1888.

440,391. Insulating Composition. Frederick E. Blaisdell, Camden, N. J., assignor to the Sil-Crusta Manufacturing Company, same place. Filed May 3, 1890.

440,395. Method of Manufacturing Insulating-Tubing for Electric Connecting-Wires. Henry B. Cobb, Wilmington, Del. Filed Apr. 29, 1890.

440,420. Galvanic Battery. William Cohlman, Philadelphia, Pa. Filed Jan. 20, 1890.

440,424. Dynamo-Electric Machine. Walter K. Freeman, Brooklyn, N. Y., assignor to Wm. S. Hadaway, Jr., trustee, Boston, Mass. Filed Sep. 20, 1890.

440,425. Current-Collector for Dynamo-Electric Machines. Walter K. Freeman, Brooklyn, N. Y., assignor to William S. Hadaway, Jr., trustee, Boston, Mass. Filed Sep. 20, 1890.

440,431. Electric Meter. Etienne Marès, Paris, France. Filed Feb. 26, 1890.

440,441. Electric Clock. Frank Schwartz, Halifax, Canada. Filed Oct. 22, 1889.

440,502. Electric-Railway Switch and Signal Mechanism. Joseph Ramsey, Jr., and Fredric C. Weir, Cincinnati, Ohio. Filed Mar. 21, 1889.

440,503. Electric Switch and Signal Mechanism. Joseph Ramsey, Jr., and Fredric C. Weir, Cincinnati, Ohio. Filed Mar. 21, 1889.

440,505. Electrolyte for Secondary Batteries. Bernard Renault and Maurice Desvernay, Paris, France. Filed Jan. 11, 1890. Patented in France.

440,508. Electric Train-Signal. Fitzwilliam Sargent, Aurora, Ill. Filed May 6, 1890.

440,534. Method of and Apparatus for Making Metallic Wheels by Electricity. William P. Bettendorf and Joseph W. Bettendorf, Davenport, Iowa. Filed May 26, 1890.

440,557. Dynamo-Electric Machine. Walter K. Freeman, Brooklyn, N. Y., assignor to Wm. S. Hadaway, Jr., trustee, Boston, Mass. Filed Sept. 20, 1890.

440,563. Combined System of Fire-Alarm and Police-Patrol Telephone and Telegraph. George C. Hale and Albert Barret, Kansas City, Mo. Filed Mar. 28, 1890.

440,590. Electrical Governor. Franklin D. Hardy, Chicago, Ill., assignor of part to Crews and Owen and Edwin J. Blood, all of same place. Filed Feb. 1, 1890.

440,595. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor by mesne assignments, to the Thomson-Houston Electric Company, Boston, Mass. Original application filed Sept. 23, 1886. Divided and this application filed May 29, 1889.



NO. 420,213.—ELECTRIC SWITCH.

440,596. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Original application filed Mar. 24, 1887. Divided and this application filed July 28, 1890.

440,597. Contact Device for Electric Cars. Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place. Original application filed Jan. 26, 1887. Divided and this application filed Aug. 11, 1890.

TRADE NOTES.

Messrs. Chas. A. Schieren & Co., of this city, the well-known makers of leather belting, on Aug. 20th last, furnished the Metropolitan Street Railway Co., Toronto, Ont., with 48 feet of 12 inch, and 85 feet of 28 inch double electric perforated belt. In answer to an inquiry in reference to the working of the belts, the following was received by the makers:

TORONTO, Nov. 8th, 1890.

In regard to the belts, as far as we are able to judge, they are giving every satisfaction. We have certainly realized that the power required for electric railway purposes is very exceptional, and the demand is very irregular. We are glad however, to state that the belts seem to meet all requirements. We have not had so far, the slightest trouble with slippage, and cannot but express ourselves as greatly pleased. If they will stand the test of time, we do not see that we can desire any improvement. If any parties in this market require anything of the kind, we shall be very pleased to have you refer them to us, and will show them our belts in operation.

Yours truly,

METROPOLITAN ST. RY. CO., OF TORONTO.
CHAS. D. WARREN, president.

VIBRATIONS OF AN INCANDESCENT PLATINUM WIRE.*

BY M. ARGYROPOULOS.

I stretched horizontally a platinum wire .7 of a metre in length and a fraction of a millimetre in diameter, and sent an electric current into it, in order to heat it to white heat. Observing the great dilatation of the wire during the passage of the current, I thought that some vibratory movement would be produced by successive interruptions of the current. I therefore introduced into the circuit a large trembler interrupter, or, better still, the interrupter proposed by Foucault for large Ruhmkorff coils; the platinum wire immediately began to vibrate, subdividing itself into stationary waves.

We can observe very clearly one, two, three, and as many as eight, ventral segments separated by nodes which seem to be stationary. By very slowly lessening the tension of the platinum wire the number of these ventral points is increased; on the other hand, if we slowly increase the tension, the number of ventral points is lessened, and the incandescent wire vibrates transversely, forming a single ventral segment in the middle.

The support on which I stretched the wire had two actions, one to stretch the wire more or less, and the other to lengthen or shorten it.

The experiment was performed in the following manner: First, I took a long length of wire and sent through it a current of from 45 to 50 Bunsen elements, keeping the interrupter inoperative. Then the wire was shortened until it became incandescent. The interrupter was then set in motion and the wire began to vibrate. Then the wire was slowly stretched, until at last it vibrated as a whole, forming one single ventral segment in the middle. By lessening the tension of the wire I could produce as many as eight ventral segments, or even more.

This experiment enables us to illustrate before a large audience the vibratory movements of strings.

* Presented to the Académie des Sciences, by M. Cornu.

THIS SPACE

RESERVED FOR THE

Duralite Company,

No. 85 WATER ST.,

BOSTON, MASS.

Telephone Companies, Supply Houses, Bell Hangers, Physicians, and all users of open circuit batteries are requested to write the

LAW TELEPHONE CO.,

85 John street,

NEW YORK.

We have something to interest you.

THE WESTON STANDARD

Voltmeters and Ammeters



These instruments are the most accurate, reliable and sensitive portable instruments ever offered. A large variety of ranges to meet the requirements of all kinds of work. Address:

Weston Electrical Instrument Co.,

Send for Illustrated Catalogue. 114 & 116 William St., NEWARK, N. J.

The Writing Telegraph in Canada.

THE WRITING TELEGRAPH COMPANY, of 57 Murray Street, N. Y. (P. O. Box 1322), having fully perfected the invention, will sell their Canadian Patents, or will arrange with suitable parties to incorporate a company to exploit the system in that country.

Similar arrangements are also desired for Australia and South America.

HAROLD BINNEY. E. E.—PATENTS.

Late Asst. Examiner of Electricity, U. S. Patent Office, now with **Gilbert M. Plympton,** Counsellor at Law in Patent Cases, 245 Broadway, N. Y.

Patents procured, litigated and their validity examined. Inventions theoretically and practically investigated. Referring, by permission, to the Editors of this journal.

BUSINESS NOTICES.

Advertisements under this head not occupying over one-half inch of space, $1.00 per each insertion.

FOR SALE.—A six-horse power Baxter engine and wrought iron boiler, heavy galvanized stack, nearly as good as new, cost $850.00. Too small for our present use. Will sell for $300 cash. Address ENGINE-BOILER, ELECTRIC AGE Office, World Building, New York, N. Y.

SITUATION WANTED by an experienced electrician, who is capable of taking care of a central station plant of any capacity. Address SITUATION WANTED, ELECTRIC AGE, N. Y.

EXPERIENCED MECHANICAL DRAUGHTSMEN wanted immediately; those having experience with electrical apparatus preferred. Permanency to good men. Address E. KOLBEN, Edison General Electric Company, Schenectady Works, Schenectady, N. Y.

Telegraph Pole

—:)o(:—

I am prepared to furnish any nur ber on short notice, both cedar a cypress. Parties wishing to buy w save money by giving me a chance bid before they do so.

A. BUSHNELL,

S. E. Cor. 9th and Broadway,

KANSAS CITY, M

THE CLARK SYSTEM OF ARC LIGHTING,

The Safest, the Most Economical, Durable and Perfectly Regulated System in the United States.

Manufactured by the CLARK ELECTRIC CO., 192 Broadway, New York.

MASON'S BATTERY.

Electric Light without machinery—Specially adapted for private houses—A good and reliable battery at last—Unequalled for sewing machine and fan motors—Portable electric light.

SMALL ELECTRIC LIGHT PLANTS.

The following list will illustrate the expense attending the purchase and use of small installations. and serve as guides when ordering plants for domestic purposes.

PLANT No. 1.		PLANT No. 2.		*PLANT No. 3.	
2 No. 9 Cells at $1.50	$3.00	4 No. 9 Cells at $1.25	$5.00	6 No. 9 Cells at $1.25	$7.50
1 1-C.P. Incandescent Lamp (large bulb)	.85	1 3-C.P. Incandescent Lamp (large bulb)	.85	1 6-C.P. Incandescent Lamp (large bulb)	.85
1 Key Socket	1.20	1 Key Socket	1.20	1 Key Socket	1.20
1 Shade and Holder	.50	1 Shade and Holder	.50	1 Shade and Holder	.50
50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.50	50 Feet of Insulated Electric Wire	.50
4 Charges of Depolarizer (will run 80 hours)	.40	2 Charges of Depolarizer (will run 40 hours)	.40	3 Charges of Depolarizer (will run 70 hours)	.90
	$6.45		$8.15		$11.4

*This plant will be found useful for lighting small rooms, dining tables, desks, and for reading purposes. It will also properly light two stalls in a stable.
NOTE.—Any number of 1-C.P. incandescent lamps can be employed, provided that not more than one is used at any one time.

JAMES H. MASON,

Office and Factory: 114-120 Park Ave., Brooklyn, N. Y.

AGENTS { EMPIRE CITY ELECTRIC COMPANY, 15 Dey Street, New York.
NOVELTY ELECTRIC COMPANY, 50-54 North Fourth Street, Philadelphia, Pa.
THE ELECTRIC GAS LIGHTING COMPANY, 195 Devonshire Street, Boston, Mass.

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TRADE MARK.

Wires, Cables, Tapes, and Tubing.

CONNECTED BY PRIVATE WIRE POSTAL-TELEGRAPH CABLE CO.

CENTRAL ELECTRIC CO.

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ELECTRICAL SUPPLIES OF EVERY DESCRIPTION AT LOWEST PRICES.

Shipments Prompt.

OKONITE

TRADE MARK

Wires, Cables, Tapes, and Tubing.

A CHANCE TO MAKE MONEY.

I bought one of Griffith's machines for platimg with gold, silver or nickel, and it works to perfection. No sooner did people hear of it than I had more spoons, knives, forks, and jewelry than I could plate in a month. The first week I cleared $57.30, the first month $167 85 and I think by July 1st I will have $1,000 cash, and give my farm considerable attention too. My daughter made $27 40 in four days. Any person can get one of these machines by sending $5 to W. H. Griffith & Co., Zanesville, Ohio, or can obtain circulars by addressing them. You can learn to use the machine in one hour. As this is my first lucky streak, I give my experience, hoping others may be benefitted as much as I have been.

Yours truly,

M. O. MOREHEAD.

ELECTRIC LIGHTING,

FRANKFORT, INDIANA.

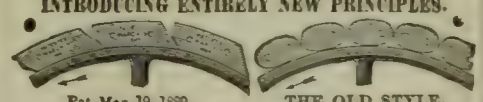
PROPOSALS are wanted until December 19th, 1890, for lighting by electricity and gas, the public streets, etc., of this city for a period of five years.

Address, S. A COOK,
City Clerk as above.

By Order of Committee. J. H. CHAMBERLAIN. J. W. HAMMOND. J. S. VANARSDAL.



INTRODUCING ENTIRELY NEW PRINCIPLES.



Pat. Mar. 19, 1889. THE OLD STYLE.

THE ACME LINK BELT

IS MADE ONLY BY THE

Page Belting Company, Concord, N. H.

BRANCHES: Boston, New York, Chicago, San Francisco. Also, manufacturers of all the staple grades of Leather Belting and Lacing. Send for Illustrated Catalogue—a valuable treatise on belting, Free.

ELECTRIC MERCHANDISE CO.

11 Adams Street, Opposite Pullman Building. CHICAGO, ILLS.

MANUFACTURERS AND DEALERS IN

ELECTRIC RAILWAY SUPPLIES.

Standard and Special Devices for use on all road IRRESPECTIVE OF SYSTEM USED.

Catalogues Furnished. Correspondence Solicited.

Office and Salesroom, 11 Adams Street.

W. R. MASON, - General Manager.

OUR METALLIC LATH.

Have you used it? If not you will find it adapted to all kinds of surfaces, the form of fire-proofing, and most easily and cheaply applied. Leading architects specify it.

THE CINCINNATI CORRUGATING CO.

P. O. BOX 270. PIQUA, OHIO.

ESTABLISHED 1867.

FRANKLIN S. CARTER. CHAS. M. WILKINS. E. WARD WILKINS. } Trading as

PARTRICK & CARTER,

Manufacturers of and Dealers in every Description of

ELECTRICAL SUPPLIES.

SOLE PROPRIETORS OF THE

NEW PATENT NEEDLE ANNUNCIATORS WITH GUEST CALL AND FIRE ALARM SYSTEMS.

We make a specialty of supplies for Hotel and House work.

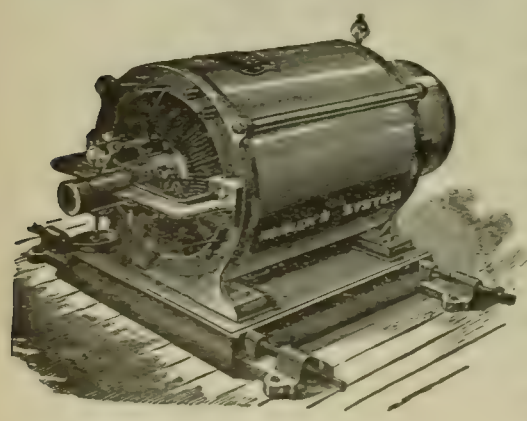
114 S. Second Street, - - - PHILADELPHIA, PA.

Catalogues and Discount Sheets will be sent to those in the trade upon receipt of application and business card.

Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889

THE HEISLER PATENT LONG DISTANCE

INCANDESCENT ELECTRIC LIGHT SYSTEM.



Unequalled for Distribution over Wide Areas

SPECIALLY ADAPTED FOR

STREET, COMMERCIAL AND DOMESTIC ILLUMINATION FROM CENTRAL STATIONS.

SAFETY, RELIABILITY AND FINANCIAL SUCCESS FULLY DEMONSTRATED.

Plan of Wiring the Simplest, Cheapest and Most Efficient

—: STRICTLY SERIES. :—

Noted for the Brilliancy and Beauty of the Light. Lamps, 16 to 1,200 Candle Power. Long Life without Blackening.

Greatest Production of Candle Power per Horse Power.

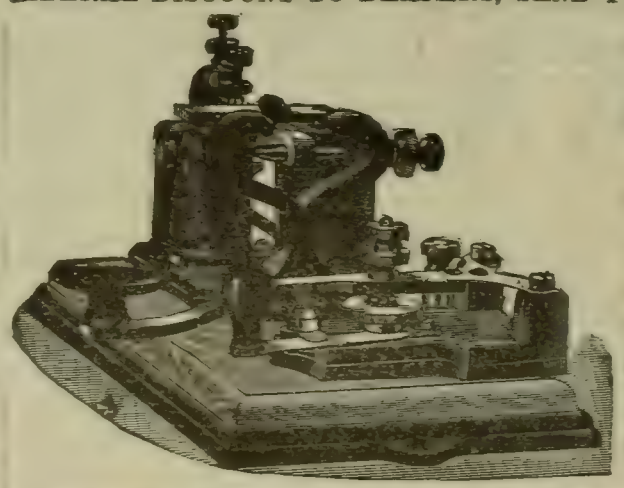
Dynamo Self-Contained and Perfectly Automatic.

Plant may be located where Power can be secured Cheapest, even if Miles Distant from the Lighting

SEND FOR CIRCULARS. - CORRESPONDENCE SOLICITED.

HEISLER ELECTRIC LIGHT CO., 809-817 South 7th St., ST. LOUIS, MO.

LIBERAL DISCOUNT TO DEALERS, SEND FOR REDUCED PRICE



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WITH SOUNDER AND KE

On same base, or separate, as or

Complete Outfit, - -

Sounder, - - -

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THE LONG DISTANCE TELEPHONE.

The map of the lines of the Long Distance Telephone which we present to our readers on another page, is official and correct up to date. This is the first time a map of this company's vast system has ever been published, and no doubt there are thousands of people who will be glad of the opportunity to get this map. It is hard to make some people believe that conversation can most successfully be carried on between New York and Boston, or New York and Buffalo, or any other two distant points over a wire with telephone apparatus at each end. To these the map will be a surprise, and they will come to the conclusion that the Long Distance Telephone must be a real and practical thing, or its promoters would not build such an extensive system of lines as represented on the map.

The fact is, the Long Distance Telephone is becoming more and more important to the business community; much time and money is saved by its use. A merchant can talk with another in a distant city and transact business with as great facility as if the two were in each other's presence. This saves a great deal of time wasted in travelling, and the time may come when merchants will do a good deal less travelling than they do now. This view of the telephone, carried far enough, it would seem, might tell on the earnings of railroads, but these useful institutions, no doubt, will always be kept busy.

The Long Distance Telephone occupies now a very important position in relation to business, and is as much depended on in some lines as sunlight. Any meritorious labor and time-saving device has a great charm for business men, and they are not slow to take advantage of it. The Long Distance Telephone is such a thing, and business men find that it pays to use it, and the more they use it the better it pays.

The telephone occupies a permanent position in the long list of valuable inventions, and well it may for there is nothing more valuable and serviceable to mankind in their domestic and business relations than the telephone.

THE PIONEERS OF THE ELECTRIC RAILWAY.—In his paper before the Chicago Electric Club, on Nov. 17th, Mr. Theo. P. Bailey brings out prominently a fact in connection with the wonderful development of the electric railway that has been generally lost sight of. He thought justice to the pioneers had not been done. What he meant by pioneers was the manufacturers of the apparatus. When it is considered what they did to inspire confidence in the electric railway it will be conceded that they merit all of the success that has resulted from their enterprise. In order to get a start, contracts with all sorts of guarantees were made. Long trial periods were given, and it was guaranteed that cost of maintenance would be less than for the same number of cars operated by animal power. Besides these guarantees they agreed to use a current of sufficiently low pressure as not to be dangerous to human life, and they warranted their apparatus to work in a thoroughly practical and successful manner. These enthusiastic and confident projectors deserve unbounded credit for their persistence. They had many obstacles to overcome, which they successfully did, as the importance of the electric railway of to-day amply testifies. Theirs was a glorious victory over scepticism and timidity on the part of the capitalists. Nowhere in industrial history can we find a record of such an achievement where a new industry was so absolutely vouched for by its projectors.

LOW SPEED MOTORS AND DYNAMOS.—We print elsewhere in this issue an interesting article on low speed multipolar dynamos and motors for continuous currents, by Mr. Frank A. Perret. Mr. Perret is a pioneer in the motor industry and is well qualified to speak on this very important subject. Low speed in dynamos and motors is a very desirable feature and of great importance, and the advantages thereof have long been recognized. It means simplicity in the application of the machine to all classes of work, and in most cases the use of countershafting, or similar speed-reducing mechanism, is dispensed with. It is the prevailing opinion that there exists serious difficulties in manufacturing this class of machines on a commercial basis, but Mr. Perret, who has given the subject years of study, claims to have solved the problem. The article referred to sets forth, in a clear manner, in language and illustrations, the principles which govern the action of multipolar machines, and demonstrates that the obstacles heretofore existent have been successfully overcome. This article, *per se*, is a valuable addition to the literature on the subject. Mr. Perret has developed the subject most carefully and in a masterly way, and it would seem that his statements of the facts in the case could be accepted as scientifically correct.

AN INTERESTING ELECTRIC ROAD.—The English electrical engineers who planned the City and South London Railway deserve much credit for their enterprise. The undertaking was a most extraordinary one, and the projectors did not have the experience of others to guide them, as the work was of surpassing magnitude. From all reports of the opening of the road the electrical equipment seems to have properly and successfully performed its duty. The most remarkable feature of the plant is the great size and power of the electric motors. The weight of each of the two armatures alone is about two tons, and the weight of copper on each machine is nearly one and a half tons. Each machine is capable of generating a current of 450 volts and 450 amperes. The weight of each motor is over 17 tons. Another important feature of the electric "locomotive" is the method of applying the motive power to the axles. There is no gearing; the axle and the armature shaft being one and the same. The operation of this road, no doubt, will be watched with great interest by electrical engineers everywhere as it embodies some new features that have not before been put to the test of practical experience.

BOSTON'S ELECTRIC ROADS.—The report of President Whitney, of the West End Street Railway Company, is interesting reading, and goes to show what the electric railway does for the welfare of each community most concerned. What is true of Boston is true of all other places operating electric roads. The brief history of the electric railway is full of instances where the suburbs of cities have received life and developed in a most extraordinary degree, when connected with the business centre by these roads. People naturally want to live away from the business section of our cities. They want to enjoy quiet when at home, and until the advent of the electric railway transportation to the suburbs was too slow and unsatisfactory. The electric road, however, has changed all this. In many cities the outlying districts, where there is plenty of room and fresh air, are within easy access, and, altogether the electric railway has proved to be one of the greatest blessings to mankind. It enables many people to live in better homes and at the same time enhances the value of property wherever it goes.

MAGNETIC CLUB DINNER.—The autumn meeting of the Magnetic Club was held at Martinelli's restaurant on Fifth ave., Wednesday evening, Nov. 19th, and was very largely attended. Dr. Norving Green, President of the Western Union Telegraph Company, and Mr. Thomas F. Clark of the same company were the guests of the club. It was expected that General Thomas T. Eckert would be present also as a guest of the club, but owing to his confinement at home with a sprained ankle, he was unable to attend. The meeting was very enthusiastic. Dr. Green and Mr. Clark made some very appropriate remarks, and the rest of the after-dinner programme consisted of orchestral and vocal music, recitations, etc. It was a very enjoyable meeting, and one of the most successful the club has yet held. The bringing together of the rank and file of the great corporation will no doubt go far towards cementing the relations of the two and they will understand each other better.

MUSIC OVER THE LONG DISTANCE TELEPHONE.—A novel entertainment was given by the Bee Society of the North Congregational Church, at Middletown, Conn., Nov. 14th. The programme consisted entirely of selections of instrumental and vocal music from, New York, over the long distance telephone, and phonograph music. During the intermission an opportunity was given the audience to converse over the long distance telephone with parties in New York, New Haven, Hartford and Bridgeport, and also to speak into the phonograph.

LAID IT TO THE DYNAMO.—A combination of telegraphic error and imagination has added a new terror to electricity. On the 19th instant a cablegram from Queenstown stated that a dynamo pipe on the steamer City of New York, had exploded during the voyage, and the fumes of ammonia which were let loose by the explosion suffocated several steerage passengers. The fact was that the ammonia pipe did burst, but, of course, it had nothing to do with the dynamo; it was part of the refrigerating apparatus.

A FINE POINT.—Constitutional lawyers have a nut to crack in the determination of the question as to whether a voter may register by telephone if unable to do so in flesh and blood before the proper authority. A case of this sort has arisen in Macon, Georgia, and is the subject of considerable discussion. It presents a nice point, although on the face of it it would seem to be contrary to the letter of the law.

LONG DISTANCE TELEPHONE LINES.

Very few people have any conception of the magnitude of the Long Distance Telephone plant. To state that the lines run from New York to Boston, or New York to Buffalo, does not give much of an idea of their extent, but when we produce a map showing the territory covered by these lines their importance may then be appreciated. This is what we have done, and we present a map herewith, showing what the long distance company really does amount to, as far as its plant is concerned.

This is the first time a map of the route of this company's lines has ever been published in an electrical paper, and this particular map is the more valuable because it is absolutely correct up to date. No doubt this map will be in the nature of a revelation to a great many people. The vast territory covered by these lines at once strikes the observer, and some conception may be had of the importance of the long distance telephone in the business world of the East. This map does not, by any means indicate the ultimate limits of the system, but simply shows how far the "talking wires" have been extended up to the present time. They are spreading out in every direction, farther and farther, and the already long list of places reached by the long distance telephone is constantly being added to.

As is already very generally known, the Long Distance Telephone lines are built in the most substantial manner. Hard drawn copper wire is used throughout, and the poles are very high and straight. Long distance telephone lines may be picked out from others unfailingly every time by these characteristic features. To see this company's lines once in any one place is to see them always in all places. They are the same everywhere, and kept up to the highest standard. About 44 poles to the mile are used, and the copper wire is ten times more durable than iron wire.

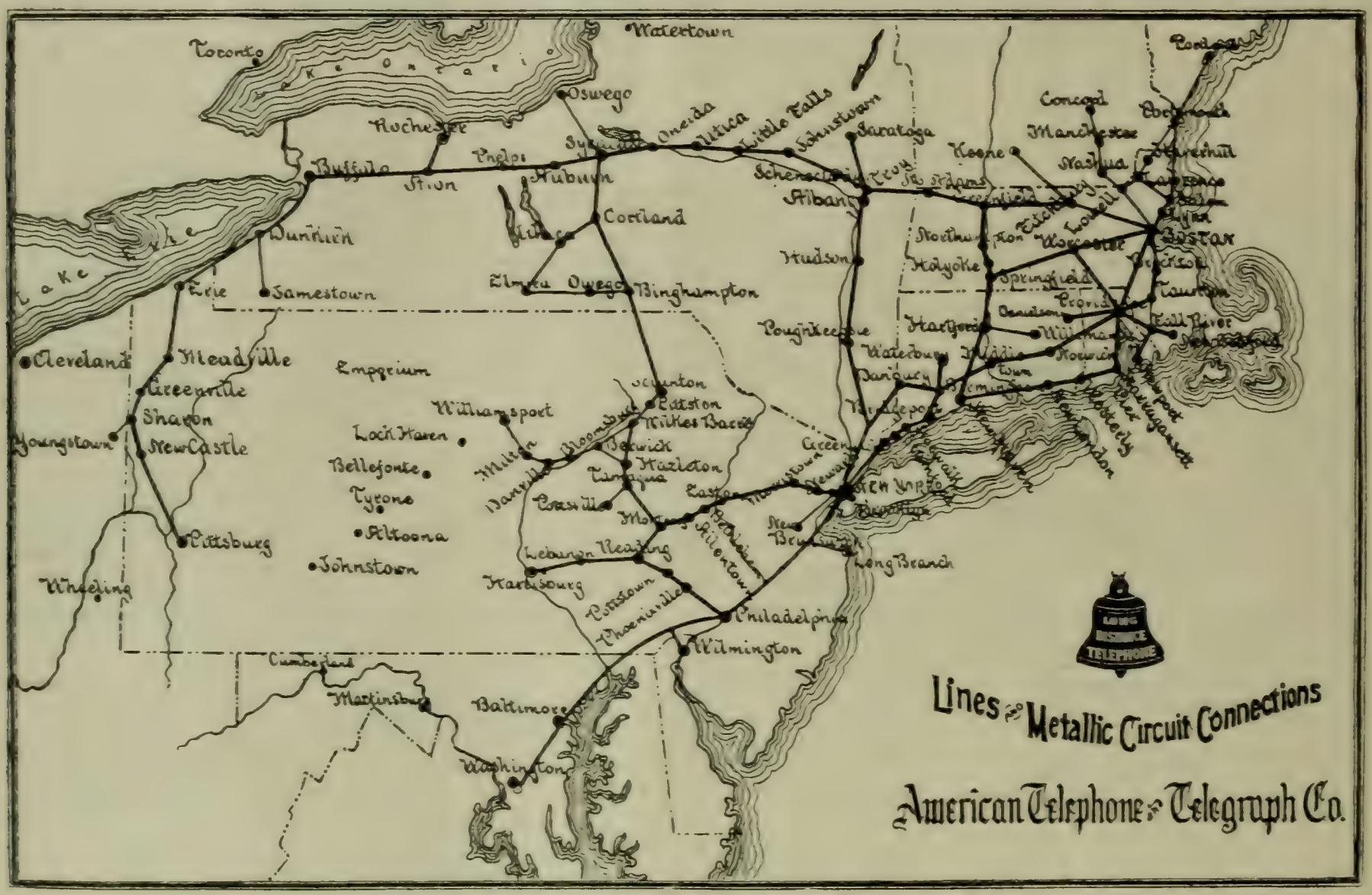
The importance and value of the long distance telephone to the business community is being more and more recognized and appreciated. The system is remarkable for its "staying qualities." During the memorable blizzard in 1888, the long distance telephone wires were the only ones that survived, and, for several days it was the only means of communication between New York and eastern points. On many occasions since these lines have proved themselves invulnerable, and all through the worst storms that have ever occurred within the territory covered by the lines, work has been carried on uninterruptedly. For these reasons business men have finally come to feel that the long distance telephone is the most reliable of all systems of communicating intelligence between cities.

Many people predicted that the telephone would rob the telegraph of much of its business, but experience has proved quite the contrary. As is most always the case with new things, they form the centre of an independent field of activity. So it has been with the long distance telephone—it has created a business of its own, which can not be transacted by any other system of communication. Two merchants, for instance, may converse with each other and transact as much business in five minutes as would take a whole day or more to transact by any other method. Besides this, the slowness of the mails and the danger of error in the telegraph are entirely overcome. These are very important considerations in a business transaction, and these and many other points of advantage in the use of the long distance telephone are becoming more and more appreciated by the business community.

It is frequently asked "How far can conversation by long distance telephone be carried on." In this connection it will be of extreme interest to state that a circuit of 1,475 miles was once made up and conversation successfully carried on. When the company's lines are completed to Chicago conversation will be carried on between these two distant cities with as great facility as over the present shorter lines. The New York and Chicago line, no doubt, will be of immense value and importance to business houses in the two places.

The American Telephone and Telegraph Company, which is the proper name of the company operating the long distance telephone lines, has now 46,000 miles of wire in operation.

About one thousand cities and towns containing eighty thousand telephone subscribers are now connected by over one hundred thousand miles of local telephone line, affording the means of personal inter-communication to thirty million people. In New York City, eight thousand subscribers through eight exchanges are connected by 20,000 miles of wire and use the telephone more than one hundred thousand times per day. In 1889 more than 400 million conversations were carried on by telephone in the United States.



MAP OF THE LINES OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

ZINC.—According to *l'Electricien*, M. Cahaigne, of Paris, has succeeded in producing chemically pure zinc on a commercial scale and at a price but little higher than that of ordinary zinc. MM. Pouchard, Mathioux et Cie., makers of electric clocks, have used Cahaigne zinc rods in the Leclanché cells employed by them. The cells in question furnish current for about ninety hours, and the consumption of the chemically pure zinc amounted to 28 grms. per cell, while the consumption of ordinary well-amalgamated zincs amounted to 36 to 38 grms. The Cahaigne zinc was, moreover, uniformly consumed, while the amalgamated rods were very irregularly attacked

The Brunetti Theatre, in Bologna, is now lighted by electricity. The prefectoral authorities, in order to ensure the safety of the public, informed the proprietors that they must either erect an iron curtain for the stage, or adopt the electric light, the latter alternative being eventually chosen.

TELE-PHOTOGRAPHY.*

BY HENRY SUTTON.

Under various names the problem of transmitting optical images by aid of the telegraph wire has at different times had attention drawn to it.

In putting forward something new in this direction, I will begin by inventing a new name, and propose calling the subject Telephany, and the electro-optic instrument the Telephane.

The art of telephony is simple compared with that of telephany. In the former we deal with a consecutive series of waves of varying rate and length, and it is the consecutive character of sound waves that lends itself so admirably to electrical translation.

In telephany we are met, at the outset, with a great preliminary difficulty, having to deal with a surface or plane in which the effect appealing to the brain must be observed in all the varying character at one and the same time.

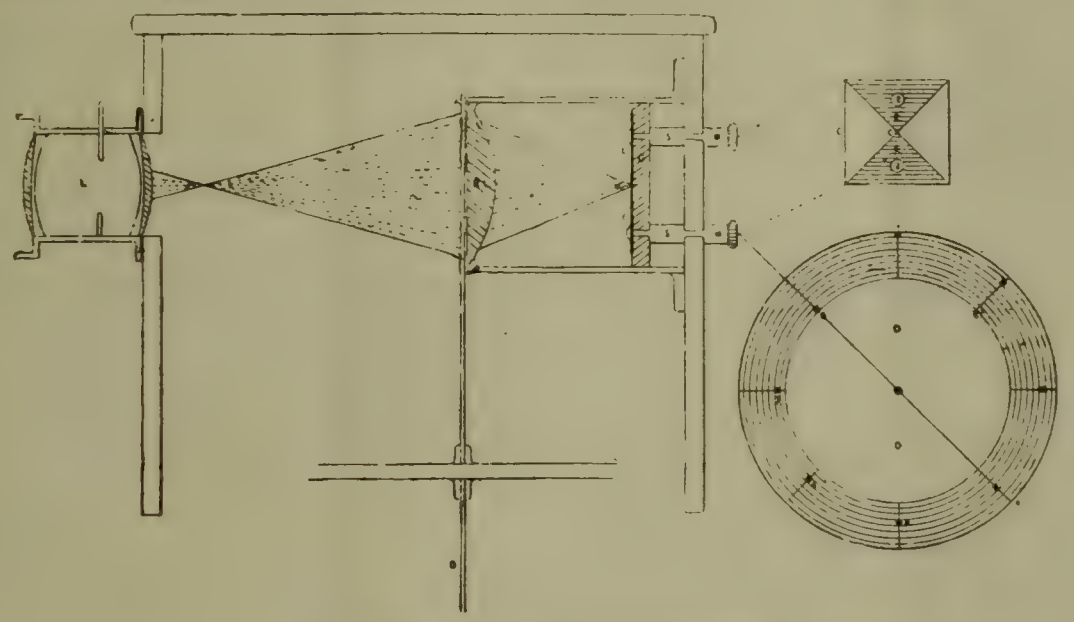
The problem stands thus: a means has to be devised whereby the varying effects on a plane surface are translated into consecutive series of electrical currents, and by means of the consecutive series of currents reconstructed, so to speak, a copy of the original surface; that is, we have to take an optical image, seen as a *surface*, translate it into a *line* of consecutive varying electrical currents, and by means of these produce an effect as a *surface*, having the characteristics of the original image.

We have here two images as surfaces having no time value, and a series of electrical currents having a time value, yet these opposing characteristics are to be presented to the brain as a momentary impression.

Before showing how this apparently impossible problem may be handled, I will explain a probable means for electrically transmitting a photograph.

If we make what photo-mechanical operators call a *screen* negative of a portrait, using a coarse screen, and from this a photo-litographic transfer, transfer it to zinc, and transmit the result by any of the several autographic systems, we have the desired result. In fact, if we apply our knowledge of *half-tone block* making to telegraphy, we are at once in possession of a means of electrically transmitting the photographic semblance of any person.

We may make a *screen* negative, and from that obtain a print on zinc or copper coated with sensitive albumen or bitumen, using the usual solvents, water or turpentine, as the case may be, with which to wash away the unexposed albumen or bitumen, then let the stylus of any autographic system traverse the developed image, the result at the receiving end is a fac-simile portrait. I have used the expression *screen negative*, as it is an understood trade name; as a matter of fact, a *screen positive* would be necessary. We may go further. Instead of receiving the fac-simile on chemically prepared paper, as in the Caselli autographic telegraph, we can make the receiving stylus perforate thin paper (with the electric spark) by means of a constantly working induction coil, but only put into the receiving circuit by the transmitted current. Place this paper on a lithographic stone or zinc plate, pass a roller charged with greasy ink over it, and we have a *printing surface*, the portrait being *transmitted and reproduced for the printer*, photo-electro-mechanically.



FIGS. 1, 2 AND 3.—TELE-PHOTOGRAPHY.

But this is not telephany; the latter must be understood as the means of transmitting images which may be in motion, as seen in a photographic camera, but not in colors.

Having spent some years in studying the problem, I designed the following system five years ago, as my Victorian scientific friends can testify. It may be of much assistance to workers in this direction. I think it offers a fair approximation to the solution of this very difficult problem; at any rate, if in its present form it is not the actual solution, I feel sure it is in the direction indicated by my method, that the successful accomplishment of telephany will result.

Transmitter.

L (figs. 1 and 5) is a photographic objective of the rapid type, producing an intensely illuminated aerial image at A A.

D D (figs. 1, 2 and 4), light metal disc revolving at a fixed rate of not less than 650 revolutions per minute under the control of La Cour's phonic wheel and fork apparatus as in the Delany multiplex system.

G (figs. 1, 3 and 5), a glass or other insulating plate, to the front surface of which is held, by binding terminals S, S, two triangular pieces of metal just separated from each other, E E.

C (figs. 1, 3 and 5), a small piece of lamp-black, selenium or other substance, the resistance of which may be varied by heat or light. Lamp-black compressed is probably the most suitable.

The disc, D D, has a series of small holes, 1, 2, 3, 4, 5, 6, 7, 8, perforated in it, and gradually approaching its centre, as a spiral, these holes must be numerous, and yet only one at a time in the field of the image at A A.

R L (figs. 1 and 5) is the most important part of the transmitter. This, I term the regulating lens; it is a lens placed with its plane surface just to receive the aerial image from the objective L, its focal length being such as to bring all rays

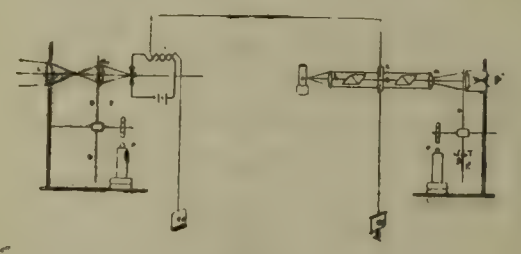


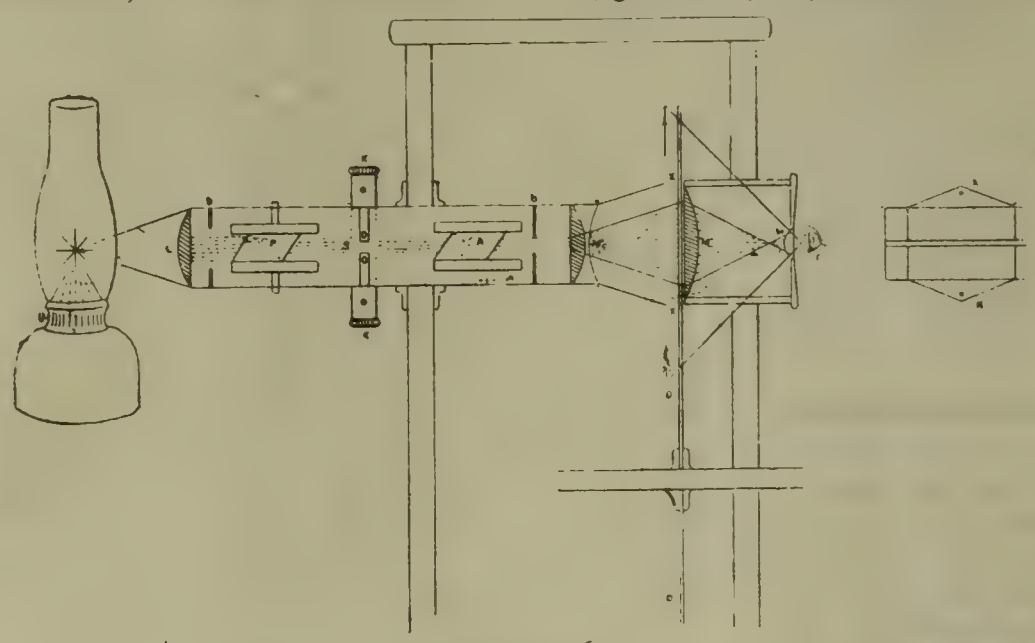
FIG. 4.

reaching it through the perforated disc to a point or focus at C, and therefore its function is to introduce them consecutively to the circuit comprised in S_1, E_1, C, E, S.

Under the influence of this regulating lens the whole image, A A, is allowed to act in consecutive manner, and therefore vary the resistance of C in accord with the lights and shades of the original. We thus solve the big problem of translating the plane image into a line of consecutively varying strength of current, and by bringing C under the influence of the whole image within one-tenth of a second, and during the same time reconstruct our image at the receiving station, persistence of vision will enable us to see the image as one impression.

Receiver.

S_1 (figs. 4 and 5), any artificial source of light,



FIGS. 5 AND 6.

a beam of which is by means of lens, L, passed through a pair of Nicol prisms, P, A, this beam reaching lens, M_1, is magnified and received by the eye-piece, M, M, and viewed by the eye, E. It is absolutely requisite this beam be received by the eye through optical means. The presence of a translucent screen at X, X, would be fatal, owing to the delicate nature of the desired effect.

D D (fig. 4), is a perforated disc, similar to and revolving synchronously with the disc in transmitter.

K K (figs. 4, 5 and 6), terminals inserted in glass and having a small space between, holding a drop of bisulphide of carbon, S.

* London *Electrical Review*.

On rotating the Nicol, P, 45°, we reach the position of extinction.

The terminals, K, K, being placed in the secondary circuit of the transmitter—that is, to line—the variable electrostatic strain produced in the drop of bisulphide of carbon under the action of induced currents received from transmitter, is to produce variable rotation of the polarized beam, and, therefore, variable quantities of light reach the eye, E.

It is obvious the varying tints will be seen in similar position as in original image, owing to the synchronous movement of the discs.

The receiver is, then, based on Dr. Kers's discovery of the rotation of a plane polarized beam of light, through electric stress producing a strain in the medium.

There seems to me no question that the electric impulses will do their work within one-tenth of a second, and the point is whether the stress at O O will be sufficient to produce an observable effect, and whether this may be increased by passing the light through a bisulphide carbon cell having a longer path of, say, $\frac{1}{16}$th inch diameter, as shown at fig. 6, instead of through the drop of bisulphide; so that, conceding the telephone is based on a rightly conceived principle, it becomes a question whether the quantitative results of the physical effects utilized in its design are sufficiently great.

I think the transmitter may be considered as near the right thing as the present state of our knowledge will admit us to reach; there is an appearance of finality about it.

With regard to the receiver it is a question of degree; the actual quantity of light required to reach the eye may be very small when received optically; in fact, so small as to have no power of illumination on a translucent screen: but a quantity of light producing no visible effect on any media, when received by means of an eyepiece shows a bright disc. Owing to being away from references, I regret my inability at the moment to give the name of the inventor of the revolving disc; with the exception of these discs the whole design is original, and was devised at Ballarat, Victoria.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part XV.—Converters (concluded.)

265—Are the cores of converters made of solid metal. If not, how are they made?

No; the cores are thoroughly laminated.

266—Why are the cores laminated?

To prevent loss of energy.

267—How is energy lost in cores?

The energy is spent in heating the iron.

268—What causes the heating?

"Eddy" currents, which are produced in the iron parts whenever there is a variation in the strength of electric currents.

269—What kind of iron is used for the laminations of cores?

Sheet iron.

270—How is the core built up?

Figures 1 and 2 show this. Figure 1 shows a cross section of a converter of the Westinghouse make. C is the core. Figure 2 shows a longitudinal section of the converter, the laminated core being distinctly shown.

271—Are converters connected to the main wires in series or in multiple arc?

Generally in multiple arc.

272—Give an example of how the lengths of wire in the two coils are proportioned so as to effect a transformation at a given ratio.

EXAMPLE—If the primary coil of a given converter has 1000 turns of wire, and the secondary coil 10, then if a current of one ampere with a pressure of 500 volts passes through the primary coil, the current induced in the secondary coil will have—theoretically—a volume of 100 amperes and a pressure of 5co volts. The ratio in this case is 100. The high electromotive force and small current in the primary are transformed into low electromotive force and large current in the secondary coil as the figures show. A general rule may be given as follows: First, determine the ratio between the windings of the primary and secondary coils; second, divide the voltage of the primary coil by this ratio and the result will be the voltage of the secondary coil; third, multiply the amperage of the primary coil by the ratio and the result will be the amperage of the secondary coil.

273—When and by whom was the first transformer made?

In 1831, by Faraday.

274—Are converters usually of one size?

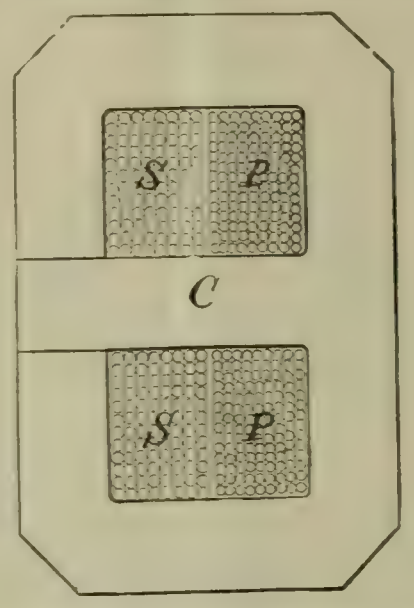


FIG. 1. CROSS SECTION OF WESTINGHOUSE CONVERTER.

No; they are made of different sizes.

275—What is the basis for the determination of their size?

The number of lights to be supplied.

276—What are the ordinary sizes?

The practice in this country has settled on the ordinary sizes as those required to supply 20, 30 and 40 fifty-volt, 16-candle power lamps.

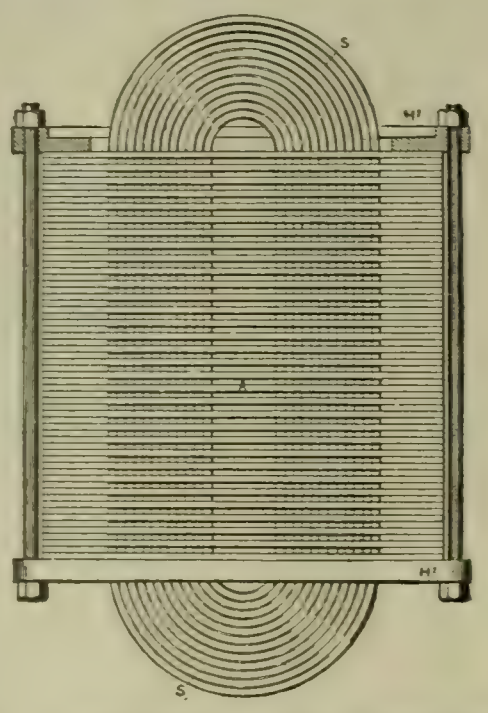


FIG. 2. LONGITUDINAL SECTION OF CONVERTER.

277—Is incandescent lighting by alternating currents taken directly from the armature possible?

Yes.

278—Is there any such system in operation in the United States - if so, what is the name?

Yes; the Heisler system.

279—What are the principal features of the system?

Low resistance incandescent lamps of 30-candle power, and a three to four ampere current, carried on a No. 8 copper wire.

280—Are the lamps used in this system connected in series or in parallel?

In series.

281—In case a lamp filament breaks does it cut off the current from all the remaining lamps?

No; each lamp is provided with a short circuiting device which cuts the lamp out of circuit in case the filament breaks.

282—For what class of illumination is this kind of lamp best adapted?

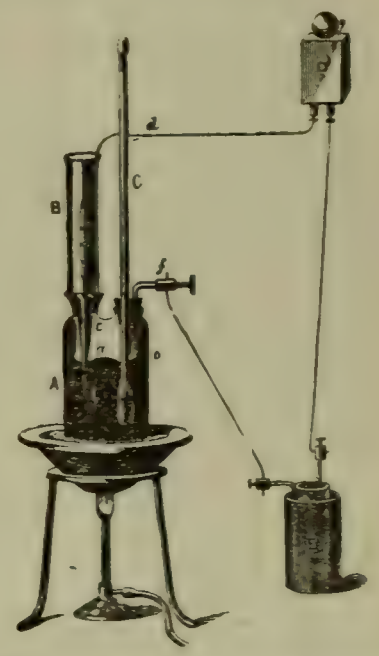
For lighting streets and large buildings.

(To be continued.)

DETERMINATION OF MELTING POINTS.

The apparatus shown in the accompanying sketch is due to the ingenuity of A. C. Christomanos, who gives an elaborate description of it in the *Berichte der Deutschen Chemischen Gesellschaft*. He claims that by means of it a more correct determination of the melting point of substances may be ensured.

The essential features of this apparatus are: The cylindrical vessel, A, which is 12cm. in height and 6cm. in diameter, is heated on a sand bath or in an air bath, and is provided with two apertures; a thermometer, c, and a platinum wire, *f*, pass through a cork fitting into one of the apertures, whilst the other, *c*, is conical and fluted, and serves for the reception of a drawn



APPARATUS FOR DETERMINATION OF MELTING POINTS.

out test tube, B. The vessel, A, is filled with pure mercury to such a depth that the end, *b*, of the test tube is about 2cm. below the surface, *a o*, of the metal.

The substance is introduced in a melted condition into the end, *b*, of the drawn out test tube, so that it forms a layer of from 0.5 to 1.5cm. in length, and when it has completely solidified again the test tube is placed in position, and the space, *a c*, immediately above the substance filled with mercury, into which dips the platinum wire, *d*.

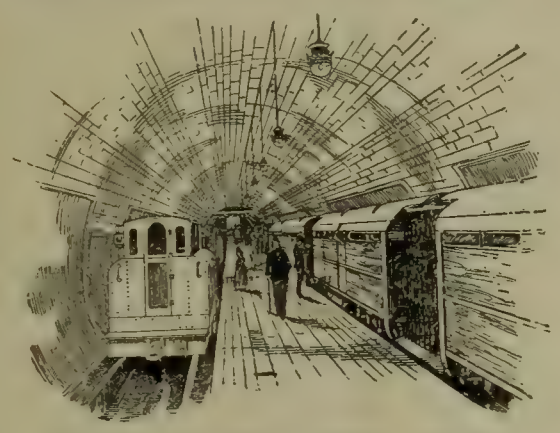
On applying heat, the mercury in A is uniformly heated throughout its whole mass, so that the thermometer and the substance are always at the same temperature; the moment the substance melts the two mercury columns come in contact, the circuit is completed, the bell, D, rings, and the temperature is noted.—*Electrical Review*, London.

SUCCESSFULLY WIRED.—J. M. Lane & Co., of Brooklyn, N. Y., have recently wired the residence of Mr. A. Carnegie, of this city, and Mr. Lane declares that it is now one of the best wired houses in the metropolis. The Interior Conduit and Insulating Company's tubing is used throughout the house, and any wire or number of wires can be changed or renewed inside of five minutes.

* Copyrighted.

THE CITY AND SOUTH LONDON RAILWAY.

On Nov. 4th, the City and South London Railway was successfully inaugurated amid great ceremony in the presence of the Prince of Wales and other prominent persons. This road, in many respects, is a remarkable one as will be seen from the following general description of the same. It runs under the streets, and therefore does not interfere with property on the surface. The scale upon which electric propulsion is carried on in this case is quite unprecedented, it being claimed that this undertaking is the



THE CITY AND SOUTH LONDON RAILWAY. VIEW IN TUNNEL.

largest of its kind in the world, and it is believed to be the forerunner of even greater things in this line.

This railway is a subway about 3¼ miles in length, passing from a point in King William street, city, under the Thames, and on to Stockwell, and constructed on a novel method, designed by Mr. Greathead, M.I.C.E., in the form of two iron circular tunnels 10 feet in diameter, driven throughout the London clay, about 60 feet below the surface, and at a cost of about $1,100,000 per mile.

consulting engineer, with Mr. G. A. Grindle as resident engineer.

The following are the particulars of the plan of Messrs. Mather and Platt, and details of various parts of the work :

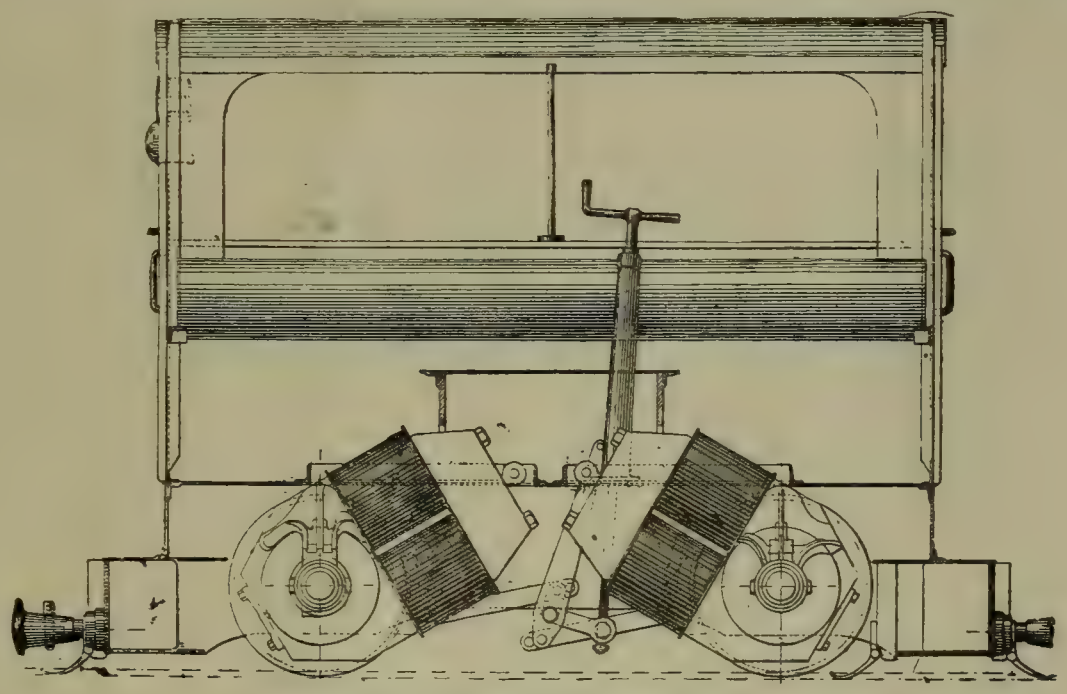
The whole of the machinery for generating the electrical current is situated at Stockwell, the suburban terminus of the line. At this point a complete plant has been erected for the generation of the electrical current. There are three large generator dynamos of the Edison-Hopkinson type, each worked independently by a vertical compound engine, designed and constructed by Messrs. John Fowler & Co.

The engines work at a steam pressure of 140 lbs. per square inch, and have been built of exceptionally massive proportions. They run at 100 revolutions per minute, giving a piston speed of 450 feet per minute, and will indicate up to 375 horse-power each. The flywheels are 14 feet diameter and 28 inches broad, and drive the dynamos direct by means of leather chain-belts 26 inches wide.

The engines are supplied with steam from six Lancashire boilers, 7 feet diameter by 28 feet long, which are fitted by Vicar's mechanical stokers.

The generator dynamos are of the Edison-Hopkinson patent type, with bar armatures, fitted with all the latest patented improvements of Messrs. Mather and Platt. The weight of the armature alone is about 2 tons, and the weight of the entire machine something over 17 tons. Each machine is capable of generating 450 volts and 450 amperes. The commutators are of hard copper insulated with mica, and there are three brushes on each rocking arm, each separately adjustable, with bring-forward thrust, and hold-off catch. The magnet limbs are exceedingly massive, each limb, with its pole piece, being over 4 tons, and the yoke of the machine weighs about 3 tons.

The machine can be run as shunt, or compound only, as required. The total weight of



THE CITY AND SOUTH LONDON RAILWAY. SECTIONAL VIEW OF ELECTRIC LOCOMOTIVE.

The scheme to work this railway by electricity to avoid the use of steam and its noxious results, or the use of rope traction with slow speed and other disadvantages, was submitted to the City and South London Railway Company by Messrs. Mather and Platt, engineers, Manchester. The company accepted the idea, which is entirely original in its main features, though based upon the experience obtained by Dr. Edward Hopkinson, a partner of the above firm, in the construction of the Bessbrook and Newry narrow-gauge electrical railway in Ireland. The whole electrical plant has been carried out under the special superintendence of Dr. Edward Hopkinson, F.R.S., who has acted throughout as

copper wire on the magnet of each machine is nearly 1½ tons

Sir William Thomson's multicellular electrostatic voltmeters are used for measuring the electromotive force. The current from the dynamos is conveyed to a general distributing and testing switchboard, fixed in a recess of the engine house. From this board the main circuits are taken to various parts of the line, and the current passing through each circuit is measured, and suitable arrangements are provided for switching over from one circuit to another.

The main cables have been manufactured by the Fowler-Waring Company, of North Woolwich, and consist of a copper core of 61/14 B.W.G., insulated with Fowler-Waring patent insulating material, and lead-sheathed.

The working conductor is of channel steel carried on glass insulators, the joints being fished, and also connected with copper strips. The steel employed is of very high conductivity and has been rolled specially for the purpose. The working conductor is divided into sections for convenience of testing and carrying out repairs on the permanent way. The insulation obtained is extraordinarily high. When the full pressure of 500 volts is on the complete system of working and feeding conductors, the leakage current does not exceed one ampere, so that the total loss by leakage is less than one horse power ; this is a small fraction of one per cent. of the total power required for working the line to its full capacity. The current is collected from the working conductor by sliding shoes of iron or steel arranged in a very similar way to that employed on the Bessbrook line.

Fourteen 10-ton electric locomotives have been supplied by Messrs. Mather and Platt for working the line, each capable of developing 100 effective horse power and of running up to 25 or 26 miles per hour. The armatures of the locomotives are constructed so that the shaft of the armature is the axle of the locomotive, in this way all intermediate gear and all reciprocating parts are entirely obviated. The method was suggested by the late Sir William Siemens some years ago, but has not as yet been employed elsewhere. A motor is fitted on each axle, the axles not being coupled, but working quite independently. The current is conveyed from the collecting shoes through an amperemeter to a regulating switch, then to a reversing switch, thence to the magnets and back through the framework of the locomotive to the rails, so completing the electrical circuit. The locomotives are fitted with a Westinghouse automatic air brake and also a screw hand brake, and they are lighted from the working conductor. The train, when loaded, will weigh 30 tons, and it is intended that ten trains shall be worked on the line at one time.

Out of every 100 units of power developed by the boilers, 75 will be given out in electricity by the dynamos at the generating station ; the average loss in the couductor will be at most another 5 per cent., rising from nothing at the central station to 10 per cent. at the extreme end of the line. Leakage with the system of insulation adopted will be almost *nil*. It is claimed that the motors will give an efficiency of 90 per cent. and since there is no gearing there should be a total estimated efficient to 64 per cent.

A train consists of an electric locomotive and three passenger carriages 32 feet in length from end to end of the footboard. The carriages are lighted by electric light, the current for the lamps being, in like manner, taken off from the conductors.

Each train carries its own reservoir of compressed air, sufficient for 40 stoppages, and as it arrives at the depot station of the line, recharges its air supply. The trains are also fitted with hand brakes, the stopping power being thus completely independent of the motive power. Block signalling has been adopted. Should, by any failure of the engine at the depot, or any other cause, the train be brought to a standstill, passengers could leave the tunnel safely, as a passage two feet wide is provided, clear of the rails, and at no point could the distance to be traversed exceed three-eights of a mile.

It is claimed that this railway has a great advantage over others in the way of safety to passengers. In the event of a train breaking down, the current will be cut off from the section and it cannot be run into by a train following.

The new Westinghouse Electric Car Service, with its noiseless smooth running motor, is said to be giving better satisfaction than was anticipated for it. Every demand put upon it, has been met without any trouble whatever.

THE DISCHARGE OF ACCUMULATORS LEFT ON OPEN CIRCUIT.*

When it is not required to make use of a battery of accumulators during a certain period, what must one do to prevent them from being injuriously affected? That is a question which has often been put to me, and to which I have always replied :—"Charge the battery to 'saturation,' and leave it to itself." I am aware that this is not the opinion of everyone, and that some recommend that accumulators should be charged to "saturation," and the liquid then emptied out, while others advise substituting pure water for the ordinary solution, and others still the substitution of concentrated acid for the ordinary solution. My opinion was based upon an experiment which I carry out each year at the Ecole de Physique et Chimie Industrielles de la Ville de Paris during the summer holidays. The experiment was repeated as usual this year, and I determined the exact amount of charge lost by the accumulators left on open circuit. The tests were made on two storage cells of the Julien type, having capacity of 200 ampere hours, which were separated from the remainder of the battery. These accumulators are provided with paraffin spray arresters. The cells are of glass, and are contained in wooden boxes filled with sawdust, and supported on oil insulators. The cells, therefore, are thoroughly well insulated. The solution has a density of 1.2, when the cells are fully charged, and contains 6 per cent. in volume of saturated sulphate of soda.

The two cells were charged to saturation on August 5th, discharged on August 6th, and recharged on the 7th of the same month. I then left them to themselves until October 20th, that is to say, for 2 months and 13 days, when they were discharged. The discharge was stopped both on August 6th and October 20th, when the E.M.F. had fallen to 1.8 volts per cell. The quantity of electricity was found to be 233 ampere hours on October 20th. Assuming that in each charge the accumulators stored the same quantity of electricity, we may conclude that the accumulators only lost on open circuit 13 ampere hours, or 6 per cent. of their charge during two and a-half months. This result seems to me to prove that accumulators well made, well charged and well insulated, are not injured by being left on open circuit. It also shows the good quality of these particular cells, and proves again that there is no local action between the active material and the antimony alloy supports. I should have liked to have carried out a similar test on accumulators with plain lead grids, but I had none at my disposal.

EARLY ELECTRIC MOTORS.

The first electric motor for producing rotary motion direct—as distinguished from the earlier "electric engines," which had a reciprocating action—was that invented in 1833, by Professor Henry, in America. This motor was but a toy, but shortly afterwards Davenport in America, Professor Jacobi in Russia, Davidson in Scotland, and Little in England, constructed motors of considerable size. Amongst these the best known is Jacobi's motor, as applied to the propulsion of a boat on the Neva, in 1839. In this instance the motive power was furnished by a primary battery, and the motor developed about two horse power.

In 1845, Professor Page invented a new form of electric engine, based on the "axial force of electro-magnetism," and a few years later he proposed the use of this engine for the propulsion of railway trains. The idea gained public favor, and Congress actually placed $30,000 at the disposal of Professor Page for the purpose of practically developing the invention.

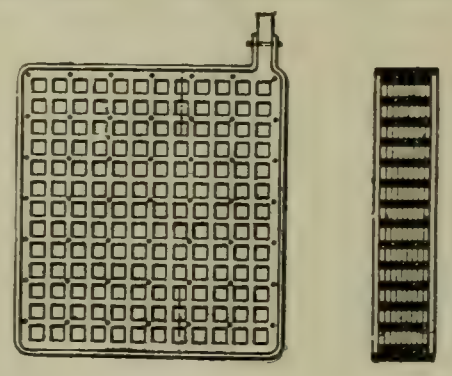
In 1851, an electric locomotive was built and employed to draw a train of cars between Washington and Bladensburg, a distance of five miles. The speed obtained was 19 miles an hour, but since the current was furnished by batteries, the working expenses were so great as to preclude the possibility of commercial success. It was only after the discovery of the dynamic principle by Varley, Siemens, and Wheatstone that electric railways and, indeed, any form of electric transmission of energy, became commercially possible. The idea of generating electricity at a fixed point by dynamo-machines and conveying the current through conductors and sliding contacts to the car whilst in motion, was first put into practice by Siemens in 1879, and this system forms to the present day, the basis of all electric railways operated direct from the generating dynamo.

*Gaston Roux, in *L'Electricien*.

IMPROVED FORM OF SECONDARY BATTERY PLATE.

A secondary battery plate of novel construction has been patented by Albert E. Woolf, of New York City. The plate or electrode, consists essentially of a plurality of supports for the active material.

Between and in contact with the surfaces of adjoining supports, the active material is mechanically applied in layers, and the supports are



SECONDARY BATTERY PLATE.

perforated to permit of a free circulation of the liquid in the cell. There are small ledges formed on the supports, in their manufacture, for the purpose of holding firmly in place the active material.

The method of holding the compound parts of the plates in proper position is also covered in the patent specification. This plate gives an extraordinary amount of active surface, as will be seen from our illustration.

EFFECT OF ELECTRIC LIGHT ON MINERS.—It is said that the electric light in mining operations has a peculiar effect on the miners. Dr. Desfontaines, chief of the medical staff at the Creusot mines and iron works, in France, has made many interesting observations in this line. He says that strange maladies arise in the coal and iron mines at Creusot, where many lamps of a high candle power are often grouped together for special purposes. Those persons for whom electricity has an affinity suffer most. After remaining an hour or thereabouts in a powerful electrical light, their faces, necks and hands—these being the parts exposed—begin to tingle and itch and then to grow brick-red. Their sight is affected and everything looks saffron-colored to them. The lachrymose glands are strongly stimulated. Tears roll down the cheeks, and there is the sensation of a grain of sand under the eyelid, with inflammation of the conjunctiva, which lasts for four or five days. The other symptoms are headache, fever and peeling off of the reddened skin. Heat plays a part in sunstroke. It plays no part in electro-light stroke, since at twelve yards' distance from an arc lamp the effect above described is produced. Dr. Desfontaines attributes the stroke to the chemical action of the light, and declares that it deteriorates the retina, the conjunctiva and even the pulp of the brain, and must lead to a revolution in ophthalmology, because it will alter the constitution of the eye.

ELECTRIC RAILWAYS.

The Short Electric Railway Company, of Cleveland, Ohio, announces for the month of November, the following contracts for electrical equipment: The Schuykill Electric Railway Co., Pottsville, Pa.; the Watervliet & Turnpike Railway Co., Albany, N. Y.; the Texarkana Street Railway Co., Texarkana, Ark.; the Lindell Avenue Railway Co., St. Louis, Mo.; the Syracuse & Onondaga Railway Co., Syracuse, N. Y.

Considerable opposition exists in East Orange, N. J., against the extension of the Newark electric roads through the township to Orange. Both the Newark Passenger Railroad Company, and the Rapid Transit Company had petitioned for the right of way, but the opposition party have kept them unacted upon for some time. On the night of Nov. 18th, however, the matter came up before the township committee for final action, resulting in the rejection of both petitions. It is claimed that members of the committee having the matter in charge had been approached by representatives of the two railway companies, and money had been offered to influence their action on the petitions. No specific statements were made, but it was said that the bribery matter would be brought before the proper authorities.

On Nov. 18th, the State Railroad Commission, at Albany, approved the application of the Brooklyn City Railroad for permission to change its motor power from horse and steam power to the electric single trolley wire system on its Third avenue road from the Brooklyn city line to Fort Hamilton, and also to use electric motive-force on a road about to be built by the Brooklyn City Railroad Company, to run from the intersection of Third avenue and 65th street, in New Utrecht, to the foot of 25th avenue, Gravesend. The total length of the new road will be about five miles.

OPPOSED TO ELECTRIC LIGHT.—Mr. David M. Stone, the proprietor of the *Journal of Commerce*, and a resident of Brooklyn, occupies the position of an uncompromising opponent of lighting by electricity. Mr. Stone was, until recently, the President of the Brooklyn Club, which is the leading organization of that class in Brooklyn. The directors of the club recently voted to introduce the electric light into the club house, after strong opposition from Mr. Stone. He urged all sorts of objections against the light, declaring it to be a general nuisance, and if he had his own way he would not have it in the place. It is said he called at the club rooms daily for two or three weeks and inquired if the work of putting in the lights had been commenced, and was answered in the negative. Finally the crisis came. He called one morning and asked his usual question. He received "yes" for a reply this time. Mr. Stone then immediately sat down and wrote his resignation as president of the club, which was duly accepted. Thus ended the affair. How a man occupying the prominence in business and society that this gentleman does, can with reason stand in the way of progress and try to oppose it, is quite beyond comprehension.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.—We have received from Secretary Allen R. Foote, a copy of the prospectus of the National Electric Light Association. It contains a copy of the constitution of the Association; the names of the officers, committees to report to the thirteenth convention, active and associate members, and a review of the proceedings of the twelfth convention.

The telegraph office at Newcastle-on-Tyne has been fitted up with the electric light. As there has been considerable sickness among the employés in that office, it is thought that the electric light will tend to decrease the amount of sickness.

THE ELECTRIC RAILWAY.

On Monday evening, Nov. 17, Mr. Theo. P. Bailey, manager of the railway department of the Thomson-Houston Electric Company, read an interesting paper before the Chicago Electric Club, on the Practical Development of Electric Street Railways.

"The practical development of electrical street railways, and their commercial perfection," said Mr. Bailey, "may properly be said to have been accomplished within two years, and yet there are at the present time 246 electrical street railway plants either in operation or ready to be put in operation within a short time. * * * Just think of this statement for a moment: 246 electrical railways in operation, embracing 2,024 miles of track, and 3,830 motor cars, requiring in the neighborhood of 6,400 motors with a probable aggregate capacity of 174,435 horse power, employing an electrical generating capacity at the station of about 94,880 horse power. Did any one of you anticipate two years ago, that such a condition of facts could under any circumstances be realized within so short a time? I attribute this wonderful development and success to the following causes:

"First, the full practicability of the undertaking; second, the wonderful earning capacity of the electrically equipped car as compared with the horse car; third, a determination on the part of the electrical manufacturers to meet the requirements of the railway companies, and fourth, the untiring and indefatigable efforts of the exploiter or salesman.

"Among the numerous and possibly fatal objections raised to the use of electricity, when it was proposed to apply it to street car propulsion, was that grades exceeding five per cent. could not be mounted. But experience and practice has shown that grades as high as fourteen per cent. can be ascended with reasonable safety and satisfaction. There is a grade of 13 2/10 per cent. at one point on the line of the street railway at Lynn, Mass., over which sixteen foot cars equipped with two 15 horse power motors are in daily and successful operation. At Milwaukee, a grade of 10 3/10 per cent., 430 feet long, is encountered and successfully operated over or upon by twenty foot cars, equipped with two 15 horse power motors, the total weight of car complete with passengers being 10½ tons. A similar grade is met with at Newport, R. I., and Omaha, Nebr, and numerous grades almost as heavy are seen in the electric railway systems at Des Moines and Davenport, Iowa, and Kansas City, Mo."

Mr. Bailey then gave some figures showing, approximately, the number of street railways in the United States operated by the various methods of propulsion and the amount of capital invested in these properties, and continues: "I find that the cost per car mile for the several methods referred to, including all operating expenses and fixed charges, other than interest, is as follows: Horses, 5.7 cents; Cable, 2½ cents; Electric, 2.2 cents; Steam, 5 cents. A large majority of the street cars equipped electrically at the present time are mounted upon a single truck, to which is attached one or two motors, as required by the conditions existing in each particular case. The lightest equipment with which I have had to do has been a single 15 horse power motor upon one truck, and the heaviest equipment has been two 15 horse power motors upon one truck. The tendency, however, at the present time seems to be in the direction of longer cars, double trucks and heavier motors.

"The use of the longer car with double trucks is recommended further as a means of comfort to the passengers, and also on account of the car and its equipments. This style of car is, of course, unattended by the oscillating motion found in a shorter car with a single truck. Where the shorter motor car is used with a trailer, experience shows that there is a great loss in wear and tear by reason of the cars jamming together when the brakes are applied. This fault is obviated in the longer car, and while its seating capacity may not be equal to that of two shorter cars, it is approximately so. It is claimed further for the longer car with double trucks that less energy is required to operate it; also that it saves the expense of one man, decreases the expense of maintenance and increases the facility for handling passengers.

"In treating the subject of electric railways from a commercial standpoint. I have considered only that branch designated as the single wire overhead system.

"For obvious reasons too much care cannot be observed in the planning and locating of the various factors which go to make up a complete electric railway plant. The selection of a site should be made with reference to obtaining the best facility for handling coal and obtaining water, and also with reference to the electrical centre of the railway system, in order to realize the highest degree of economy in the operation of the plant. The arrangement of the power station is equally as important as its location, with regard to handling the work with the least cost for labor. The selection of the steam plant is a matter of great importance, and should be left with a thoroughly competent and reliable engineer to determine what particular type of engine, boiler, etc., should be used; and the matter should be left under his direction and care until the installation has been completed. It is manifest that in so doing serious blunders will be avoided."

In the matter of car houses, Mr. Bailey thought the location and arrangement of the same was a question of considerable importance. "The car house" he said, "should be provided with suitable pits for the inspection of the motors and also have proper accommodations for cleaning the car bodies. The work of inspection should be done thoroughly by competent and faithful attendants."

The speaker dwelt upon the importance of extreme care in the construction of overhead lines, both as to details and general arrangement, and gave some suggestions as to the proper material to use.

"When a conduit can be constructed that will permit of the safe, reliable and economical operation of street railways by means of electricity we will all rejoice and be glad. If its first cost can be made sufficiently reasonable to permit of its use in cities of say 50,000 inhabitants, it will be a magnificent achievement, and one that will surely bring its just reward to the successful inventor.

"This thought is not prompted by reason of any vexations, troubles or annoyances which have occurred in the operation of the overhead system, but wholly on account of the operations which have been raised to the rapid multiplication of poles and wires in the streets, occasioned by the remarkable development and progress of the electrical science.

"One of the most important features of an electric railway system is the track or roadbed. My experience has been that sufficient attention has not been given to that part of the equipment, especially until very recently. The track should be constructed of a good form of girder or "T" rail, weighing 54 or 40 pounds per yard respectively, and should be attached securely to suitable ties placed not more than 2½ feet apart. It should be well ballasted, and where crossings are made over other tracks, solid castings should be used in order to prevent the jolting and jarring which occurs when passing over them. The rails should be kept as clean as possible, where they are used as a part of the return circuit. In order to use the rails of the track in completing the return circuit they should be firmly connected together by a copper wire in addition to the ordinary fish plates, and in certain cases depending wholly upon the length of the line, number and extent of grades, and number of cars and amount of traffic, there should be used a supplementary copper wire, the size of which must depend upon the conditions just named. It is asserted by some electricans that the efficiency of the return circuit is increased in all cases by the use of a supplementary wire; but my experience has been that upon small roads, where the grades and traffic are light, that satisfaction and economical operation is secured where the supplementary wire is omitted.

"Some of the essential requisites of an electric motor car are proper controlling mechanism and reversing switch for controlling the speed and direction of the car, a lighting arrester and multiple fuse-box. It should also be provided with suitable life guards, gong bells and headlights. The wheels of the car should, in my judgment, be at least 33 inches in diameter and weigh 300 pounds each. This will give increased adhesion and allow the motors to be raised sufficiently high from the ground to practically prevent the possibility of being injured by striking obstacles between the rails.

"Increased speed with a very slight increase of power will result by the use of the 33-inch instead of the 30-inch wheel.

"The possible speed of a car equipped electrically is measured only by the limit of safety. The regulation speed in the majority of places is twelve miles per hour, and the average mileage per car, per day, about 115. It is well-known that upon well regulated steam railroads the locomotives rarely make a continuous run of over 100 miles per day; and considering the extraordinary care that is given to them, and remembering in the same connection the very slight degree of care given to the average electric street railway motor, I think the latter is entitled to a very handsome compliment for the good service it gives us; and when you know that the best average mileage that can be made by a car propelled by the Kentucky horse or Texas mule is sixty miles per day, and even in doing this it is necessary to make at least four changes per day, I think you will admit that the electric railway motor is doing most admirable service.

"The smallest town in the United States which has an electric street railway in operation is Southington, Conn., with a population of 5,400. Two cars are in service over two miles of track, and the average daily receipts are $9.00 per car. The largest electric railway is at Boston, Mass. This entire system comprises 284 miles of track; sixty of which are electrically equipped, and there are 312 motor cars in operation. During the month of August, they had 300 motor cars in service, making a total mileage of 384,700,000. The mileage of the tow cars was 59,948,000; making a total car mileage of 444,648,000. From August 10th to August 16th, 700,000 passengers were carried by these cars without a single delay. In the month of September, 312 motor cars were in operation, making a mileage of 343,466,000, and the mileage of tow cars 56,047,000, making a total car mileage of 399,513,000."

Mr. Bailey gave a table, showing that the average electrical horse power per car on the Boston roads was 4.9; cost of operating per car per day, $6.65, and receipts per car, per day, $27.65.

"Most flattering testimonials have been received from railway companies who have adopted the electric system," continued Mr. Bailey, "and while they express their absolute satisfaction with the new motive power they also state that the earning capacity of their road has been materially increased.

"We cannot overlook the fact that there are still some complaints of excessive cost for repairs and maintenance of the electrical apparatus, but I insist that the responsibility for this condition does not rest altogether with its manufacturers. The managers of these electric roads must appreciate that they are exacting a greater mileage duty of their motors than is expected of the ordinary railroad steam engine and under con-

ditions manifestly more unfavorable. If they will admit this, and see to it that their tracks are put in good order and so maintained, and the same degree of care and attention given to their motors that is given to the steam engine, I am satisfied they will have little to complain of.

"Several railway companies which adopted the cable system before the possibilities of the electric system were fully appreciated, or understood, are now seriously considering the complete displacement of that system and the substitution of electricity in its stead.

"There is no system or method of rapid street transportation that is so universally popular as the electric system; its wonderful flexibility is unparalleled in the history of street railways; capable of moving in either direction with equal facility its value is materially enhanced from the stand-point of safety. Its first cost is about the same as for the animal system, and considerably less than the cable system Knowing what the possibilities of the electric system are, and how cheaply it can be maintained and operated under proper conditions I think we will see street railways thus equipped in many towns of a population not exceeding 10,000 and in some cases even less, and at a period not very remote.

"I have previously alluded to the remarkable growth of the electric railway business, and given some reasons for it, but I do not feel that full justice has been done to the pioneers—I mean the manufacturers of the apparatus. When you consider what they had to do, and what they did do in order to inspire confidence in the undertaking, I think you will all agree with me that they have merited even greater success than has attended their efforts, if that be possible. Contracts with all sorts of guarantees were made, long trial periods were given, the cost of maintenance guaranteed to be less than for the same number of cars operated by animal power, the current guaranteed not to be fatal to human life, and the system warranted to work in a thoroughly practical and successful manner, with a general and sweeping provision that in case of failure in any of the guarantees the railway company could, at their option, throw the apparatus out and assess the electrical company any damages which they had sustained by reason of the alleged experiment. Was there ever a new industry vouched for so absolutely by its projectors? Had the electric companies been less liberal with their guarantees, and not exhibited such a marked degree of confidence themselves, we undoubtedly would have been able to-day to count the number of electric railways by tens instead of by hundreds, for it is but a short time since the financial world has given its unqualified endorsement to the system."

In closing, Mr. Bailey predicted that within a few years surface and elevated railways operated by animal, cable or steam power would be numbered with the events of the past, and that electricity, would claim supremacy in the broad realm of street railway transportation.

THE BOSTON ELECTRIC ROADS.

The annual meeting of the West End Street Railway Company was held in Boston, Nov. 13th, and in President Whitney's address some very interesting statements were made with reference to the operation of the road.

"Our experience with electricity during the last year" said he, "has more than justified the expectations of the company and the directors as reported to the stockholders a year ago. We find that wherever electricity is put in, the number of passengers to be carried increases very largely, showing to our mind, the great satisfaction that the electric service is giving."

On the lines which are now operated by the electric system but which were last year operated by horses, the increase in the travel this year has been 44.18 per cent.

President Whitney considers at great length the increased travel on the lines, which he thinks is due to the favor with which electricity is regarded by the people, and sees the necessity for providing for the greatly increased travel in the future.

"I have no question at all" he continues, "that within three years from this time, we shall be called upon to carry from 30 to 50 per cent. more people than we do now. If our travel is growing over our electric systems at the rate of 10, 20, 30, 40 and 50 per cent., it seems to me absolutely certain that within three years we shall be called upon to carry from 30 to 50 per cent. more of people on the surface. What shall we do with them? That is the question. Where shall we bring them to and where shall we leave them? Is there any more room on Washington street or Tremont street to put cars? Fifty per cent. more of people means from 175,000 to 200,000 people more a day.

Well, what are you going to do with them? It is physically impossible for any more cars to be put upon these streets between the northern depots and Boylston st.; between Scollay square and Boylston st. it is physically impossible to put any more cars. And the result will be that if some other means is not provided by which these people can be carried to and fro, stations must be established at each end of the city and people must be brought to those points and left there. We must establish depots similar to the steam car depots. This is not because we would not do otherwise, for we would be willing and glad to carry these people further, but because it is physically impossible to do it. You cannot put two cars in the space where one only can go; and that is all there is to the problem. The company must face another year the problem of carrying 30 per cent. more people over its electric lines than it did last year.

Although we have more than one fifth of our lines ready for the overhead wires and all that sort of thing, yet for the want of power, we are running only about one fifth of our system by electricity. Now we must face this problem of what shall be done with these cars when they get down town. And the people also, must face this question. It cannot be left for the railroad to solve. It can be solved only in one of two ways. These two ways are these: Either the people must be content to stop in places remote from the centre of the city, or else some other way must be provided to take them through.

Well, now, realizing all these facts, desiring to carry this community as far and as well as we can, desiring to give the communities we reach the best service for the least sum, we went to the legislature last year and asked for a charter for an elevated railroad. A charter was granted and a route has been proposed. I have given this subject a great deal of study. Every man upon the board of directors has done likewise. I do not know of any route but one upon which that road can be built. But I believe that if the city of Boston will co-operate with the road and will accept the proposition which we have made in regard to it, the road can be built upon that line and be made a very profitable investment for the stockholders. I do not know of any other route upon which the road can be built.

I know that the elevated road is the only possible solution of this transportation problem for the city of Boston, and I know that every man who will examine it candidly, free his mind from cant, and look at the whole question, will say amen to the proposition of the West End road, because there is no other way by which this community can be so well served as by the plan which we propose. And while I am aware that it will cost a large sum of money to build this road, I know that the economies that will be introduced in the electric system, and the large increase of travel that will come with these increased facilities will fully justify the stockholders in undertaking it."

Self Regulation.—Broadly speaking, the self-regulating motor is the converse of the self-regulating dynamo wound for constant pressure.

ACCUMULATORS IN ENGLAND.

The Accumulator Company, 44 Broadway, this city, has received a letter from the Foreign and Colonial Electrical Power Storage Company, Limited, of London, England, regarding the large central station lighting plant at Chelsea, England, which is operated by accumulators. The letter is an interesting one, and is as follows:

London, E. C., Oct. 22, 1890.

D. H. Bates, Esq., Gen'l Manager,
Electrical Accumulator Co., New York.

Dear Sir: I have pleasure in informing you that the central station in Chelsea is not only giving every satisfaction to the technical staff, but what is more important is being highly appreciated by the consumers in the neighborhood.

The point I presume that will be of most interest to you, is the question of the life of the storage batteries in use. These are all of the L 31 type, and you will be happy to learn that no renewal either of the positive or negative plates has taken place with any of the batteries, even to the oldest, which was brought into operation about 20 months ago. Very little deposit has accumulated at the botton of the cells, although some of the batteries have received very heavy work, and we are in hopes that no considerable renewal of positive plates will arise for, at any rate, 18 months or two years.

The method of charging the batteries in series proves to be an exceptionally good one, because every cell is always in the same condition as its neighbor, and this advantage is further accentuated by all the cells of the main batteries being worked to the same extent, and for the purpose of regulating, counter electromotive force cells are only employed.

You can rely that I shall have from time to time much pleasure in giving you any information that you may write for, and whenever you or your representatives happen to be in this country, it will be my company's best pleasure to show you the station in operation.

In conclusion I would mention that the original capital required for working an installation on the E.P.S. system is little if any more than by any other good system with similar advantages. I am, dear sir, faithfully yours,

The Foreign & Colonial Electrical
Power Storage Co., Limited.
Hubert Musgrove, Engineer.

Equity of Rules.—The grievance of ill-framed and conflicting fire insurance rules, says the *British Architect*, is not only that they interfere with the carrying out of the work in the manner best suited to the circumstances, but there is difficulty in knowing what is required. By insisting, or appearing to insist, on a certain class of material, certain conditions, etc., in one-case, and passing very different things in another, there is a further difficulty in not knowing what, by chance or caprice, they may accept. Meantime, those who require the electric light and know nothing of the matter are still further bewildered, and are apt to choose the work which is the least expensive, so that the insurance companies defeat the professed object. It appears from some recent correspondence in the London *Times*, that of 33 offices, 10 offices used the Phœnix rules, 10 others have their own special rules, seven deal with each risk as it arises, six use the Institution rules. The writer of the article strongly urges that the rules of the Institution of Electrical Engineers, with perhaps a few additions, be accepted by all the fire insurance companies.

Catalogue.—The Short Electric Railway Company, of Cleveland, Ohio, have just issued an elegant catalogue. The cover is beautifully and artistically executed in raised work, and bronzed. On the pages are excellently printed views of Short electric cars in various cities, and the Short motor complete, and in parts, is well illustrated.

LOW SPEED MULTIPOLAR DYNAMOS AND MOTORS FOR CONTINUOUS CURRENTS.

BY FRANK A. PERRET.

The many practical advantages of a lower rate of speed in dynamo electric machinery have long been recognized, yet until recently few attempts have been made to secure it. The widespread use of the electric motor has, however, rendered low speed a feature of great importance, in that it so greatly simplifies the application of the machine to all classes of work, in most cases obviating the necessity of countershafting or similar speed reducing mechanism.

The writer is aware of a prevailing opinion that serious difficulties are encountered in the attempts to manufacture this class of machines on a commercial basis, but believing the difficulties to be surmountable he devoted several years to a careful study of the subject with the result that he designed a type of machine in which he believes the desired end is attained without the introduction of any element of danger or the sacrifice of a single feature essential to a thoroughly practical machine.

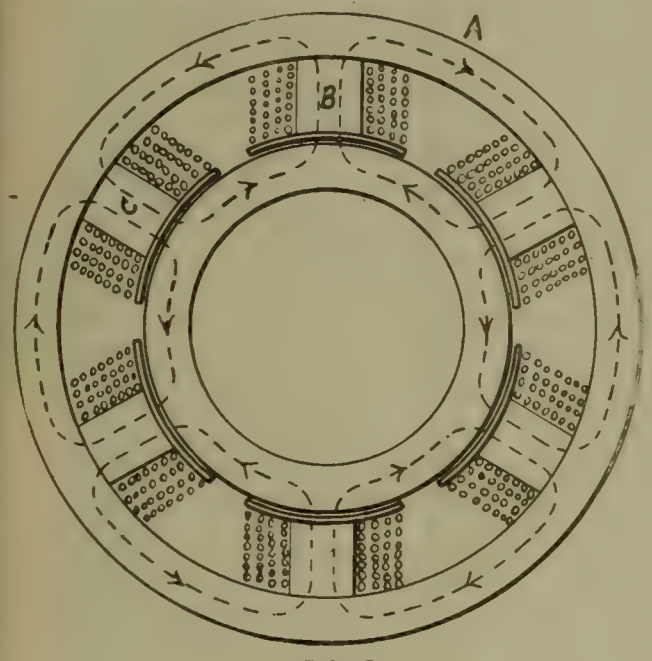


FIG. 1.

In the light of this experiment it is proposed to consider briefly some of the principles which govern the action of multipolar machines, and to demonstrate that the obstacles which have heretofore stood in the way of low speed may be, and have been, overcome.

The prime function of an armature conductor is the generation of an electromotive force, the value of which is proportionate to the number of magnetic lines of force cut by it in a given time. Now the number of lines cut per second is dependent upon two factors (1), the total number of lines of force in the magnetic circuit, and (2), the number of times they are cut per second. As our aim is to generate a given E. M. F. at a *lower* speed than is usual, it is evident that the quantities in either or both of the above factors must be increased. In the case of the first we are limited by the saturation point of iron which prevents our indefinitely increasing the strength of the magnetic circuit without adding abnormally to the weight and size of the machine, and even were it possible to do this, an increased exciting current would be required which would detract directly from the total efficiency. We turn, then, to the second factor, and, paradoxical as it appears at first, it is here we find the solution of the problem. How are we to cause an armature conductor to cut a given number of lines of force a greater number of times per second without increasing the speed? In the ordinary two-pole machine the armature conductor crosses the magnetic circuit and cuts all the lines of force twice during a complete revolution, viz., where they enter the armature core at one pole and where they leave at the other. Now, if we so dispose the magnetic circuit as to cause the lines of force to enter the armature core at one point, to leave it at another, to *enter it again at a third point and to leave it at a fourth* it is obvious that the conductor will cut all the lines at four points in each revolution, and that it will therefore generate the same E. M. F. at one-half the original speed. If we increase the number of poles to six we shall obtain the same effect at one-third the speed, etc., etc. This, then, is the principle of construction by which we secure low speed.

It should be noted that we do not increase the number of lines of force in the magnetic circuit, we do not add to the turns of wire in series on the armature, we do not increase the amount of either copper or iron in the entire machine, but we simply cause the armature conductor to cross the magnetic circuit as often in one revolution as it ordinarily does in two or three revolutions, as the case may be. The writer wishes to emphasize these points, as there seems to be some misunderstanding in regard to them. We do not *wind an armature to run slowly*, but we design the machine for low speed. The resistance of our armature is no higher than that of a high speed machine of the same power, its current capacity is not reduced, in fact, as we shall see later, it is increased. The efficiency is no lower, the regulation no less perfect, and the weight and bulk no greater. We see, then, that in theory the multipolar machine is perfect, consequently if any difficulties have been encountered in its practical operation they must be due to some faults of construction, to a consideration of which the attention of the reader is now invited.

If we take as an example a motor having a six-pole field, and imagine the same in action we see that the distribution of potential is such as to form the equivalent of three ordinary armature windings on the one ring and connected to the commutator, which has three times as many segments as that of a two-pole machine. Each of these windings, *i. e.*, the wire lying under one pair of poles, has exactly the same number of turns as an armature of a two-pole machine, but of smaller wire, and carries but one-third of the total current, the three acting together in multiple. This being the case, any relative difference in the strength of the field magnet poles will cause an unequal distribution of potential and current in the armature. This is, in my opinion, the most important point to be considered in the designing of such machines, as any inequality is sure to cause trouble.

In a bi polar machine there is one path for the lines of force, which circumstance insures equal poles, but in the multipolar type, as ordinarily constructed, a variation in the magnetic conductivity of any part of the circuit will cause an inequality.

Fig. 1 represents a form commonly given to multipolar fields. It will be seen that an internal blow hole or hard spot or other imperfection in the casting at A would choke some of the lines proceeding from B, and they would, therefore, flow through C and cause a difference in the strength of the poles. Cast iron should therefore be excluded from the magnetic circuit, there should be no joints, and the number of magnetizing coils should be as small as possible.

Fig. 2 is a diagram of the magnetic circuit of the machine designed by the writer. In this construction there are but three magnets, each being isolated magnetically from the others excepting through the medium of the armature core, and completely isolated from the frame work of the machine. They are formed of plates of soft sheet iron, which are punched to the required shape and strung together on non-magnetic bolts by which they are secured to their supports. A single magnetizing coil forms two salient poles, and, as each magnet is built of a large number of plates, a uniform magnetic conductivity is secured. By this method of construction, all danger of any inequality in the strength of the poles is avoided, and a magnetic circuit without joints and of the lowest possible resistance is secured. It is understood, of course, that in all cases the number of ampere turns on each magnet must be equal.

In proportion as we decrease the "feet per minute" we increase the "pounds raised," or in other words, the mechanical effort or torque is greater in a low speed than in a high speed machine. Extra pains should therefore be taken to secure a substantial mechanical mounting for the armature upon the shaft, and also for the wires upon the core. The armature is therefore built up on eight insulated steel bolts, the ends of which are secured to non-magnetic spiders, which in turn are keyed to the shaft. The wires are wound in longitudinal channels on the periphery of the armature core, which holds the coils rigidly in place, and entirely prevents that minute shifting of the wires which certainly is the cause of so many "break downs" and "burn outs" in armatures. The driving force in a motor and the resisting force in a dynamo is exerted by the armature conductors, and we should always provide a positive mechanical connection between them and the core; friction does not suffice. The importance of this point

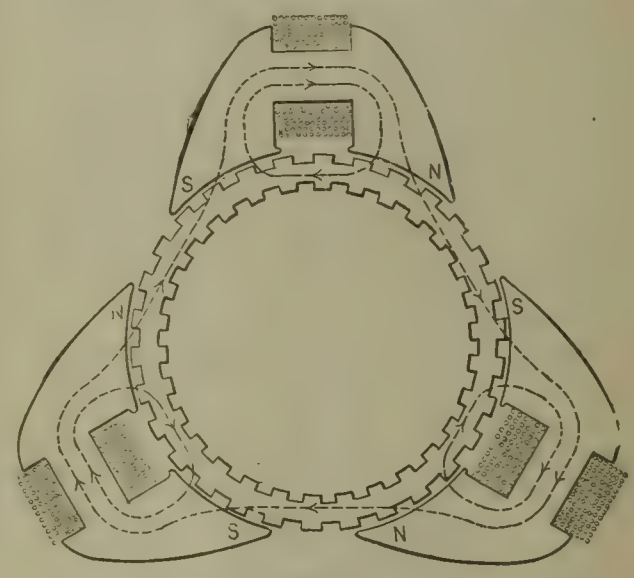


FIG. 2.

is fully understood by Kapp, who writes: "In many machines the friction produced by the binding-hoops is alone relied on to carry the wires through the field; but experience has shown this to be insufficient. Even if the wires are not bodily torn off the armature by the magnetic resistance of the field, they shift and work off the surface of the core; and it is only a question of time when the insulation will be destroyed and the machine break down."

We have a choice of two methods of coupling the armature circuits together in multiple, one of which is by the use of six brushes distributed around the commutator 60° apart, three negative and three positive, and the other consists of a system of cross connections in the armature or commutator which connects those coils which are simultaneously undergoing the same induction; these in a six-pole machine are situated 120° apart. By this means a single pair of brushes suffices and these bear on the commutator at points diametrically opposite, exactly as in a two-pole machine. This method is preferred when copper brushes are used, and I have in use a simple system of cross connections at the back of the commutator, at which all danger of short circuiting is avoided; but the carbon brush is so peculiarly adapted to the method first described that it forms one of the simplest and most reliable means of commutation that can be devised. The high resistance of the carbon brush, as ordinarily constructed, has prevented its universal adoption, but the construction of this machine permits the use of three pairs of brushes, each pair carrying but one-third of the total current, and the resistance is greatly reduced by reason of the increased contact surface.

In a two-pole machine the armature current

is equally divided between two circuits, while that of a six-pole machine splits into six. This the writer considers, in most cases, an advantage, as the current carrying capacity is increased by reason of the greater surface exposed to radiation, and the machine will consequently bear a greater overload without injury, while the wire is not so large as to be unmanageable. In many machines of the two-pole type a stranded armature conductor must be used because a single wire would be too stiff and would heat too much; in a multipolar machine these troubles are avoided.

A great deal has been said and written in respect to the difference of potential that should be allowed to exist between adjacent commutator segments, some writers having advanced erroneous opinions on this point to the disparagement of multipolar machines. One tells us that 10 volts should be the limit because "10 volts will just form an arc," while another puts the limit at nineteen volts and gives the same reason. Now, an arc has to be started or "drawn," and the only time this can happen is when the brush connects two adjacent bars as they pass under it. But this only takes place at the so-called neutral points where the difference of potential between adjacent bars is almost nothing. Theoretically, this difference of potential is simply the product of half the total current and the resistance of the coil connected to the two bars. We see, therefore, that we should not take for a basis of calculation the average difference of potential between adjacent bars for the reason that the E. M. F. of each coil is continually varying from zero to maximum and down to zero again A very clever description of this action will be found in the fourth chapter of S. P. Thompson's "Dynamo Electric Machinery," together with the method used in determining it, and I recommend a perusal of this to the writers referred to.

In a machine wound for 220 volts and having twenty-two coils, acting in series, we do not find a uniform difference of potential of ten volts between adjacent commutator bars, but those coils which are passing the poles are generating fifteen or twenty volts, while those in the neutral zone are generating practically nothing. In some of the most widely used closed coil machines in this country the average difference of potential between adjacent segments is far greater than the limits given by the above mentioned writer. In one of these it is twenty-seven volts, in another fifty volts, and in others it is still higher. Yet these machines give no trouble whatever. Let me not be understood to favor the use of a small number of commutator sections, I simply wish to show that no one is limited to ten or to nineteen volts, average potential difference between adjacent bars. In the machines of my own design which I have partially described, the number of sections in the commutator is ninety-six, of which sixteen act in series. At an E. M. F. of 220 volts they average therefore 13¾ volts each, and 500 volts total E. M. F. they will average 31¼ volts.

As bearing upon some of the statements which I have made I present the following details of my ten and twenty H. P. machine which fairly represent them all.

Ten H. P. 220 Volt Motor,
Speed 600 revolutions per minute.
Weight, 900 lbs.
Resistance of armature, .19 ohms,
Resistance of shunt, .175 ohms.

Twenty H. P. 110 Volt Dynamo (Compound),
Speed 600 revolutions per minute.
Weight. 1,300 lbs.
Resistance of armature, .029 ohms.
Resistance of shunt, 26 ohms.
Resistance of series coil, .007 ohms.

It will be seen that a low speed multipolar machine is not necessarily a heavy one, but that on the contrary it may be made very light. The writer has recently built several twenty-five H. P. series wound motors which weighed 1,300 lbs. each and ran at a speed of 500 revolutions per minute. If one of these were so wound as to run at 1,000 revolutions per minute, it would develop fifty H. P. and weigh only twenty-six pounds per H. P. For traction purposes these motors are designed to run as slow as 450 revolutions per minute and weigh about seventy pounds per H. P.

In regard to their practical operation, I will simply say that the first machines which were constructed, a year ago, have been in constant and satisfactory use ever since and they have proved themselves to be in every respect the equals of the high speed machine.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Nov. 20, 1890.

A movement is on foot among Brockton citizens for the taking of stock by people there in the Economic Electric Supply Co., which has been established a year or so.

There are indications that the electric road from Rockland to Camden, Me., will be built. The streets are being surveyed for that purpose, and Hon. Frank Jones is said to be interested.

The association of the electrical engineers in the Lynn factory, which was such a useful organization last winter, will renew its meetings as soon as proper quarters can be found.

The officers of the Whitman Electric Road Company will oppose the granting of the franchise to the Hatherly Street Railway Co., of Rockland and Abington. This applies only to the granting of that portion of the franchise which allows the Rockland company a location here.

The Electric Light Co., at Amesbury, has just put in a new 200 horse power engine, which will more than double their present motive power. A new incandescent machine of 500 lights will also be put in. The electric cars of the Newburyport and Amesbury railroad are now supplied with power, as well as several factories in the vicinity.

The Quincy and Boston Street Railway Company held a meeting of its stockholders yesterday, and voted to increase the capital stock from $50,000 to $100,000. It is intended to improve the roadbed of this electric road in order to stand the wear of heavier traffic, having been operating in part over a line originally constructed for horses.

The Selectmen of Methuen gave a hearing in the town hall, Nov, 12th, on the petition of the Merrimac Valley Street Railway Co., to use electricity as a motive power for its cars within the limits of the town. The corporation was represented by President Ferguson, Directors Eaton and Oswald, with Superintendent Morton A petition was received from the N. E. Telegraph and Telephone Co., remonstrating against granting the company the right to use the single trolley system, which was claimed would injure the telephone service. The Selectmen will render their decision Saturday, when the petition of the railway company will probably be granted.

Many of the people who see the experimental car running at the Thomson-Houston Works, Lynn, do not realize one of the great benefits that the public will derive from the conduit system of running cars if it can be made successful. One of the worst features to the public in the overhead system is the great noise that is made when the car is in motion. As the new car comes down Federal street and turns into Western avenue, the only thing that is heard is a little squeak as the car turns the corner. If this experiment works successfully it looks as if cities will not only be rid of the unsightly overhead wires, which are now a necessity, but will also be rid of the unpleasant noise.

An adjourned hearing before the Beverly selectmen on the petition of the Naumkeag street railroad to extend its trolley system to Beverly was held in the town hall last Friday. Many of the citizens opposed the trolley system on account of the danger which they claimed threatened life and limb. The storage system was advocated, and nearly all the people showed the strong opposition to the overhead system.

At Hyde Park last week, a gang of Western Union employés was engaged in setting new poles near the O. C. depot, and had got one pole raised as the 3 o'clock express came around the bend. Every one present was horrified to see the pole fall across the tracks in front of the engine. James McKeever, one of the pole men, ran to the small end of the pole to throw the broken cross-arm off the track. He was hit by the engine, hurled to one side and killed instantly, several of the other men had narrow escapes and some were severely bruised. No one seemed to know how it happened that the pole got beyond the control of the men. Deceased leaves a widow and children in Nova Scotia.

The principal assessors of Lowell gave a hearing in the Board of Aldeman chamber, Friday morning, on the petition of the directors of the Erie Telephone Company that an abatement be made of the taxes assessed on the directors in 1889. The claim of the directors is that they are not the owners of all the shares credited to them, and that the property of the company is assessed in the States where business is being done. These States are Ohio, Arkansas, Minnesota, Texas, Wisconsin and Dakota. It is believed that the issue involved in this assessment will be carried to the Supreme Court of Massachusetts. The valuation placed on the shares held by the directors and trustees is $176,000, and the tax called for from each trustee is $2,576.

In the proposed underground conduit of the Western Union Telegraph Co., four lines of three inch pipe, each containing sixty conductor cables, will run from the office of the company, 109 State street, to the Albany and O. C. Depot. One pipe line will run to the N. Y. and N E. railroad station, and another to the Shoe and Leather Exchange, in Bedford street. Six years ago the company built and has since used successfully a conduit for their trunk lines to the Eastern railroad, and the present conduit is to carry out a scheme of connecting the pole-line locations, as they approach the city from east and west, with the main office, thus reducing to a minimum the liability of their new lines becoming inoperative in case of fire or other disaster. The whole is under the direction of Mr. Thos. Roche, Superintendent of the Western Union Co., and the details of the electric work are intrusted to Mr. J. W. Larish, the electrician of the company. The plans, which are very complete in detail, were furnished by D. W. Hyde, Civil Engineer, of Boston.

The Thomson Electric Welding Company has just perfected a machine which will have a large sale as a welder. It is so built that by means of a series of interchangeable clamps it will be adapted to a great variety of work. It can therefore be used by many small manufactures, who could not afford to put in large plants. It will be especially useful in machine shops, repair shops, railway car shops, carriage and wagon works, shipyards or anywhere where welding of a greater variety than quantity is now done by the old forge method. There are three sizes, welding sections from five square inches to small rods. By shifting the clamps, it can be adapted to all sorts of works. The Welding company is receiving many duplicate orders for plants, sent by concerns already using them. In each case they are for larger plants. A recently perfected machine is for welding axes, the dull iron or steel blade. This class of work will demand several hundred thousand welds yearly. The Weed Sewing Machine Company of Hartford, on Wed-

nesday ordered another plant for welding bicycle tires. The Edison company have just ordered three more machines for their Schenectady factories. The Okonite company of Passaic, N. J., which now has three machines in operation, has ordered three more. The Welding company now has three months' work ahead. Lieut. Woods' shell welding machine has been perfected and is now ready.

Rudolph M. Hunter has patented an electric railway, covering the track-rails, a line of poles or supports arranged along the line of tracks, a supply-conductor also supported on the poles or supports and electrically connected at intervals with the working-conductor, an electric generator for supplying current to the supply-conductor, a suspended electric working conductor supported by said poles or supports at an elevation, a car, an electric motor mechanically connected with axle to propel said car, a moving current-collector carried by the car and making a traveling contact with the working conductor and an electrical connection between the collector and motor. W. J. P.

NEW YORK NOTES.

A contract was made on Nov. 18th with the Edison Illuminating Company, for the lighting of the City Hall dome by electricity.

J. H. Mason, electrical manufacturer, of Brooklyn, N. Y., who makes small electric light plants a specialty, reports that he has done more business in the last month than during the entire previous year. His primary battery is meeting with a very large and satisfactory sale.

Architecture and Building, of Nov. 15, published a large lithograph showing the hall and staircase of the new house of Mr. A. S. Hibbard, General Superintendent of the American Telephone and Telegraph Company, in Morristown, N. J. The finish of the room is of the Colonial style, and the appointments are of elegant design, showing that the owner of the house is a man of refined tastes.

One of the novelties to be seen in the store of Alexander, Barney & Chapin, 20 Cortlandt street, is an electric cigar lighter of artistic design. It represents a male and female figure bending forward, in the act of giving a light. The cigarettes (which, of course, are metal), held in the hands of the figures are in close proximity, so that by applying the alcohol-saturated torch to the two points formed by the ends of the cigarettes the circuit is closed and the torch is fired. The affair is very ornamental and attracts a good deal of attention.

At Old Christ Church, 35th street and 5th avenue, is on exhibition a large painting representing the "New Ideal of the Christ." The picture is illuminated by a 32 c.p. light supplied by a battery of Mason's No. 11 cells. From twelve to twenty cells are used according to the amount of light required. From the centre of the dome of the building is suspended another light at a height of 120 feet, also supplied by the same battery, and it illuminates the floor of the church with sufficient light to read by. The object of placing the light so high is to prevent reflection on the picture. This battery plant is giving excellent satisfaction, and is an instance of the convenience and flexibility of this system of lighting. R. J. G.

Combined Lamps.—Arc lamps are sometimes placed in series with groups of incandescent lamps. In such cases the current strength of each group and that of each arc lamp must be the same.

Sudden Death of a Well-known Telegrapher.—Mr. Thomas G. Kennedy, a well-known old-time telegrapher, dropped dead on the 20th inst., of apoplexy. He was for many years one of the night chief operators and was held in high esteem by all who knew him.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Ill., Nov. 22, 1890.

Mr. C. H. Cone has gone out of town on a somewhat extended business trip, and will be away several weeks.

The Belding Motor and Manufacturing Company of this city has increased its capital stock from $1,000,000 to $2,000,000.

The Calumet Electric Street Railway Company, located in this city, has filed certificate of increase of capital stock to $500,000.

Mr. C. B. Hanna, general agent of the Carpenter-Nevens system of electric car heating, is in the city in the interests of that system and will make some tests within a few days.

Storage Battery Traction in Chicago.—The first exhibition of the application of storage batteries to the propulsion of a street railway car given in Chicago was on Saturday, Nov. 22d, when Mr. Hood of the Accumulator Company took a party of some twenty-eight gentlemen over a portion of the North Chicago Street Railway Company's line in a car equipped with the Edco System. The line over which the car was run was on Clark street from Dewey Court north to Lawrence avenue, a distance of 3¼ miles. The trip out was run in 17 minutes and the return made in 13 minutes. The car was driven by two 15 H. P. motors, eighty-eight 23 M. cells furnishing the current. These cells weigh about 40 lbs each. The car is lighted with three incandescent lamps in the inside and one over each platform on the outside, and is provided with two electric headlights. On the car were the following gentlemen: E. H. Sheafe, C. D. Etnyre and S. B. Wadsworth, of the firm of E. H. Sheafe and Company of Council Bluffs, Iowa; J. M. Roach, superintendent; J. Miller, chief engineer and F. L. Thready, general manager, of the North Chicago Street Railway Company; C. B. Hanna, general agent of the Carpenter-Nevens system of electric car heating, Minneapolis, Minn.; L. F. Ziegler of Chicago, and the following representatives of the press: E. V. Cavell and S. L. K. Monroe of the *Street Railway Gazette*, F. K. Bauerlien of the Chicago *Tribune*, L. E. Torrey, W. F. Collins, D. B. Dean, J. B. O'Hara, and F. M. Ireland of the Electric Age. The trip was an enjoyable one, the car voted a success, and Mr. Hood received the thanks of all concerned. The officials of the North Chicago Street Railway Company seem especially gratified with the result of the test.

Columbus Street Railway Convention. A feat of journalistic enterprise was that exhibited by the *Street Railway Gazette*, of Chicago, this week, in connection with the convention held at Columbus, O. The *Gazette* chartered the private car "Baca," and took down to the convention a number of delegates from this city, over the Chicago and Erie and the Hocking Valley Railroad. Many of these gentlemen would probably not otherwise have attended the convention, and the *Gazette* therefore earned the thanks of all present for contributing so largely to make the convention a glittering success. The following gentlemen formed the party: A. H. Englund, of the Electric Merchandise Company; C. K. Harding, President of the Harding Electric Railway Company, of Atlantic, Ia.; Payson K. Andrews, western selling agent of the J. G. Brill Company, Philadelphia; D. F. Morras, western agent of Millican Bros., New York; W. J. Cook, vice-president of the Maguire Manufacturing Company; R. M. Johnson, selling agent of the Northern Car Company, of Minneapolis, and the following gentlemen representing the street railway and electrical press: D. B. Dean, western manager of the *Electrical Review*; John M. Reynolds, proprietor of the *National Car Builders' Supplement*; J. B. O'Harra, associate editor of the *Western Electrician*; W. F. Collins, western manager of the *Electrical Engineer*, and S. L. K. Monroe, manager, and E. V. Cavell, editor of the *Street Railway Gazette*. Mr. Cavell acted as quartermaster of the expedition, and all the gentlemen of the party are enthusiastic in mentioning this item. Mr. C. B. Hanna, of Minneapolis, was to have accompanied the party, but was unfortunately detained at Pittsburgh. The car left Chicago Tuesday evening at 7.45, and returned on Friday morning. At Columbus a banquet was given the delegates at the Columbus Club, twenty-six plates being laid. The banquet was an elaborate affair, a number of happy speeches were made, and everybody left Columbus with the opinion that they had had a glorious time. The gentlemen to whom the courtesy of the *Street Railway Gazette* was extended, will not soon forget the pleasant time they had.

F. M. I.

ELECTRICAL SOCIETIES.

In the Department of Electricity, of the Brooklyn Institute, on Friday evening, Nov. 28th, an exhibit will be made of telegraphic, telephonic, and phonographic instruments and appliances, by members and other electricians. The exhibition will be held at 67 Schermerhorn street.

The Franklin Club is the name of a prosperous society, composed of young men, in Newark, N. J. The object of the club is to carry on experimental work in physics, chiefly in electricity. The club has been in existence about a year, and its rooms are at the corner of Bloomfield and Belleville avenues.

FOREIGN NOTES OF INTEREST.

The trunk telephone wire between Cologne and Coblenz is now completed.

The British Postal authorities will connect the Island of Crete with Benghazi with a submarine cable.

The following figures with regard to the position of the electric light in Switzerland are gathered from a recently published table. The total number of installations at the end of 1889 was 351, of which 11 only were central stations. Of the 340 isolated plants no less than 182 or 51 per cent., were in mills or factories of various descriptions. The number of dynamos running at the end of last year was 408, having a total output of 5.150 kilowatts, or an average of 12.6 kilowatts each; these machines supplied 51,155 incandescent and 845 arc lamps. The eleven central stations are those at Aussersihl, Brunnen, Faido, Geneva, Interlaken, Lausanne, Leukbad, Lucerne, Martigny, Meyringen, and Vevey-Montreux. The stations at Brunnen, Lucerne, and Vevey-Montreux are on the alternate-current transformer system, the others employing the continuous-current system. Power is derived in 177 cases from turbines, in 138 cases from steam engines, in 32 cases from gas engines, in 4 cases from electric motors. Besides these installations there are 24 transmission of power installations, 7 electro motor stations, and 41 accumulator installations. The power transmitted varies from 2 to 280 horse power, and the distance from .05 to 10 kilometres. The number of machines is 76 and their capacity 1,714 kilowatts. The electric tramway at Vevey-Montreux, 10.6 kilometres long with 7 motor cars, and the electric rope railway on the Bürgenstock are included.

Trade Notes.—Messrs. Chas. A. Schieren & Co., of this city, have just furnished the Louisville Cotton Mills Louisville, Ky., with 89 feet of 32-inch, three-ply, Patent Perforated Electric Belt. This is a very heavy belt for the perforated style. The demand for this belt is constantly growing, and all users of it have discovered its merits, and speak in the highest terms of it.

VARIATION OF ELECTROMOTIVE FORCE WITH TEMPERATURE.

A new apparatus—or, perhaps, more correctly speaking, a new *method* by means of which the seat of the variation of electromotive force with variation of temperature may be examined, says the London *Electrical Review*, has been devised by a German physicist, A. Gockel. It consists, in its essential features, as follows:

Four cells are taken and placed at the corners of a rectangle; these are joined up, according as they are required, along the sides of the rectangle by means of siphons, and filled with certain electrolytes.

The cells at one pair of adjacent corners, for example, contain a solution of zinc sulphate, and are provided with zinc electrodes, whilst the other pair of cells contain a solution of copper sulphate with copper electrodes.

It is obvious that this arrangement gives, practically, two Daniell cells, one of which can be warmed in a water bath, whilst the other remains cold, the necessary connection being made by means of the siphons.

By suitable combination, the temperature coefficients of the different contacts may be determined. Gockel shows that from these coefficients the temperature coefficient of the whole galvanic element may be calculated by summation.

It is stated that the agreement between direct experiment and calculation is fairly satisfactory, and this assertion will give confidence to other observers who may be inclined to experiment with this apparatus.

CORRECTION.—In the description of the electrical plant in the *World* building, published in the issue of Nov. 19, an error was made in giving the name of the company supplying the wire. The name "New York Safety Insulated Wire Company" was used, when it should have been "New York Insulated Wire Company," who are the manufacturers of the well and favorably known Grimshaw "White Core" wire.

SWITZERLAND.—Some interesting statistics are given on another page concerining electric lighting in Switzerland. More than one-half of the total power used for running the dynamo is obtained from turbines

A GIRL WORTH HAVING.

A few weeks ago I read in your paper Mr. Morehead's experience in the Plating Business, in which he cleared $167 85 in a month; but I beat that if I am a girl. I sent as he directed and got a Plater, and cleared $208 17 in one month. Can any of your readers beat this? You can get spoons, forks or jewelry to plate at every house. Send $3 to W. H. Griffith & Co., Zanesville, O., and they will send you a Plater, and you can make money enough in three hours to pay for it, or address them for circulars. There is plenty of work to do in both city and country; then why should any person be poor or out of employment with such an opportunity at hand. I hope my experience will help others as much as Mr. Moorehead's did me.

LAURA B.———

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Duralite Company, 85 Water Street.

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Applegates Electric Floor Mat Manufacturing Co., Electric Mats, 37 Market Street.

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Central Electric Co, General Electrical Supplies, 118 Franklin Street.
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Electrical Supply Co., Annunciators, etc., 171 Randolph Street.
Bleckert & Nelson, Electric Light and Combination Fixtures, 83-87 Fifth Avenue.
Electric Merchandise Co., Electric Railway Supplies, 11 Adams Street.
Adams, Waldo P., Electrical Constructor, 144 Adams Street.

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Detroit Motor Co., Motors, 212 Griswold Street.
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Lockwood Instrument Co., Electrical Measuring Instruments, 61 Buhl Block.

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Lennon, J. M., Electrical Expert, 22 Loan and Trust Building.

MONTREAL, QUE.

Ness, T. W., Electrical Supplies, 644 Craig Street.

NEW YORK CITY.

Alexander, Barney & Chapin, General Electrical Supplies, 20 Cortland Street.
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Ansonia Brass and Copper Co., 19 Cliff Street.
A. B. C. Motor Co., 44 Gold Street.
Bergmann Electric and Gas Fixture Co., 527-537 West 34th Street.
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Bogart, A. L., Electrical Gas Lighting Apparatus, 22 Union Square.
Bunnell, J. H. & Co., General Electrical Supplies, 76 Cortlandt Street.
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D. Van Nostrand Co., Electrical Books, 23 Murray St.
Desant Electric Co., Electric Signals, 45 Broadway.
Edison General Electric Co., 44 Broad Street.
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Freeman, Walter K., Transformer System, 150 Nassau Street.
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Lynch, Eugene T., Jr., Electrical Engineer, 120 Broadway.
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Sabine, J. B., Patent Attorney, 181 Broadway.
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ELECTRICIANS IN THE NAVY.

In the annual report of the Secretary of the Navy submitted to Congress December 1st, Secretary Tracy calls attention to the fact that the extensive employment of electricity in its applications on ship-board makes it necessary for naval officers to acquire a certain amount of electrical knowledge. "But it is impossible for all, or even for any great number of them," he says, "to become expert electricians; nor is it desirable that they should do so at the expense of other branches of their profession of more pre sing importance." To meet this want he suggests that a corps of naval electricians be established in the different States that have created a naval militia, to be attached to this militia and to receive the naval training which it is the great object of the militia to give.

"By this means a corps of electrical specialists would be organized, famil ar with the needs and usages of the naval service, and the extended applications of electricity to naval vessels would be rapidly developed in time of peace as well as in war. In the latter contingency the corps would be especia'ly valuable in fitting out new vessels with electrical apparatus, and in taking charge of the electrical plant on board ships in commission. The number of officers available in an emergency would thus be increased, as those now detailed to electrical work could be assigned to other duties, and their work could be carried on by the experts of the naval militia."

A SIGN OF THE TIMES.—The citizens of St. Louis interested in the adoption of electricity as the motive power of the street railway lines have organized for the purpose of compelling the substitution of electric for mule power. There is a big gap between mules and electricity, but all great achievements are accomplished at one stroke.

UNDERGROUND CONDUCTORS FOR ELECTRIC RAILWAYS.

One of the greatest wants in large cities and towns to-day is a practical system of electric street railway that will require no overhead wires. Manifestly the wires must be placed underground if not overhead. An underground system is a great *desideratum* in every large place. Many of our largest cities are helpless witnesses to the progress of much smaller places in the matter of street railway operations. The latter places are using the overhead system with great success, but cities, in most cases, are using electricity very sparingly. Of course there are many good reasons why the overhead electric railway wires cannot be permitted to be erected in large cities, and it is in such places that any other practical system of electric propulsion will be greatly welcomed.

We describe, on another page, a system in which the conductors are placed underground and which seems to have some very meritorious features. It belongs to the class of underground systems in which the working conductor is laid in sections insulated from each other and charged only when a car is passing. The main supply conductor is necessarily continuous, and, in this case, is insulated and protected in the lower part of the conduit. The sections of the working conductor receive their current from the feed conductor by the operation of electro-magnetic devices which are brought into action by the passing car. When the car has passed a section the current is automatically disconnected thereupon and all factors of danger are likewise removed.

The system described is ingenious and, no doubt, the article will be read and studied with a great deal of interest, particularly by street railway managers who are looking forward to the day when horses will be displaced by a successful underground system.

The description of this system will very naturally remind the reader of a similar system invented by Mr. Wheless of Nashville, Tenn., and the Lineff system in England, both of which are of the class using sectional working conductors and electro magnetic contact devices.

The system described is that invented by Mr. C. K. Harding, of Atlantic, Iowa, and it certainly possesses many valuable features.

HEATING STREET CARS BY ELECTRICITY.—A system of heating street cars by electricity is described in another page in this issue. It is that of the Carpenter-Nevens Electro Heating Company, of Minneapolis, Minn., which has explored the field of electric heating probably more than any other concern or individual. They have not only explored it but made a practical success of it. At the recent Exposition at Minneapolis that company had on exhibition various domestic utensils heated, and heated quickly by electricity. There is nothing new in the idea of heating our homes by electricity. The idea will some day undoubtedly assume a concrete form. A near approach to it is the case described in the article referred to. Here is a car heated by electricity by simply "turning a button." We are doing very many things these days by "turning a button." We get light in that manner, also power, and why not heat? The provisions for the distribution of heat in this installation are indeed very ingenious, as will be readily perceived by reference to the illustrations in the article. The variation of the heat is accomplished with great ease, and this is a great feature of the system. The company owning this system of heating deserve considerable praise and encouragement for their enterprise. They have gone further in this field than any one else, and they have accomplished so much that one would seem justified in predicting that our homes and places of business may before long be heated as well as lighted by electricity.

THE LIGHTS WENT OUT.—An embarrassing situation occurred at the White House during the ceremonies on November 28th, attending the presentation to the President, of the officers of the Brazilian men-of-war, now in New York harbor. For the first time in its history the White House was on that date lighted by electricity, and in order to have the electric lights ready for this occasion it was necessary to hurry the work some. The current was turned on for the first time just before the hour for the reception, and the lights shone brilliantly. The curtains of the reception room had been drawn so as to enhance the effectiveness of the scene with electric light instead of daylight, and while in the midst of the ceremonies the electric lights suddenly went out. The light of the orb of day was re-admitted to the room and the ceremonies were resumed. No attempt was made during the rest of the day to try the electric light again.

THE ELECTRIC RAILWAY IN OHIO.—Electricity pervaded the meeting of the Ohio State Tramway Association, at Columbus, Ohio, November 19th, as it did the Buffalo Convention, and it is a noteworthy fact that little of anything else but electricity was discussed. Aside from the practical value of electric propulsion, it is remarkable how the power has possessed street railway managers. There is a veritable stampede everywhere in favor of electricity, and that systems calculated to meet every condition are forthcoming is quite evident to the most casual observer. The underground conduit system received much consideration at Columbus, and it is only a question of a short time, at least, when a successful system of electric railway with underground conductors will be just as much a fact as the overhead system. Much time and experimentation are being devoted to the underground system in many directions, and when it is brought to the condition of perfect reliability and low cost, there are many places ready to adopt it.

SUCCESSFUL WATER POWER ELECTRIC LIGHT PLANT.—The plant of the Willamette Falls Electric Company, of Portland, Oregon, is one of the most interesting in this country. The water power at Willamette Falls is utilized in the generation of the current, and the latter is conveyed to Portland, a distance of 12 miles. The value of the Westinghouse system for long distance lighting is very satisfactorily demonstrated in this case, and the existing plant has so successfully performed its work that it is to be extended to meet the demand for more light. Three thousand volt dynamos are used in the generation of current at the falls.

THE ST. PAUL AND MINNEAPOLIS ELECTRIC ROAD.—The citizens of St. Paul and Minneapolis are becoming impatient over the delay in getting the electric railway in operation between the twin cities. The company, however, expect to have everything ready by the 10th of December, when they will begin operations. Indeed they have already covered much of the ground, and cars are in regular service. When the main line between St. Paul and Minneapolis is completed, and in working order, it will be a triumph of electrical engineering.

TO DIE.—The U S. Supreme Court on November 24, rendered an opinion in the case of Jugiro, the Japanese who is in Sing Sing prison under sentence of death by electricity. It was sought to secure Jugiro's release on habeas corpus, on the ground that the Kemmler case had demonstrated that death by electricity was cruel and unusual punishment, and as such prohibited by the Constitution. Chief Justice Fuller announced the decision of the Court. The Court affirmed the judgment upon the authority of the decision in the Kemmler case.

ELECTRICAL EXECUTIONS.—The Empire State authorities are now busy scouring their dynamo and getting it ready to execute more condemned murderers. It is hoped that better success will attend their efforts than they experienced at the Kemmler execution.

ELECTRIC CAR HEATER.

The accompanying illustrations (Figs. 1 and 2) show a system of electric street car heating now being placed on the market by Mr C. B Hanna, General Agent of the Carpenter-Nevens Electro-Heating Company, of Minneapolis, Minn., and of which the superior points of merit over all others were fully explained by him at the recent Street Railway Convention in Buffalo.

The heater, as shown in Fig. 1, consists of a narrow strip, or ribbon, of asbestos enclosed in sheet iron, about 3'' width and about ¼ in. in thickness, which is intended to extend from one end of the car to the other, under the seats, on both sides, midway between the seat and the car flooring, and protected from the person or clothing of the passenger by a wire screen. It is enclosed on all sides except the face in a copper radiator or reflector in order to divert the heat into the proper channel and to protect against loss. A second strip of iron of the same dimensions is attached to the first strip by a single row of small bolts extending from end to end, thus serving the purpose of a compressing plate and, at the same time, forming the other side of the heater. The resistance wires are imbedded in asbestos, and the compression plates are bound firmly together by means of the small bolts before mentioned, and are located between the two strips of iron. Three or more resistances, of reflex or zigzag form are used which not only extend from end to end of the heater, but also, connected by proper wiring each resistance with its companion on the other heater on the opposite side of the car, so that a single resistance extends not only down one side of the car in both heaters, but also around the car on both sides: in other words, it is intended that from two or three resistances, each one in parallel and independent of the other, extending from end to end of the heater, but each one connected in series with that of a companion on the opposite side of the car, shall be used, in order that, when the circuit is closed upon one of them, a certain amount of it will flow, which of course, with the given number of volts, is inversely as the number of ohms and the heat resulting from the flow of the current through the resistance becomes equally distributed on both sides of the car from end to end, thus increasing the amount of heat evolved. Since two or more resistances are then in the circuit, so, if three resistances are cut in the circuit, the amount of heat will be increased again over that of the other two, and if these resistances have the same number of ohms under all conditions there will be three times as much current consumed and consequently, three times as much heat evolved as when only one resistance alone is used in the circuit. This provision is made in order that the heater may be adopted to any kind of climatic or atmospheric conditions.

With regard to the amount of power required to generate the requisite amount of electricity for the development of the required temperature, it is claimed that 9 amperes of current, equal to about 7½ to 8 H. P., are used at first, but only for a few minutes, after which but 1½ amperes are used.

The current is controlled by the motor-man.

Fig. 2 shows the heater as placed on the Pullman street car—a section of the seat having been removed in order to obtain a view of the heater in position.



FIG. 2—ELECTRIC CAR HEATER.

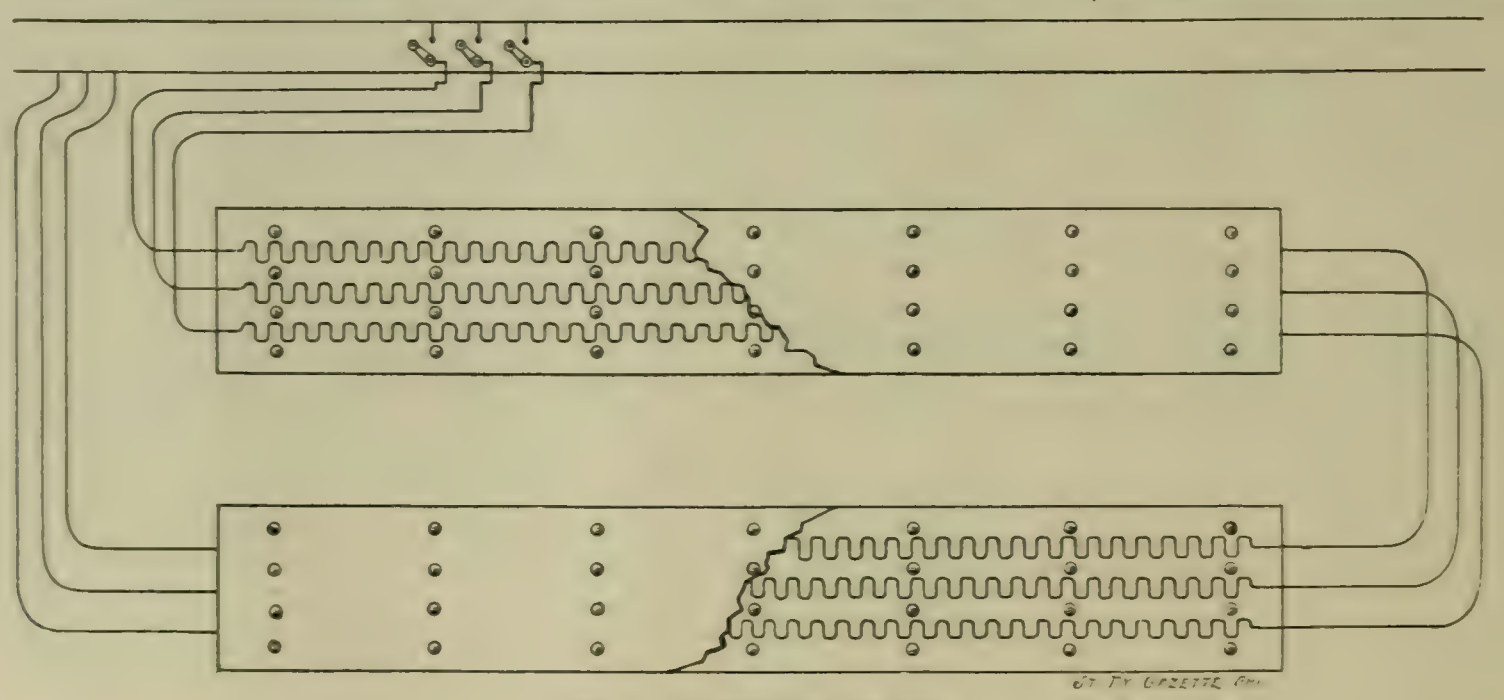


FIG. 1.—ELECTRIC CAR HEATER.

Mr. W. H. Markland, electrician for the P.R.R., at Altoona, Pa., was in town last week.

FIELD MAGNETS.

The proper function of the field magnets in a dynamo or motor is to produce lines of force which pass across the armature core. All other lines which miss the armature are useless and may even be detrimental to the working of the machine. The greater the number of useful lines the greater will be the electro-motive force generated at a given speed and with a given armature. Our aim should therefore be to produce a maximum number of lines, and as a first step towards the realization of this object we must determine the relation between the number of lines and the constructive data of the machine. One of the data is the exciting power, that is, the product of the number of turns of wire wound on the magnet, and the magnetizing current sent through the wire. It is customary to reckon the exciting power in ampere turns, and it is shown by experiment and theory that the manner in which the product is made up is quite immaterial. We may have a large number of turns of fine wire and a small current, or a few turns of stout wire and a large current. The effect will always be the same if the product of amperes and turns be the same. Experiment also shows that for low degrees of magnetization the electro-motive force produced in the armature is proportional, or nearly so, to the exciting power applied to the field magnets; and since electromotive force and strength of field Z are always proportional, we find that in these cases X is proportional to X. We can represent this relation mathematically by introducing the conception of magnetic resistance. According to this there is in every magnetic circuit a passive force opposing the creation of lines, and the number of lines which are created is the quotient of the magnetizing force and this resistance. Calling the latter R, we have,

$$Z = \frac{X}{R}$$

This formula is rigorously correct, provided we succeed in determining the magnetic resistance for every condition of magnetization. For low degrees of magnetization the resistance is nearly constant, and in these cases there exists simple proportionality between Z and X; for higher degrees of magnetization the resistance increases and the relation between Z and X becomes more complicated. A limit is ultimately approached beyond which we cannot increase the strength of the field although we may increase the exciting power indefinitely. In this case the magetic resistance has become infinite, and this condition is generally expressed by saying that the magnet is saturated.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part XVI.—Arc Lamps.

283—How many classes of electric lamps are there?

Two

284—What are they?

Arc lamps and incandescent lamps.

285—What is an arc lamp?

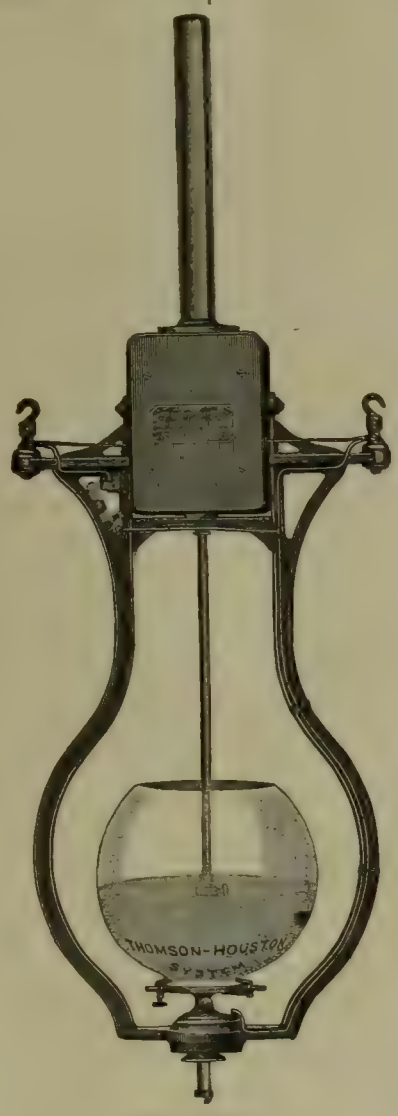
Essentially, an arc lamp is one in which the light is produced by a voltaic arc formed between two or more carbon electrodes.

286—What is an incandescent lamp?

An incandescent lamp essentially, is one in which light is produced by the incandescence, by an electric current, of a strip or filament of suitable material, usually carbon, which is kept in a vacuum.

287—What is a voltaic arc?

A voltaic arc is the brilliant light produced between the two carbon points of an arc lamp.



ARC LAMP.

288—Of the two classes of lights, which is the older, the arc or the incandescent?

The arc.

289—How are arc light carbons made?

Carbons are made by the carbonization of a mixture of pulverized carbon (powdered coke, or gas retort carbon) with different carbonizable liquids. (molasses, tar or any other hydro-carbon liquid). The mixture is then pressed into shape by powerful hydraulic presses, then the carbons are baked at a very intense heat for several hours.

290—What is the object of baking the carbons?

To carbonize the hydro carbon liquid, and giving greater density to the finished carbon.

291—Why are hydro-carbons used in the manufacture of carbons?

To give coherency to the mass

292—Is there but one way of making carbons?

No; there are as many methods as there are manufacturers. Each maker's method differs more or less from all others in the nature and proportions of the ingredients used, and in most cases is a trade secret. But the general method of manufacture is that given in answer to question 289.

293—What is the shape of carbons?

They are usually made with the general dimensions of a lead pencil, that is cylindrical and long as compared with their diameter.

294—Of what length are carbons usually made.

About 12 inches.

295—What is the diameter of carbons?

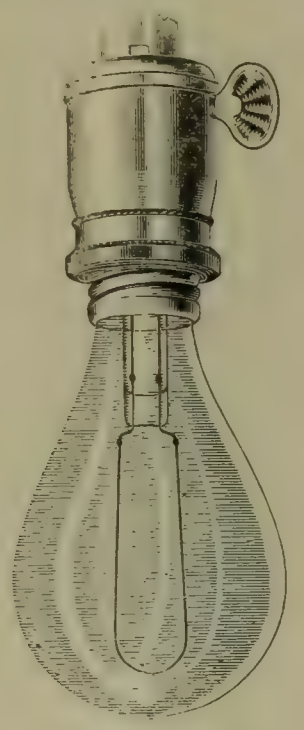
The diameter varies according to the strength of current and candle power of the light for which the carbons are intended. It ranges, however, from 7/16 to half an inch. For very powerful lights, such as are required for lighthouses, or search lights, carbons exceeding an inch in diameter are required.

296—Is the resistance of carbons any serious objection?

Resistance is a very important consideration in electric lighting and various methods of reducing the resistance at the carbons is practiced.

297—Please enumerate the principal methods adopted for reducing the resistance at the carbons.

The most common practice is to plate the carbons with copper or other metal. Sometimes an



INCANDESCENT LAMP,

iron wire is embedded in the centre of the carbon.

298—Is the resistance of the carbon diminished by the copper plating?

No; the resistance of the carbon itself remains unaltered, but the copper surface of the carbon offers a path of low resistance to the current.

299—Is the copper plate heavy enough to cause any interference with the production of the light?

No; it is extremely thin and is readily volatilized by the heat of the arc.

300—How many carbons are generally used in arc lamps?

Some have two and some four.

201—What is the difference between lamps using two carbons and those using four?

The difference is that a lamp having two carbons will give light half as long as one having four carbons.

302—In lamps having four carbons are all in use at the same time?

No; only one set is in use at a time. The second set comes into operation when the first is consumed.

303—What is the rate of consumption of carbons?

Carbons are consumed at varying rates, according to materials used in their manufacture. In practice, however, the usual street light carbons last about eight hours.

304—What are lamps with double sets of carbons used for?

For all-night lighting generally.

305—In practice, to what extent are the carbons separated to produce the voltaic arc?

The most practical length of the arc is from one-sixteenth to one-eighth of an inch according to the amount of illumination for which the lamp is intended.

306—How is the separation of the carbons maintained at a given distance?

By automatic regulation.

307—How is the automatic regulation accomplished?

By the magnetic action of the current itself upon properly constructed mechanism.

308—What is the cause of flickering of the arc light?

The flickering is caused by the consumption of impurities in the carbon, which causes a variation in the length of the arc.

309—What is the cause of the change of color of the arc light?

The change of color is caused by the variation of the length of the arc, or the distance between the carbons. The normal arc gives an intense white light, while an arc longer than the normal gives less light with greater color.

310—Are the carbons in arc lamps of equal length?

In lamps using the direct current, no; in lamps using alternating currents, yes.

311—Why are the carbons of direct current arc lamps of unequal length?

On account of the different rate of consumption in each.

312—Which one of the two carbons is consumed the faster?

The upper, or positive.

313—How much faster is it consumed than the lower carbon?

About twice as fast.

314—Why is the positive, or upper carbon consumed faster than the negative, or lower carbon?

It is supposed some of the volatized particles driven off from the positive, or upper carbon, are condensed on the lower carbon, thus to some extent repairing the loss in the latter.

315—Is the upper carbon always the positive?

Yes.

316—Why?

Because the light is most intense on the surface of the upper carbon, and is radiated therefrom downward.

316—Are the carbons consumed at the same rate when alternating currents are used?

Yes?

318—Why are carbons consumed at the same rate by alternating currents?

Because each is subjected to the same tension or work alternately.

(To be continued.)

* Copyrighted.

MUNICIPAL LIGHTING.—We are in receipt from Mr. Allen R. Foote, secretary of the National Electric Light Association, of a pamphlet containing the paper of Mr. M. J. Francisco, read at Cape May Convention of that Association, together with correspondence with Mr. John P. Barrett, of Chicago, on the subject of Municipal Lighting. It makes interesting reading

LIGHTING MINES.—An estimate has been made which is of the greatest interes to the mining industry. It specifies the relative cost for mine lighting on a colliery raising 1,000 tons a day, of electricity, gas and oil. Under original outlay, electricity is entered as $1.000; gas, main pipes and fittings, as $750. and oil as $400. Under working cost, including repairs and depreciation, per annum, electricity is estimated at $300, gas at $765, and oil at $700. These figures are suggestive as well as instructive.

Messrs. Seimens & Halske, of Berlin, are making a transformer for a tension of 40,000 volts, to be used for testing cables.

NEW CONDUIT SYSTEM OF ELECTRIC RAILWAY.

In view of the great interest taken by street railway managers in electric propulsion, as was shown at the recent convention, in Buffalo, of the American Street Railway Association, the following description and illustrations of the improved conduit system of the Harding Electric Railway Company, Atlantic, Ia., will be read with much interest.

There is no question that a commercially successful electric conduit system will find a very large field for operation.

As the case now stands in the larger cities, where rapid transit is the most necessary, the use of overhead wires, which have hitherto been the only practical method of operating electric railways, have been prohibited.

They are holding off for the appearance of a successful underground system, which many people think will eventually be produced.

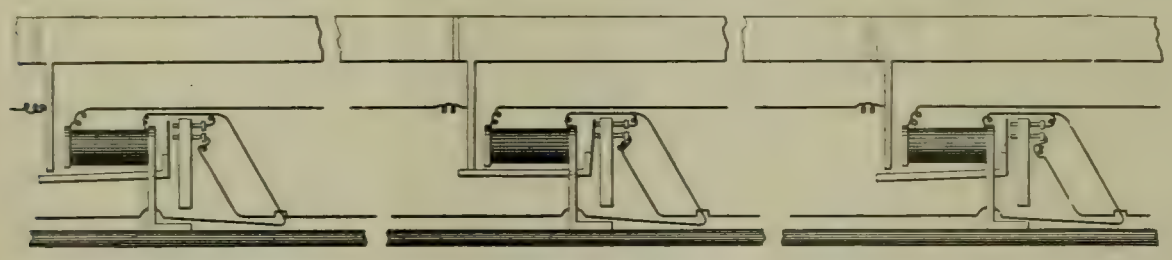


Fig. 1

"In looking for the weak points of electric railways, said Mr. C. K. Harding, the president of the company, in explaining the system, "we will adopt the natural classification made by Dr. Allen in his paper before the Buffalo Convention, *i. e.*:

1. The Central Station.
2. The Motors.
3. The Transmitting Lines.

In the first division there is little more to be desired. We have good engines and efficient generators, and with a system practical in the larger cities, the increased number of cars will make the sometimes very severe vibrations of load relatively much less—thus avoiding the trouble at the central station.

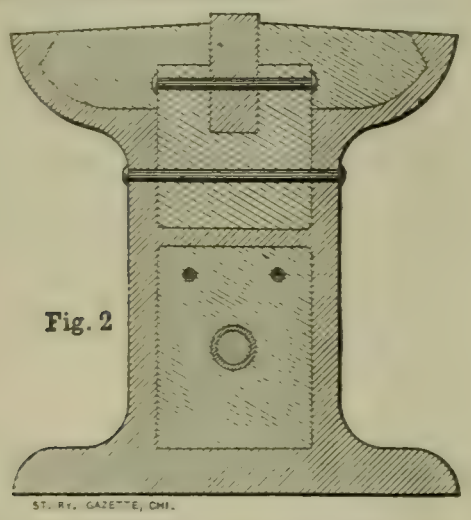


Fig. 2

In the second division the electric car motors are not all that could be desired. The noisy and expensive gearing which a high speed motor renders necessary, and the duplication of motors on the same car, are objections that need not exist in a system using a higher voltage, which would admit of the use of a slow speed motor, with a free running armature and direct gearing, without increasing the weight of the motor beyond a desirable point, or necessitating the employment of a special car for carrying it.

And here we come to the third division, the transmitting device for supplying the current from a central station to the moving car.

And here is the primary cause of all the trouble.

An ideal system would be the overhead wire freed from its objections, which are:

Danger to life and property.

The limitation of voltage made necessary by defective insulation at the expense of economy and distribution.

The liability of dynamos and motors being destroyed by lightning, which no lightning arrester can protect.

The inductive interference with telephones which exist with all but double trolley systems: and lastly, the unsightliness and expensive maintenance of a system of overhead wires and guards.

Storage battery systems overcome a large number of these objections, but contain others which are hardly less important.

The main fault is, however, their lack of economy, caused by the roundabout way of applying the current, and the imperfect manner of storing it.

The fact that with a multitude of enthusiastic supporters for a number of years, it has failed to make any important advances, or to be used on other than a small scale, speaks louder than any criticism for its inefficiency.

Even if the batteries could be made several times more efficient, it could never hope to compete with the direct method, especially one with improved insulation and carrying a high voltage, which could distribute over large areas with practically no loss or drop of potential, caused by the resistance of its conductors. It was to overcome some of the disadvantages above referred to, that I devised the conduit system which I will now describe.

My invention embraces as its principal features, a continuous main or supply conductor, insulated and protected in the tubular lower part of a casing, a cross section of which is shown in Fig. 2; and a series of working conductor sections, insulated and supported in the top channel of the casing, with their upper service exposed and adapted to come in contact with brushes on the car—and electro magnetic contact-making devices, for bringing the conductor sections separately and successively into electric connection with the main insulated supply conductor. These contacts are arranged to be operated by a very small current, derived from the main conductor and extending through branch wires to the adjacent sections, thence through the forward brush to a rheostat on a car, and thence to ground or a return conductor. Fig. 1 shows a working plan of the apparatus; the car itself is supplied with two brushes, at a distance apart, equal to the length of a section of the working conductor, which is laid centrally between the tracks.

The ends of the section are separated by insulated material, and the contact length of each collector is sufficient to overlap this insulation and momentarily receive current from two adjacent sections As a matter of fact these collectors are intended, each to consist of a pair of small wheels running on the supply rail.

Closed at the start, a single one of the switches throws current into one of the sections on which the car rests, and thereafter, whether the car is moving or at rest, the operation of the parts is entirely automatic. Fig. 1 shows three sections of the track and three of the automatic switches. It will be seen that this switch consists of an electro magnet, furnished with an armature which serves to lead the current to a projection from the working conductor.

The opposite end is turned upward at right angles, and forms another switch of which the purpose will be seen later. The terminals of each magnet are connected respectively to the preceding and succeeding sections of the working conductor, to the former through the contact devices shown, and directly to the later.

Suppose now the switch of the left hand section shown open, to be closed, and the rear collector of the car to be just leaving the section, while the forward collector is just passing from the central to the right hand section shown. Current now passes into the first section of the working conductor through the closed switch, and also through the double contacts connected together by the rear end of the magnet armature through the small connecting wire, to and through the magnet of the middle section, and thence to the car, through the forward part of the forward brush. Thus the magnet of the central section will be energized and its armature attracted closing the switch and letting the current pass from the supply conductor to the central section of the working conductor; but as soon as this switch is closed, the magnet of the first section is shunted around by the low resistance of the direct connection between the supply conductor and the central section of the working conductor.

Hence its armature fails, and failing breaks all connection with the first section and leaves it insulated.

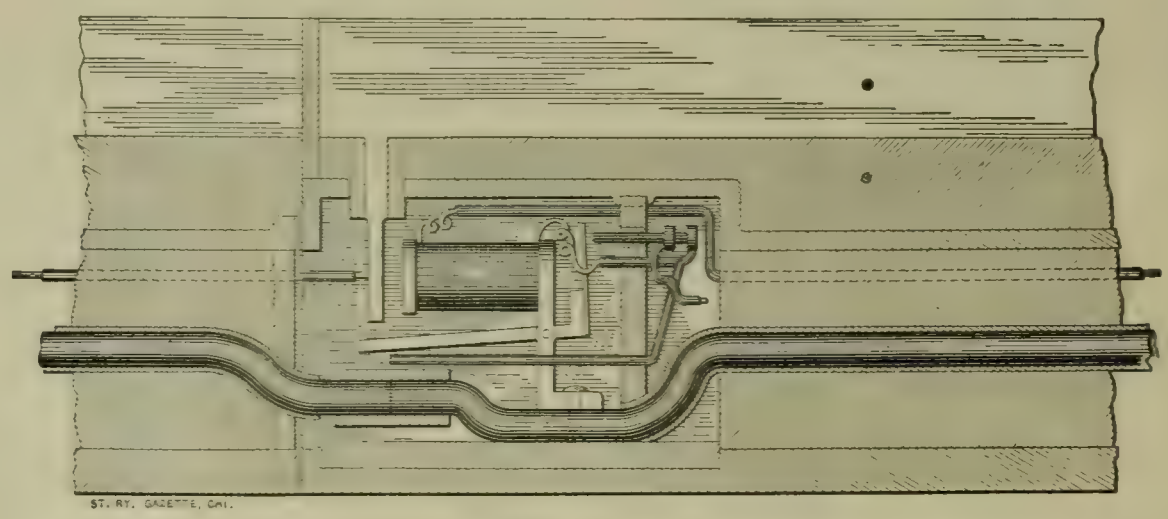


Fig. 3

As the car passes on this operation is successively repeated through the following sections.

The result of this arrangement is a continuous supply to the sections immediately under the car, the remainder of the working conductor being insulated consequently there is but little tendency to leakage and the insulation, usually so difficult, becomes comparatively simple. It will be readily understood, that neither moisture nor a conductor accidentally coming in contact with a section of the working conductor, and grounding it, would cause a short circuit, nor maintain one, after the car had passed; and this is an essential feature, possessed by no other system using a sectional rail method of supply.

The simplest form of electro magnetic contact device would be one in which the magnets would be in series with the motor, but this would require magnets of a large size, wound with a coarse wire and would require a large amount of current to maintain the contact when the car was stopped, and would be liable to sparking and sticking at the contacts. By the arrangement of the magnets in multiple arc, I am enabled to use small magnets wound with fine wire, and to put the whole contact device in a junction box about 3 x 3 x 4 inches, formed by an enlargement of the lower tube. These devices are simple and inexpensive, and may be wound with iron wire, and are adapted to be interchangeable. The whole conduit may be made complete in sections 4 to 6 feet long, and coupled together and put into position in centre on the tracks, without disturbing the track rails already down; the conduit being only about 7 inches high.

It will be seen that the conduit is entirely closed, the main wires imbedded in insulating material in the lower part, and the conductor sections in the upper flaring portion; thus avoiding all the mechanical and electrical difficulties of a slotted arrangement, which is apt to become filled with snow, ice, sleet, mud, etc.

The forward part of the car of my system is preferably supplied with a small revolving brush, which sweeps the top of the conduit, and keeps the conductor sections clean.

The absolute safety of this system cannot be questioned, as the only sections that can carry current are those immediately under the car, and protected by it.

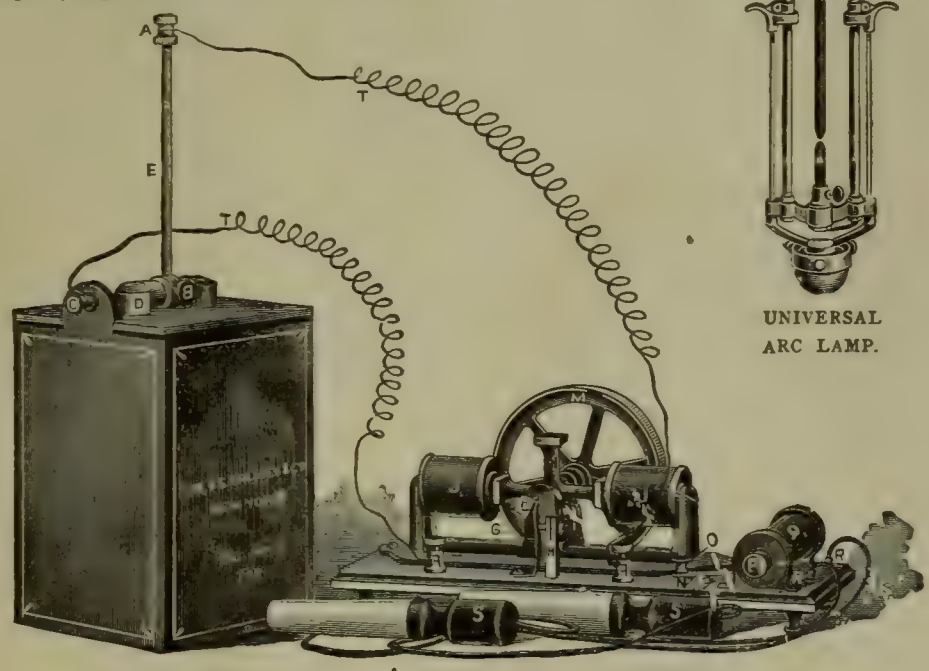
The path for the return current is preferably through the iron casing and the track rails, thus forming a parallel return, which acts the same as a double trolley system, in avoiding inductive interference with telephones.

And the placing of the main wire, under ground, is the only way that it can be effectually protected from lightning.

HOLIDAY MOTOR AND COIL OUTFIT.

The well-known electrical supply house of The E. S. Greeley & Co., 5 Dey street, while giving constant attention to the wants of the higher branches of the electrical trade, do not find it beneath their dignity to devote some time and attention to the little folks, and amateurs, particularly at the holiday season.

The accompanying illustration shows an interesting apparatus which consists of the combination of battery, motor and medical coil. The battery is built under the Nowatny patents and consists of a square shell of carbon which forms one element of the battery and at the same time is the containing vessel for the fluid. Treatment of the carbon on the outside of the shell prevents all leakage. The zinc element is in the form of two fingers which ride upon a central shaft, after the method of the Grenet battery, making a plunge battery, and all that is necessary to be done to put the battery in action is to lower the zinc, and to throw the battery out of action to raise the zincs and fasten in a raised position by means of the small clutch or screw provided for that purpose.



GREELEY & CO.'S MOTOR AND COIL OUTFIT.

The ingenuity of the device is shown in the feature of the circuit breaker or commutator of the motor acting as the circuit breaker of the medical coil, so that no vibrator whatever is required upon the coil, and the coil may be either kept in action or thrown out, as desired. In fact we understand that the outfit is made either with the motor alone, or with the motor and coil combined.

It is claimed that the battery has capacity to run the motor and coil for a period of about twelve hours at a single charging. The active solution employed being bichromate of potash, is readily procurable at all electrical establishments and druggists. The outfit has been christened the Holiday Motor and Coil Electric Outfit.

THE UNIVERSAL ARC LAMP.

There is a large field of usefulness for arc lamps on direct current incandescent circuits. The Universal Arc Lamp Company of 49 West 22d street, this city, has brought out such a lamp, which is claimed to be most satisfactory in its operation. It gives a steady and noiseless light, and can be adjusted for circuits having a pressure from 100 to 125 volts using from 8 to 9 amperes. When burning two in series the resistance is coiled about the chimney at the top of each lamp within which the carbon rod is suspended, thereby rendering any additional resistance unnecessary. The Universal Theatrical Arc Lamp is manufactured by this company for stage uses, to take the place of calcium light. The absence of noise, and its steadiness, make it especially adaptable to this purpose.



UNIVERSAL ARC LAMP.

At the company's place on West 22d street four lamps are exhibited in operation on an Edison incandescent circuit. The light they give is remarkably pure and steady, and the current used is 9 amperes at 45 volts pressure.

The Universal Arc Lamp is said to be very efficient and is giving much satisfaction to all users. The company has met with much success with this lamp and its hands are full of orders.

In this connection it will be of interest to state that the Universal Arc Lamp was on exhibition at the St. Louis exposition, and created a very favorable impression. There are 52 of these lamps now in use in Elgin, Ill., and 50 in Paterson, N. J., and from all reports they are giving the best of satisfaction in their work.

The officers of the company are well-known gentlemen in the electrical field, and their names are a sufficient guarantee that the lamp they collectively represent is meritorious and efficient. These gentlemen are: J. H. McClement, president, E. H. Johnson, F. J. Sprague and S. Bergmann. Mr. E. S. Wendels is general manager.

In the development of the lamp, efficiency was the all-important object of course. But during the process of evolution, the artistic aspect was not lost sight of, and the result is the Universal Arc Lamp possesses the feature of fine appearance as well as efficiency.

AN INTERESTING LIGHT PLANT IN A MINE.

The Westinghouse Electric and Manufacturing Company has just completed the installation of an electric light plant in one of the iron mines of the Lake Superior district. The mine is called the Ashland, owned by the Ashland Iron Mining Company, of Ironwood, Mich. There are over 2000 people occupied in the mine, which is one of the oldest and richest in the Ironwood mining region. Like most of the mines in the Lake Superior ore belt, the Ashland is in some portions considerably damp, and the installation of an electric lighting plant presented therefore a great many difficulties, owing to the trouble of accomplishing a thorough insulation of the wires. The Ashland mine is 720 feet deep and has eight layers. The descent into the mine is made by means of a number of ladders; each of them being 75 feet in length. The dampness in some parts of the mine is extraodinary, and to succeed in making the insulation perfect, the wiring had to be drawn through simplex insulating paint, and only the best Okonite wire was used in the entire plant. The work could only proceed very slowly owing to these obstacles and it took four months to finish the construction of the wiring.

The generating station of the plant is situated in the pump house. The plant has a capacity of two 300-light Westinghouse machines. The switch board is very artistically arranged and is made of a beaten board of white and brown birch wood.

PERSONAL.—Mr. Clarence E. Stump, who for the past eight years has been the business manager of the *Electrical World*, will sever his connection with that paper and assume a like position with the *Street Railway Journal*, on the 1st of January next. We congratulate the *Street Railway Journal* on the acquisition to its staff of this popular and enterprising gentleman, and no doubt the paper will soon feel the beneficial effects of his management. Mr. Stump is vice-president of the company carrying on the business of the *Street Railway Journal*.

THE MAGNETIC PROPERTIES OF IRON.

In his recent lectures on the electro-magnet, before the Society of Arts, London, Prof Silvanus P. Thompson gave a very interesting account of the magnetic properties of iron. As a knowledge of these properties are essential in the proper construction of dynamos, we give herewith this portion of his lecture:

A knowledge of the magnetic properties of iron of different kinds is absolutely fundamental to the theory and design of electro-magnets. No excuse is therefore necessary for treating this matter with some fulness. In all modern treatises of magnetism the usual terms are defined and explained. Magnetism which was formerly treated of as though it were something distributed over the end surfaces of magnets, is now known to be a phenomenon of internal structure; and the appropriate mode of considering it is to treat the magnetic materials, iron and the like, as being capable of acting as good conductors of the magnetic lines; in other words, as possessing great magnetic permeability. The precise notion now attached to this word is that of a numerical co-efficient. Suppose a magnetic force—due, let us say, to the circulation of an electric current in a surrounding coil—were to act on a space occupied by air; there would result a certain number of magnetic lines in that space. In fact, the intensity of the magnetic force, symbolized by the letter H, is often expressed by saying that it would produce H magnetic lines per square centimetre in air. Now, owing to the superior magnetic power of iron, if the space subjected to this magnetic force were filled with iron instead of air, there would be produced a larger number of magnetic lines per square centimetre. This larger number in the iron expresses the degree of magnetization in the iron; it is symbolized by the letter B. The ratio of B to H expresses the permeability of the material. The usual symbol for permeability is the Greek letter μ. So we may say that B is equal to μ times H. For example a certain specimen of iron, when subjected to a magnetic force capable of creating in air, 50 magnetic lines to the square centimetre, was found to be permeated by no fewer than 16,062 magnetic lines per square centimetre. Dividing the latter figure by the former, gives as the value of the permeability at this stage of the magnetization 321, or the permeability of the iron is 321 times that of air. The permeability of such non-magnetic materials as silk, cotton, and other insulators, also of brass, copper, and all the non-magnetic metals is taken as one; being practically the same as that of the air.

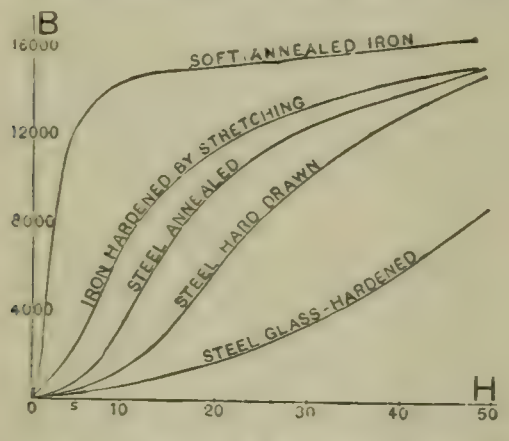


FIG. I.—CURVES OF MAGNETIZATION.

This mode of expressing the facts is, however, complicated by the fact of the tendency in all kinds of iron to magnetic saturation. In all kinds of iron the magnetizability of the material becomes diminished as the actual magnetization is pushed further. In other words, when a piece of iron has been magnetized up to a certain degree it becomes, from that degree onward, less permeable to further magnetization, and though actual saturation is never reached, there is a practical limit beyond which the magnetization cannot well be pushed. Joule was one of the first to establish this tendency towards magnetic saturation. Modern researches have shown numerically how the permeability diminishes as the magnetization is pushed to higher stages. The practical limit of the magnetization, B, in good wrought iron is about 20,000 magnetic lines to the square centimetre, or about 125,000 lines to the square inch; and in cast iron the practical saturation limit is nearly 12,000 lines per square centimetre, or about 70,000 lines per square inch. In designing the electric magnets, before calculations can be made as to the size of a piece of iron required for the core of a magnet for any particular purpose, it is necessary to know the magnetic properties of that piece of iron; for it is obvious that if the iron be of inferior magnetic permeability, a larger piece of it will be required in order to produce the same magnetic effect as might be produced with a smaller piece of higher permeability. Or, again, the piece having inferior permeability will require to have more copper wire wound on it: for in order to bring up its magnetization to the required point, it must be subjected to higher magnetizing forces than would be necessary if a piece of higher permeability had been selected.

A convenient mode of studying the magnetic facts respecting any particular brand of iron is to plot on a diagram the curve of magnetization—*i. e.*, the curve in which the values, plotted horizontally, represent the magnetic force, H, and the values plotted vertically those that correspond to the respective magnetization, B. In Fig. 1 which is modified from the researches of Prof. Ewing, are given five curves relating to soft iron, hardened iron, annealed steel, hard-drawn steel, and glass-hard steel. It will be noticed that all these curves have the same general form. For small values of H the values of B are small, and as H is increased B increases also. Further, the curve rises very suddenly, at least with all the softer sorts of iron, and then bends over and becomes nearly horizontal. When the magnetization is in the stage below the bend of the curve, the iron is said to be far from the state of saturation. But when the magnetization has been pushed beyond the bend of the curve, the iron is said to be in the stage approaching saturation; because at this stage of magnetization it requires a large increase in the magnetizing force to produce even a very small increase in the magnetization. It will be noted that for soft wrought-iron the stage of approaching saturation sets in when B has attained the value of about 16,000 lines per square centimetre, or when H has been raised to the value of about 50. As we shall see, it is not economical to push B beyond this limit; or, in other words, it does not pay to use stronger magnetic forces than those of about H—50.

IRON CORES IN ALTERNATING CURRENT APPARATUS.

BY T. H. BLAKESLEY, M.A., M. INST. C.E.

When the case is one of a transformer the problem may be solved by the employment of three dynamometers in the way I have already pointed out; but in that of an electro-magnet, where we have only one coil to deal with, the problem still admits of solution if we further employ a condenser of determined capacity, and have a knowledge of the period, by means of some speed indicator. The plan is as follows:

Arrangement.—Having the machine and magnet in series, insert the three dynamometers in series immediately at one terminal of the electro-magnet, and place one pole of the condenser to the other terminal, and the second pole of the condenser to that point of the middle dynamometer where its two coils join.

Observations.—Obtain good simultaneous readings of the three dynamometers, and, if necessary, of the speed indicator.

Calculations.—Let a_1, a_2, a_3, be the angles, read upon the instrument (1) in the generating section (2) in the electro-magnet section (3) which has its coils divided.

Let the reducing formulæ for the three instruments be

$$\left.\begin{aligned}(\text{Current})^2 &= k_1\theta\\ \text{“} &= k_2\theta\\ \text{“} &= k_3\theta\end{aligned}\right\}\ \text{respectively.}$$

Let C be the capacity of the condenser.

R “ “ resistance of the electro-magnet section of the circuit.

Then the entire power at work beyond the poles—*i. e.*, the heating of the wire, the heating of the core by induced currents, and the heating of the core due to hysteresis—is expressed by the simple formula:

$$\frac{T}{\pi C}\sqrt{k_1 a_1 k_2 a_2 - k_3^2 a_3^2}$$

T being the semi-period.

The expression itself is independent of the resistance; but if we desire to know the power heating the core, we must deduct from the above result the power heating the wire—viz., $\xi^2 R$.

The difference between these two quantities also happens to be proportional to the tangent of the magnetic lag, another proof of the invariable concurrency of lag and loss of power.

BULL FIGHTING BY ELECTRIC LIGHT.

The enormous building on the Rue Pergolèse, Paris, devoted to somewhat feeble imitations of Spanish bull fights, says the London *Electrical Review*, has been recently covered in, and in order to make use of the edifice at night, either for bull fighting or for concerts, lighting by electricity has been introduced.

The arena is circular, and has a diameter of 197 feet; the dome which covers this, springs from iron columns 98 feet in height, surrounding the arena. From the ground to the centre of the dome is 190 feet. The exterior of the building is in shape a 30-sided polygon, described on a circle whose diameter is 328 feet. There is seating accommodation for 22,000 persons. Light ironwork supports the glass of the dome, the central portion of which can be bodily raised between 12 and 13 feet, so as to ventilate the building in summer. The movable portion of the dome has a diameter of 98 feet. At night, the principal source of light comes from just below the movable roof that is to say, at a height of 197 feet. Here is a sunlight of the Patin type, and, in addition to this, a circle of 150 arc lights are arranged round the dome, the total lighting power being thus brought up to 30,000 candles. The two galleries are each provided with 60 Cance incandescent lamps of 32 candles, and the ground floor passages are lighted by 16 Cance incandescent lamps of 100 candles each, and 16 arc lamps, Patin type, of 8 amperes. The offices and dressing rooms are supplied with 200 incandescent lamps of 16 candles.

Especial attention has been paid to the arrangement, fitting and construction of the engine, boiler, and dynamo rooms, with the result that they are in reality works of art, and will no doubt produce the effect of not only familiarizing numbers with electric lighting, but also of increasing public confidence in this method of illumination, and of extending its application.

There are three Collet boilers, each supplying 3,300 lbs. of steam per hour. One of these boilers is kept in reserve, while the other two feed a Powell engine of 300 H. P., and a compound Chaligny engine of 100 H. P.

The alternating current is produced by a Ferranti dynamo of 3,000 lamps, and 4 Gramme machines of 200 lamps at 8 amperes.

There is also a battery of accumulators for feeding the relief lamps in case of accident to the main lighting.

STORAGE BATTERY.—After the first discharge of a storage battery a thin film of sulphate of lead is formed on each plate.

THE WESTINGHOUSE SNOW PLOW.

A new snow plow to be utilized upon electric street railways, is now being manufactured by the Westinghouse Electric and Manufacturing Company, in connection with the Westinghouse system of electric railway motors. The appliance differs in a good many respects from the old fashioned cylindrically shaped broom, revolving beneath the body of a truck, and sweeping the snow and dirt in all directions.

The Westinghouse snow plow consists of an ordinary car truck equipped with two motors, one of which performs the propulsion of the car, while the other is used to revolve two sets of shovels. These shovels are encased in a circular box, which is so attached to the front of the truck and so designed that it glides closely over the track and the rails of the railway line. As the snow plow moves along, all the snow on the rails is picked up by the circular box. The revolving of the shovels brings the snow to the top of the case, where it is emitted through a spout. This spout can be adjusted with the opening turned towards either side of the car.

The snow plow can be operated night or day, because it is without the objectional features of the ordinary snow sweeper, which makes a great deal of noise and interferes with the regular traffic upon the streets as well as being an annoyance to pedestrians.

The plow has a very neat appearance, it is made of the best material, in fact, mechanically as well as electrically, its construction is equal to anything the Westinghouse Electric and Manufacturing Company ever brought into the market.

NOTES ON ELECTRICAL ENGINEERING AT CORNELL UNIVERSITY.

At the meeting of the Electrical Association on the 10th inst. Instructor Saunders described his method of determining the direction in which lines of force circulate about a wire through which a current is flowing, the basis of his method being the assigning to the line of force the quality of elasticity.

On the 17th inst. Mr. Lindsay, '91, described the "Wenstrom Dynamo." The machine is run at the remarkably low speed of 300 revolutions.

A new belt-testing apparatus has been added to the equipment of Sibley College, through the kindness of Wm. Sellers & Co.

The principal feature of this apparatus is a costly dynamometer that is peculiarly adapted to practical belt testing, and it is a very valuable acquisition to the college laboratory.

On the 21st Mr. Wm. L. Launders, of the Ingersoll-Sergeant Drill Co., lectured before the Sibley College students on "The Production, Transmission and Use of Compressed Air." Mr. Launders was very impartial in describing the various air-compressing machines now on the market, giving due praise to the excellent features of those in competition with his own.

But with all his impartiality, he seemed to dwell with more pleasure upon the indicated efficiency of the generator, *i. e.*, the efficiency of "production," which was as high as 96 per cent., than upon the efficiency at the point of application of the fluid, which was only about 32 per cent. Surely electricity has not a very formidable opponent in compressed air.

Thomson, R. G., is making an extensive investigation of the Thomson-Houston arc machine, similar to that made of the Stanley dynamo by Tobey and Walbridge, the results of which were recently read before the Institute of Electrical Engineers.

Size of Conductors.—In electric lighting the size of the conductors should be proportioned to the size of the current.

THE ELECTRIC LIGHT.

The Willamette Falls Electric Company, of Portland, Ore., is making some additions to the capacity of its electric lighting plant. The central station was put up somewhat more than a year ago, and installed with Westinghouse alternating current apparatus of a capacity of six thousand incandescent and two hundred arc lamps. The plant is situated at Willamette, where the water power of the "Falls" is utilized in the generation of the electric current. From the generating station to Portlaind is twelve miles, and for the purpose of transmitting the current over this distance, the installation consists of three thousand volt dynamos. The light and the plant in general has given great satisfaction. The demand has increased, and the company has given the Westinghouse Electric Manufacturing Company the contract for apparatus to furnish an additional one hundred arc lamps.

A new electric lighting company, the Electric Contract Co., has been established in Philadelphia, and has contracted with the Westinghouse Electric Manufacturing Co. for the installation of 750 incandescent and 300 arc lights.

CONCENTRIC CONDUCTORS IN ELECTRIC LIGHTING.

The currents in the Ferranti mains running from the Deptford Station, London, will have a pressure of 10,000 volts. The mains consist of two concentric copper tubes insulated from one another, the outer one being placed to earth; inasmuch as its resistance is very low and no access can be obtained to the inner conductor, the danger to life is eliminated. The object of using tube in place of solid core is that high tension currents tend to travel near the surface of the conductor, so that the central portion would carry but little current. Faraday was probably the first to show this phenomenon for static electricity, and Sir William Thomson has proved it for alternating currents, but the reasons are not the same as in the case of static electricity. The cable was designed by Mr. Ferranti. It must be borne in mind that the stress in the substance of any conductor is but small. The strain is in the insulation surrounding it, be this an insulating material or the air. Sir W. Thomson and others have now proved that the energy of the current travels through the dielectric (insulation) and the conductor acts simply as a director. Hence the current enters the conductor from the outside surface. If the alternations are very rapid, no time is permitted for the current to penetrate far into the conductor, and, consequently, only the outer shell is used to convey the current. Hence also the resistance of the conductor will vary with the speed of the alternations. since the useful area of the wire varies with this speed. The insulation may be compared to a steam-pipe, which bears the pressure of the steam and consequently is under great strain, but there is no true analogy. It will, therefore, be a question to be decided in the future, how long the various insulations now in existence will last, when placed under great stresses. Many laboratory experiments have been made for ascertaining the life of the material. But common sense would seem to indicate from experience in other matters, that the conclusions derived from such experiments are not final, unless time enters as a factor.

Electric Micrometer.—Shoe manufacturers are interested in a new instument, the electric micrometer, which is applied to the sorting of pieces of leather according to their thickness, and distributing them in separate receptacles, its capacity in this line extending to the separation of taps which vary in thickness as little as 1000th of an inch, and this at the rate of 5000 taps an hour. Besides sorting the pieces of leather, the machine automatically records the number placed in each receptacle. When the apparatus is in operation all that is required of the attendant is to put the taps in a trough-like box. A follower is then adjusted behind the taps, which keeps them in an upright position, and maintains a constant pressure as they are fed from the trough into two abutting fingers, the taps in return being fed from the trough into micrometer fingers, which pass successively into position. The fingers, which are fed around by a ratchet movement, pause a short time over the receptacle for taps, and when a micrometer finger reaches one of these bins in which the tap that it holds should be dropped, the inner extension of the finger touches an electric contact and the tap falls from the jaws. The operation of the finger is made to actuate a counter, which indicates the number of taps in every receptacle.

The Telephone.—In the fight for the telephone field, which will inevitably begin as soon as the Bell patents begin to expire, says a Boston exchange, the Bell Telephone Company, or rather the sub-companies of which the Bell company owns a majority of the stock, will have decidedly the advantage. They will have the plant, the prestige, the patronage, and last but by no means least, they will have plenty of money with which to fight. To show how competitors will be treated it is only necessary to instance the case of a local company at Peterborough, Ont. The new company entered the field with the avowed intention of doing business at half the rates of the Bell company, claiming also that they could at this rate pay larger dividends to shareholders than was ever paid by the Bell company. When the small company had proceeded with i s installation to pretty near the limit of the capital at command, the Bell company announced that it would give all old subscribers not interested in the new company and all new subscribers telephone connections free until competition ceased. Under these conditions the fate of the new company can only be to die for want of nourishment.

Electric Meters.—For measuring the amount of energy delivered over a period of time, there are many meters corresponding to gas meters. All of them depend upon one principle, namely, an electrical apparatus working a train of wheels which revolve indicating needles over dials, the revolution being faster or slower according as more or less current is passing. The full meters generally used are termed current meters, since they take no notice of the pressure of the current. But there are forms of meters which take this into account, when the reading gives, not the quantity of current which has taken, but the quantity of energy consumed. When the current in the mains is at a fairly constant pressure, it is necessary only to know the quantity of current which has passed through the instrument. But where a meter is employed to ascertain what payment should be made to a public company, the simple registration of current delivered is manifestly unfair, for its pressure may at times have been below the normal pressure contracted for; so that in these cases either a meter indicating energy should be employed, or a strict public surveillance must exist, in order to compel every public company not to permit the pressure to fall below that contracted for, in the same way as gas companies are treated.

The New York Electrical Society.—On the evening of November 22 the New York Electrical Society, on the invitation of Mr. R. R. Bowker, first vice-president of the Edison Electric Illuminating Company, of New York, inspected the station of the latter company on 26th street, near 6th avenue. The entire station was thrown open to the members, and Mr. Van Vleck, the chief electrician of the company, explained the electric plant, the steam plant, and the details of the switchboards, underground service, etc. The visit was greatly enjoyed by those who accepted the invitation of the company. This plant is one of the model ones in the city, and there was much of interest to be seen.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED NOVEMBER 18TH, 1890.

440,614. Electric Switch. Ernest T. Barberie and James Des Brisay, New York, N. Y. Filed Apr. 8, 1890.

440,627. Electric Meter. Sebastian Z. De Ferranti, Hampstead, County of Middlesex, England. Filed Oct. 9 1888. Patented in England.

440,640. Electric Welding Transformer. Hermann Lemp, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed Apr. 16, 1890.

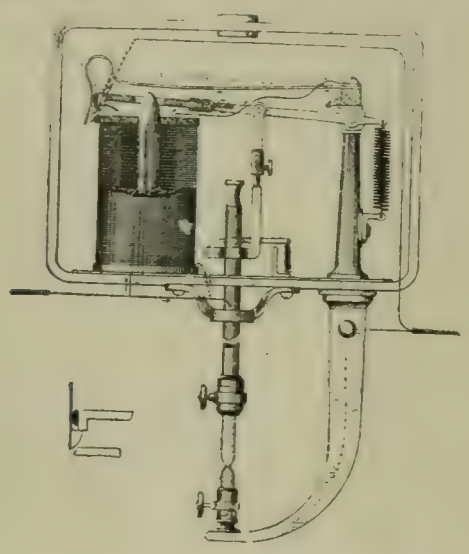
440,641. Electric Welding Apparatus. Hermann Lemp, Lynn, Mass. Filed June 13, 1890.

440,654. Lightning-Arrester. Edwin W. Rice, Jr., Lynn, Mass. Filed Aug. 15, 1889.

440,662. Electric Arc Lamp. Elihu Tomson and Edwin W. Rice, Lynn, Mass., assignors to the Thomson Houston Electric Company, of Connecticut. Filed Jan. 3, 1884.

440,663. Electric-Arc Lamp. Elihu Thomson and Edwin W. Rice, Lynn, Mass., assignors to the Thomson-Houston Electric Company, of Connecticut. Filed Jan. 3, 1884.

440,664. Method of Electric Welding. Elihu Thomson, Lynn, Mass., assignor to the Thomson Electric Welding Company, of Maine. Filed May 15, 1888.



NO. 440,662.—ELECTRIC ARC LAMP.

440,665. Trolley-Arm for Electric Railways. Elihu Thomson, Lynn, Mass. Filed Mar. 5, 1889.

440,685. Electric Cut-Out. George H. Alton and Edwin W. Rice, Jr., Lynn, Mass., assignors to the Thomson-Houston Electric Company, of Connecticut. Filed Nov. 21, 1889.

440,686. Electric Railway-Car Motor. Isaac F. Baker, Lynn, Mass., assignor to the Thomson-Houston Electric Company, of Connecticut. Filed July 1, 1889.

440,689. Electric-Railway Car. Warren S. Belding, Chicago, Ill. Filed Apr. 21, 1890.

440,691. Electric Collecting Device or Brush. Harold P. Brown, New York, N. Y. Filed June 6, 1890.

440,699. Electric Motor. Charles E. Dressler, New York, N. Y. Filed Apr. 10, 1890.

440,700. Electric Motor and Generator. Chas. E. Dressler, New York, N. Y. Filed May 12, 1890.

440,717. Electric Motor Mechanism. Samuel E. Mower, New Haven, Conn., assignor to Henry G. Thompson and Sons, same place. Filed May 8, 1890.

440,718. Electro-Motor Mechanism. Samuel E. Mower, New Haven, Conn., assignor to Henry G. Thompson & Son, same place. Filed May 10 1890.

440,720. Electric Switch. Charles A. Pfluger, Chicago, Ill , assignor to David P. Perry, same place. Filed Jan 15, 1890.

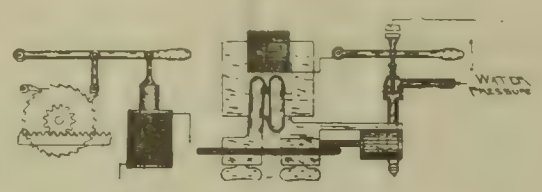
440,759. Apparatus for Flashing Filaments. Hermann Lemp, Hartford, Conn., assignor to the Schuyler Electric Company, of Connecticut. Filed Feb. 1, 1889.

440,766. Telegraphy. Patrick B. Delany, New York, N. Y. Filed May 11, 1886.

440,767. Synchronous Telegraphy. Patrick B. Delany, New York, N. Y. Filed July 30, 1886.

440,768. Multiplex Telegraphy. Patrick B. Delany, New York, N. Y. Original application filed July 30, 1886. Divided and this application filed Dec. 9, 1887.

440,776. Electric Motor. Harry B. Pullman, Cambridge, Ohio, assignor of three-fourths to Charles D. Robbins and Harrison O. Paich, both of Washington, Pa. Filed Aug. 16, 1890.



NO. 440,664.—METHOD OF ELECTRIC WELDING.

440,780. Underground Conductor. Edmond Verstraete, St. Louis, Mo., assignor of one-half to Peter M. Kling and George J. Kobusch, same place. Filed Feb. 21, 1890.

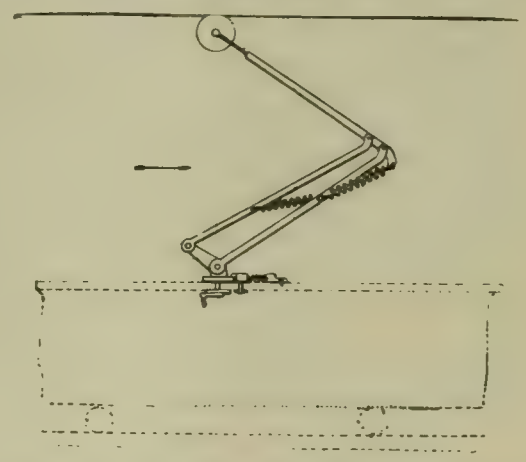
440,781. Trolley or Plow for Electric Railways. Edmond Verstraete, St. Louis, Mo., assignor of one-half to Peter M. Kling and George J. Kobusch, same place. Filed Feb. 21, 1890.

440,789. Overhead Conductor for Electric Railways. Robert D. Cushing, Boston, Mass. Filed Dec. 16, 1889.

440,814. Trolley for Electric Railways. Charles A. Lieb, New York, N. Y. Filed June 13, 1890.

440,817. Yoke and Brush Holder. Frank B. Rae, Detroit, Mich., assignor to the Detroit Electrical Works, same place. Filed Aug. 9, 1890.

440,821. Electric Motor. Leo Bock, Jr., New York, N. Y., assignor, by direct and mesne assignments, to himself and Charles L. Wright, same place. Filed Aug. 20, 1889.



NO. 440,665.—TROLLEY ARM FOR ELECTRIC RAILWAYS.

440,822. Electric Conduit. Wm. J. Brewer, New York, N. Y. Filed July 15, 1890.

440,845. Electric Switch. Charles H. Herrick, of Winchester, Mass. Filed Aug. 19, 1890.

440,881. Signaling Apparatus for Electric Railways. Frank F. Loomis, Akron, Ohio. Filed Mar. 15, 1890.

440,898. Calling Device for Clock Telephone-Lines. John A. McManman, Wilwaukee, Wis. Filed Mar. 21, 1890.

440,906. Samuel Trott, Halifax, Canada. Filed Apr. 26, 1890.

440,908. Dynamo-Electric Machine and Motor. Frederik V. Anderser. and John O. Girdlestone, London, England. Filed May 13, 1890. Patented in England.

440,925. Railway Signal. Joseph W. Riggs, Minneapolis, Minn., assignor to the Riggs Electric Traveling Danger Signal Company, same place. Filed Aug. 31, 1889.

440,926. Railway Signaling Device. Joseph W. Riggs, Minneapolis, Minn., assignor to the Riggs Electric Traveling Danger Signal Company, same place. Filed Sept. 12, 1889.

440,927. Railway Signaling System. Joseph W. Riggs, Minneapolis, Minn., assignor to the Riggs Electric Traveling Danger Signaling Company, same place. Filed Sept. 12, 1889.

440,976. System of Electrical Transmission of Power. Charles J. Van Depoele, Chicago, Ill. Filed May 10, 1886.

440,977. Generator for Pulsating Currents. Charles J. Van Depoele, Lynn, Mass. Filed Apr. 17, 1890.

441,030. Train-Signal for Railroads. William D. Sheldon, Providence, R. I. Assignor to Nicholas Sheldon, same place. Filed June 15, 1889.

441,031. Train-Signal. William D. Sheldon, Providence, R. I., assignor to Nicholas Sheldon, same place. Filed Sept. 20, 1889.

441,033. Train-Signal for Railroads. William D. Sheldon, Providence, R. I., assignor to Nicholas Sheldon, same place. Filed May 15, 1890.

441,034. Lighting Railroads, William D. Sheldon, Providence, R. I., assignor to Nicholas Sheldon, same place. Filed May 15, 1890.

441,043. Underground-Wire System. Edmond Verstraete, St. Louis, Mo., assignor of one-half to Peter M. King and George J. Kobusch, same place. Filed Feb. 21. 1890.

441,044. Electric Railway-Signal. William H. Waddell, Lexington, Va. Filed Oct. 21, 1889.

441,059. Incandescent-Electric-Lamp Socket. James W. Collier, New York, N. Y. Filed Nov. 16, 1889, Renewed Aug. 23, 1890.

441,060. Process of Magnetically Concentrating Ore. Gurdon Conkling, Glens Falls, N. Y. Filed Oct. 12, 1889.

441,066. Thermal Protector. Hammond V. Hayes, Cambridge, Mass., assignor to the American Bell Telephone Company of Massachusetts. Filed July 17, 1890.

THE IMITATION OF SOLAR PHENOMENA BY MEANS OF THE ELECTRIC DISCHARGE.—In a recent communication to the Académie des Sciences M. Ch. V. Zenger states that observations of the effects produced by the Wimhurst machine on smoked glass plates led him to experiment with a view of obtaining an electrically produced imitation of various well-known solar phenomena. A large sheet of glass well dried on one face and covered with lamp-black on the other was placed between the terminals of a Wimhurst machine. The + pole was brought very close to the blackened surface, in the centre of which there was a circular tin disc. The – pole was from 10 to 20 cm. distant from the other side. Sparkless discharges disturbed the blackened surface, and a representation of the lines of electric force was drawn upon the glass. The result was a striking reproduction of a total eclipse of the sun, the metallic disc representing the moon. The lines of force produce around the edge of this disc all the chromospheric phenomena witnessed during a solar eclipse, such as eruptive, linguiform and auroral protuberances. If the experiment is carried out in a dark room red flames may be seen coming from the edge of the disc, which exactly resemble in form and color those visible during a solar eclipse. Blackened glass balls submitted to the Wimshurst discharge exhibit white spots, the photographic negatives of which are precisely similar to those of sunspots.

FILAMENTS.—Broken filaments of incandescent lamps can often be interlocked by slightly jarring the bulb, especially when the filaments are of the corrugated or spiral form, and then the light can be renewed. Such filaments often do good service for a long time.

A MAGNETIC CUT-OUT.

The accompanying illustrations represent a new magnetic cut out, which is being placed on the market by Mr. Napier Prentice, of Stowmarket, Suffolk. The cut-out comprises an electro magnet wound with wire, included in or taken as a shunt from the circuit to be controlled, the external wires being secured by the binding screws shown. These screws are arranged on conducting pieces, one being electrically connected with the conducting piece carrying the

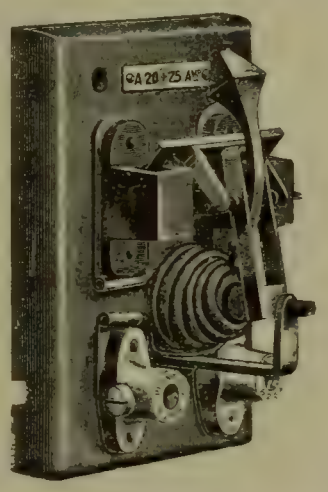


FIG. 1.—MAGNETIC CUT-OUT.

mercury cup on the right, and the other being similarly connected through the coil of the magnet with the conducting piece carrying the second mercury cup. Into these cups dip the ends of the horizontal bridge piece, which is provided with arms carrying the armature. These arms are connected by a cross piece extending behind a vertical lever, which has a counterbalance weight at its upper end, and a tail piece constituting a kicker. The screw shown in front of

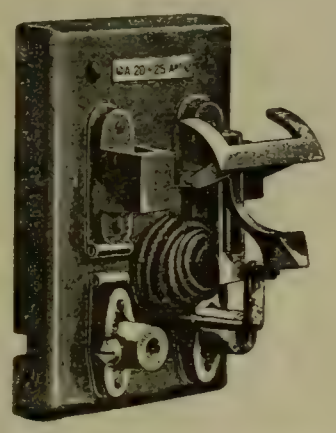


FIG. 2.—MAGNETIC CUT-OUT.

the armature permits of the position of the latter relatively to the end of the magnet core being adjusted. The parts are mounted upon a base of enameled slate. When the normal current is passing, the armature, bridge, arms and lever remain as shown in fig. 1; but on the current increasing abnormally, the electro-magnet attracts the armature and the cross piece moves the vertical lever so that its weighted head causes it to fall over in such a manner that its tail end kicks the bridge and knocks it over into the position shown in fig. 2, thus removing the contacts out of the mercury cups and breaking the circuit.—London *Electrical Review.*

According to a table prepared by Dr. Brsillon, the number of arc lamps used in Paris in 1885 was only 68; last year the number had risen to 393 arcs and 6,188 incandescents. The fires officially stated to have been caused by electricity had risen in the same period from 1 to 33.

A travelling testing laboratory on wheels for use when repairing cables, is used by a Paris electric lighting company. The van is fitted with a battery and testing instruments, including a photometer, and is large enough to hold two persons.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Nov. 26, 1890.

The Pulsion Telephone Company will shortly move their headquarters from No. 13 School street to Bedford street.

Under the statutes and ordinances recently passed Brown S. Flanders was appointed inspector of wires, at a salary of $3,000 a year.

A charter has just been issued to the Spring Garden Electric Co., of Philadelphia, with a capital of $10,000, and as directors, Aaron Fries, J. J. Martin, and others.

The new Corliss engine has arrived for the United electric light plant, at Springfield. It is the largest in that part of New England, the capacity being 800 horse power.

The Selectmen of Camden have revoked permission given to the electric railroad to lay tracks in the streets of Camden. The railroad people are still surveying the streets.

The cars on the Whitman & Brockton electric road will be started about December 1. The officials of the local company will celebrate the event with a public banquet and speech-making.

There is talk in Gardiner, Me., of establishing an independent electric light and power plant, to furnish power for a new mill, and electric lights for the extensive saw mill of H. W. Jewett & Co.

The franchise granted the Hatherly company, of Rockland, provides that they shall construct that portion between Auburnville and the village before building from the Abington line to West street.

The Ayer Electric Light Co, Dr. B. H. Hartwell, president, intend taking immediate steps toward putting in a system to comprise Ayer, Shirley, and Groten. The Groten Episcopal School will also be supplied.

Work on the large dam in the Farmington River, at Tariffville Corner, is progressing slowly owing to high water. The erection of poles and wiring to Hartford will soon begin and the transmission of the electric current for power purposes will soon follow.

Mr. W. B. Lewis of the Thomson-Houston Company, delivered a lecture before the Young Men of St. Andrew's Chapter, Lynn, a few evenings ago. His subject was "Electricity and some of its Applications," and he handled it in a masterly way. He illustrated his theme with several practical experiments.

The subject for the third lecture in the Read Fund course, Newtown, which occurred November 26, was "The Telephone," and lines from New York, Baltimore, Albany, and other distant points were connected with the hall, thus enabling the audience to hear speeches and music in those places by means of the telephone.

J. F. Baker, of Lynn, has patented an electric railway car motor, the combination, with a railway car or vehicle, of a propelling electric motor therefor, sleeved at one end upon the railway car axle, and supported at its opposite end by a slide free to move in a longitudinal direction and having a rounded bearing surface.

The People's Co operative Electric Lighting Co., of New Bedford, Mass., will soon begin operations. The by-laws which were drafted a few days ago will be formally presented at a special meeting of the company to be held next week. An electrician is busily preparing estimates regarding the cost of light and the amount of business that may be expected.

Representatives of the Columbus, O., consolidated street railway system were at the Thomson-Houston Company's factory a few days ago, and were taken around the Highland circuit. This company has decided to at once equip two of its lines with the overhead system, and others will follow. It has already given a $1,000,000 order.

An electric hoist of the Thomson-Houston type has just been installed on the dock of the Merchants' and Miners' Transportation Company, Boston, for unloading vessels.

The Selectmen of Danvers held a conference with the officials of the telephone company, November 20th, and the whole matter of difference was referred to Superintendent Lynch for the town, and Mr. Duxbury, of the telephone company, and it is probable that the telephone company will be granted a new location away from the electric light wires, so that the town will not be obliged to run double lines for their lights.

Twenty-five new electric snow ploughs, much heavier than those in use last winter, have been ordered by the West End Railway Company of this city, and four of them are already completed. The electrical equipment is complete and thorough. There are two 15 horse-power motors inside the car. These are of the ordinary railway type. Being inside the car body, they are protected from the rain, storm and wind. The ploughs are all equipped with a powerful brake, which requires no turning of a spindle, but simply the pressure of a man's foot. The results are instantaneous and effective.

G. H. Alton and E. W. Rice, Jr., of Lynn, have patented an electric cut-out, the combination, with two pairs of fuse clips, each consisting of spring jaws which project perpendicularly to their back so as to present their mouths, or openings, outwardly, of a fuse blank comprising a plate of insulating material having conducting ends to which a fuse wire is electrically connected, said fuse being adapted to be forced into the clips or holders with its conducting ends in contact therewith by bodily movement of such fuse toward the plate or support carrying the clips.

The order passed by the board, November 17, authorizing the Boston Electric Light Company to erect poles on certain streets of the city was vetoed by the mayor. In his veto message the mayor stated that the order was passed under a suspension of the rules and without public notice, and that the people in Columbus avenue were almost unanimous in their objections to the erection of the poles in the avenue. The vetoed order named Dorchester street as well as Columbus avenue. Chairman Wilson ruled that the veto did not apply to the entire order. The veto was unanimously sustained. Alderman Flood offered an order which was passed authorizing the company to erect poles in Dorchester street, as the vetoed order provided, and to which there were no objections.

The nominating committee of the Boston Electric Club has announced the following ticket for officers and directors for 1891: President, Capt. Eugene Griffin; Vice-presidents, C. J. H. Woodbury, C. L. Edgar; Treasurer, F. J. Boynton; Secretary, R. F. Ross: Historian, George W. Mansfield; Directors, one year—J. Edward Addicks, George E. Hanson, John C. Wilson, Wm. Brophy, Charles B Burleigh; two years—A. L. Rohrer, Henry B Cram, R. F. Ross, L. S. Dumoulin, George B. Neal; three years—F. J. Boynton, Frank H Monks, George W. Adams, Wm. C. Woodward, W. J. Denver; four years—Frank Ridlon, E. H. Hewins, J. R. Lovejoy, W. D. Warner, C. W. Holtzer.

C. J. Vandepoele has patented a system of electrical transmission of power, the combination, in an electric railway, of a supply circuit extending along the line and carrying current of substantially constant potential, a motor car making a tracking connection with the supply circuit, a momentum generator upon the car and in cir-

cuit with the main line, and consisting of an electro-dynamic machine connected in series and having a field magnet of normal capacity, and a series of supplemental field magnet coils, all in series with the normal field magnet and with the armature, terminals extending from the supplementary field magnet coils to a series of insulated contacts, a movable contact device, and means for actuating it, the position of the commutator brushes to change the machine from a motor, when not performing work, to a momentum generator, actuated by the momentum of the vehicle.

Mr. C. H. Bayley, of Boston, has devised and patented a revolving sign for use on street cars at night. The object of the invention is to show on the street the destination of the car. In the day time revolving visible signs are generally used, but of course, these do not answer the purpose at night. To overcome this difficulty is the object of Mr. Bayley's invention. The device is simple in construction, consisting of a wooden frame of about the same size as those now used in the day time. One end is supported by and revolved upon by a piece of hollow tubing. This tube is held in place by a bracket, through which it passes, the bracket, of course, being fixed to the top of the car. This tube extends to the centre of the sign, and has on its inner end an incandescent electric lamp, the wires passing through the tube. The sides of the frame are left open for a panel of ground glass, which slides in from the end, the glass panel bearing the lettering. This may be used with a lamp instead of an electric light, and so attached to a street car. It adds nothing to the cost of running, and is undoubtedly a device which would be highly appreciated by the traveling public. W. J. P.

NEW YORK NOTES.

The Penrhyn Slate Company report large orders for their goods for electrical purposes, such as bases for switches and cut outs. For such purposes it is said the slate gives great satisfaction.

The Independent Bung Company are showing some excellent samples of wire moulding for indoor electric light work, and they report increasing demand for their goods. The low cost of these mouldings is bringing in large orders.

A visit to the works of the Weston Electrical Instrument Co., Newark, N. J., found this enterprising concern full of business, and about settled in their new and handsome quarters, 114–116 William street. The company have every facility in the way of expert help, and machinery of the most improved patterns, as well as many ingenious special tools of their own design, for the perfected manufacture of their standard voltmeters and ammeters. They are at present busy perfecting some new instruments in their present line of manufacture, which are expected will shortly be put before the public.

Corroborative evidence showing the great merit of the Magnolia Anti-Friction Metal, accumulates daily. Mr. C. C. Martin, chief engineer and superintendent of the Brooklyn bridge plant, says regarding his experience with it: "We have used the Magnolia metal for about six months on the crank pin of a 450 horse power Wright engine, and also as packing rings on the piston rod of one of our locomotives. In both cases it has given entire satisfaction, not causing us the least trouble." The Magnolia Anti-Friction Metal Company of No. 74 Cortlandt street, N. Y., are naturally pleased at receiving this high tribute to the value of their metal.

The American Telephone and Telegraph Company, popularly known as the Long Distance Telephone, now has three long distance telephone booths in the corridors of the Astor house. They are elegant little places, and are sound proof. They are kept in use very much of the time, and while inside one feels very comfortable. Turkish rugs cover the floor, and the interiors are beautifully draped. Similar booths are found in all of the principal hotels, railway stations and ferry houses, and travelers find the long distance telephone a great convenience. A year ago the company had 50,000 calls in New York City. Now the figures have run up to 90,000, showing the rapid increase of patronage. R. J. G.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Ill., Nov. 28, 1890.

Mr. W. W. Griscom, president of the Electro-Dynamic Company of Philadelphia, has been in the city the past few days.

Mr. E. R. Gilman, president, and Mr. H. K. Gilman, vice president of the Great Western Electric Supply Company, have been in Chicago the past week.

The Monticello Supply Company has been formed at Monticello, Ill., to supply electric light and power, and steam heat; capital stock, $15,000; incorporators, W. E. Smith, Reber Houston, and H. E. Huston.

The Love Electric Traction Company has just been formed in this city with a capital stock of $10,000,000; incorporators, H. M. Hibbard, J. C. Love, A. G. Wheeler. The company propose the introduction of a new system of electric traction on the conduit plan, and expect to construct works near Chicago for the manufacture of cars and appliances.

The handsome little special circulars gotten up by the Central Electric Company, exhibiting a piece of Okonite wire that has been in use for five years, and which was referred to in these columns in a late issue, has attracted much attention, and the company has received numerous applications for specimen circulars to frame and be kept as souvenirs.

The Central Electric Company have obtained patents on a new form of glass insulator, especially designed for heavy railroad work. It is estimated that this insulator will increase the insulation resistance of a line at least 100 per cent. Unfortunately the cuts describing the article could not be obtained from the artist in time for this issue, but we expect to have them in our next.

The Central Electric Company report a continually increasing demand for improved Candee wire, and in order to meet this demand, have stocked their warerooms with a larger quantity than ever. As an instance of their unequalled facilities for doing business in a hurry, they received an order last week for 12,000 pounds of this wire to be shipped with a rush, and the wire was at the freight depot in less than one hour after the order passed through the office.

The Highland Park Electric Light Company have adopted improved Candee wire for their primary circuits throughout their system and have over fifteen miles of it in use. They report that recently, after three days of continuous rain a test showed that the insulation resistance of the primary circuits were over 1 meg-ohm, notwithstanding the fact that the wires are built through alleys and in a great many cases hang through trees.

The Sperry Electric Mining Machine Company, have installed a plant of their system in the mines of the Nellsonville Coal and Coke Company, at Nelsonville Ohio, consisting of a 50 H. P. generator, 4 669 feet of circuit, and forty incandescent lamps. Two mining machines will be sent down to the mines within a few days. This mine is one just being opened and it is expected that it will be operated entirely with electric machines if the test proves satisfactory. The Sperry company are also constructing an electric locomotive for mine Hanlage, which will be installed at Streator, Illinois, shortly.

Mr. George Cutter will open offices at 303 Rookery Building, this city, about the first of next month, and will handle electrical specialties. Mr. Cutter's name needs no introduction to electrical circles. As a dealer in electrical supplies at 80 Adams street, he built up a large business, which was transferred to the Great Western Electric Supply Company, upon the forming of that company. From that time until his withdrawal from the Great Western Company, which was announced a few weeks ago, Mr. Cutter managed the affairs of that company with great success. Mr Cutter's many friends will be glad to know he is still in the business, and wish him continued success.

NEW CORPORATIONS.—The following companies have been incorporated this week with headquarters at Chicago:

Mutual District Messenger Company, Chicago, for furnishing messengers and messenger service, delivering packages, furnishing and operating fire alarm, police, messenger and all other boxes operated by electricity, etc; capital stock $100,000; incorporators, Harold A. Douglas, George W. Conohen and William Taylor.

Morgan Park Electric Company, Chicago, to furnish electric light, power and heat; capital stock, $25,000; incorporators, F. S. Wheaton, J. H. Westover and George A. Meech.

Electrical Machine Company, to deal in electrical machines and appliances; capital stock, $5 000; incorporators. Everett S. Tomlinson. Henry A. Caldwell and John L. Flannery.

Stiger-Newhall Electric Light Company, at Chicago; capital stock, $20,000; incorporators, C. W. Stiger, Walter C. Newhall, and Charles A. Buell

Franklin-Richardson Company, at Chicago, to manufacture railway devices; capital stock, $50,000; incorporators, Philip Clark, K. Franklin Peterson, and J. R. Billings.

The Universal Power Company, at Chicago, to manufacture motors, cars, and railway appliances; capital stock, $1,000,000; incorporators, Joseph W. Lithgow, A. A. Osgood, and G. B. Johnston. F. M. L.

FUSES.—As electric light wires are liable from accidental causes to become overheated and ignite inflammable matter in close proximity, short fuses of soft metal are placed both in the mains and branch circuits, and wherever groups of lamps, as for chandeliers, or electroliers, are required. If from any abnormal increase of current the temperature of the conductors rises to an unsafe degree, the fuse melts and opens the circuit; the fuses in the main and branch circuits being adjusted to the requirements of each circuit by difference of size, which produces the difference of resistance necessary for the melting temperature; a small fuse being more easily melted by a current of given strength than a large one. These fuses are attached by binding screws, and are easily replaced by new ones when melted.

SWITCH BOARDS.—Every station, whether for arc or incandescent lighting, is provided with a switch board, embracing the terminals of the various circuits properly designated, so that connection between dynamos and the circuits in a large building, or lamp district, can be instantly opened or closed, and the supply of current thus diminished or increased, according to the number of lamps required at different hours. Several circuits may extend from the same dynamo, from different dynamos, or from connected dynamos, to the various rooms or floors of a large building, or the various sections of an extended area in the city; all under control of the operator at the station, so that any particular room, floor, or section, can be either connected or cut off by moving a switch.

TEMPERATURE OF ELECTRIC CONDUCTORS.

An undue increase of temperature is objectionable for three reasons. In the first place it spoils the insulation, reducing the insulating power of the material and rendering it so soft as to allow the conductor to sink through it. This is a very important point, and should be guarded against with great care. It has been proposed to lay underground cables in iron troughs, completely filled with a bituminous compound, in which the cables are to be imbedded. This arrangement would serve excellently well for keeping the cables dry, but it has the great drawback that any compound of that nature does not behave as a rigid body, but rather as a very thick fluid. It is well known that a stick of sealing wax fastened by strings to a card which is suspended vertically, will in course of time bend as if it were a flexible ribbon, and the strings will cut through it. This process goes on even in a cold room, but is accelerated by heat. Now in an underground conductor some amount of heat is always developed, and if we trust the bituminous compound to support the cables we shall find them, after a certain time, at the bottom of the trough, and short circuits will become very probable. The second reason why an increase of temperature is objectionable is that the resistance of the cable becomes greater causing an additional waste of energy. The third reason is that an undue increase of temperature may cause a fire risk at the points where the cables are attached to buildings.

It becomes thus a matter of great importance to determine before-hand what rise in temperature is to be expected in each given case, and if that rise should be found to be greater than appears safe, provision must be made to increase the rate at which heat is carried off. This can generally be done by increasing the superficial area of the conductor. Say we have one circular conductor of 1 square inch area, and find that with 1,000 amperes flowing it would become too hot. Now by spliting up this conductor into 10 separate wires each one-tenth of a square inch cross-sectional area we have not altered the total amount of energy transformed into heat, but we have increased the surface exposed to the cooling action of the surrounding air in the ratio of $1 : \sqrt{10}$, and therefore the 10 thin wires can dissipate more than three times the heat, as compared with the single thick wire.

The tramway at Chemnitz has been acquired by the Allgemeine Elektricitäts Gesellschaft, who intend to work the line by electricity.

Writing Telegraph.—The system of the Writing Telegraph Company of 57 Murray street, is attracting very widespread attention, and it promises to take a very important place in relation to the business world. There is now every promise of a very successful future for this valuable system.

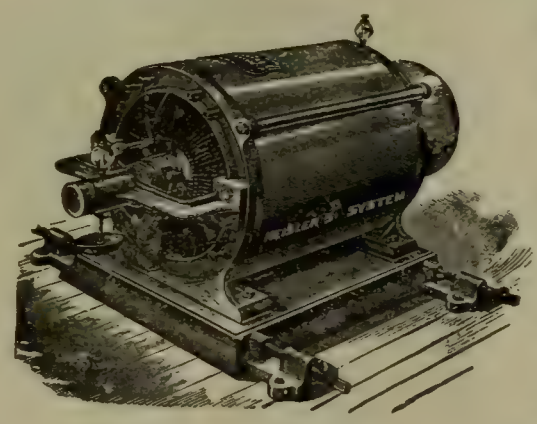
Position of Lamps.—The position of an incandescent lamp is entirely a matter of convenience. The lamp may be placed with the bulb above or below the point of support, in a vertical position.

Decomposition of Water.—In the decomposition of water by electricity oxygen gas is evolved at the positive pole and hydrogen at negative.

Awarded the Highest Distinction, a Gold Medal, by the International Jury at the Universal Exposition, Paris, 1889.

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INCANDESCENT ELECTRIC LIGHT SYSTEM.



Unequalled for Distribution over Wide Areas.

SPECIALLY ADAPTED FOR

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The best arc lamps on the market to be operated from central incandescent lighting stations or isolated plants.

Give a beautiful, steady, noiseless light, using only from 8 to 9 amperes, and can readily be adjusted for any direct current circuit of 100 to 125 volts. Additional resistance unnecessary.

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FOREIGN NOTES OF INTEREST.

At Fiume, the International Electric Company is about to erect extensive electric works from which 100 H. P. will be taken by means of alternating current motors for working a newly constructed elevator.

In the town of Karánsebes, in South Hungary, a lumber firm erected an electric light plant in one of their saw mills. Subscriptions for 500 lamps have already been taken up, and the plant has excited so much interest that it is likely that other provincial towns will move toward electric light.

The management of the Royal Hungarian State Railway has resolved to introduce the electric light in their trains, and in the first place in the express trains. At present a train of eight carriages is being experimentally arranged for the electric light, and the results obtained will be accepted as decisive for the introduction of this light on long-distance trains. The experiment will be carried out with accumulators supplied by the firm Müller and Einbeck.

The French section of the telephone line and cable which is to connect London with Paris has been completed. It consists of two overhead bronze wires, parallel, and crossed at intervals to diminish the effects of inductive disturbance.

ORIGINAL STORAGE BATTERY.—The original secondary cell as constructed by Planté, had two plates of sheet lead separated by strips of gutta-percha.

The new through telegraph line from Bombay to Calcutta,, via the Bengal-Nagpore Railway, is expected to be opened on April 1st next.

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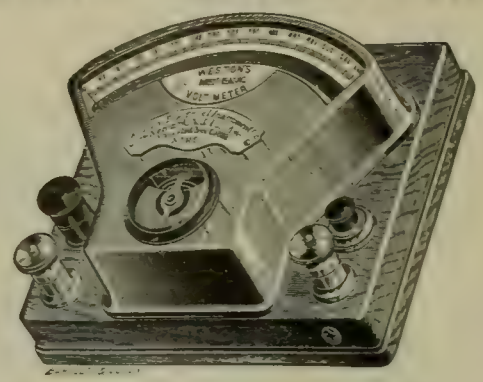
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City Clerk as above.

By Order of Committee. { J. H. CHAMBERLAIN. J. W. HAMMOND. J. S. VANARSDAL.

BUSINESS NOTICES.

Advertisements under this head not occupying over one-half inch of space, $1.00 per each insertion.

FOR SALE.—A second-hand No. 2 Caligraph, regular key-board, in good order, cash $40.00. Address Caligraph, ELECTRIC AGE office, World Building, City.

SITUATION WANTED by an experienced electrician, who is capable of taking care of a central station plant of any capacity. Address SITUATION WANTED, ELECTRIC AGE, N.Y.

HAROLD BINNEY, E. E.—PATENTS.

Late Asst. Examiner of Electricity, U. S. Patent Office, now with **Gilbert M. Plympton,** Counsellor at Law in Patent Cases, 245 Broadway, N. Y.

Patents procured, litigated and their validity examined. Inventions theoretically and practically investigated. Referring, by permission, to the Editors of this journal.

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THE ELECTRIC AGE FOR 1891.

Every business concern puts forth extraordinary effort at the close of each year to begin the succeeding year with a largely increased business. The ELECTRIC AGE, like every other progressive concern, does the same thing, and what we want now is to give our circulation a big boom. It is a large one now, but we want to double it, and treble it, if possible The ELECTRIC AGE is a widely circulated paper, and it is to the advantage of all our customers to aid in still further extending its circulation. This can easily be done. If each of our subscribers and readers would undertake to secure a new subscriber for us the circulation would at once be doubled. Many could secure several new names with little effort. Each of our readers may unhesitatingly promise prospective subscribers that the managers of the paper will make every honest effort to further improve their already excellent journal.

To each of our readers we say: "Just think of the matter a moment and make an effort to get us an extra name for our subscription list. The task is not an onerous one. By doing so you will be benefitting your own business."

The ELECTRIC AGE for 1891 will be a paper of extraordinary value and importance, and we trust that our friends will find it convenient to become a factor in the boom.

We are in the race to win.

FIRE UNDERWRITERS AND ELECTRICITY.—In Philadelphia the inspection of electric light and power plants under the auspices of the Fire Underwriters Association is conducted with great success. Elsewhere we publish an abstract from the annual report of the President of that association, which report was read at the recent annual meeting in Philadelphia. The report speaks highly of the work of the electrical department since its inception, and from the figures given it is clearly proved that when interior wiring is properly done the fire risk is nothing. The report says the department has accomplished all that its most sanguine friends could have hoped for. The changing if any portion of an electric plant is not allowed without first obtaining a permit from the association. "We think," says the president in his report, "that by our methods the property is protected and is safely guarded against fires resulting from poor work in wiring the interior of buildings." The association is strongly opposed to the trolley system of electric railway, and its sentiments were unequivocally expressed in a set of resolutions.

A NEW SUBWAY COMPANY.—At a meeting of the Board of Electrical Control in the Mayor's office, December 4th, Edward Lauterbach, the President of the Consolidated Teleg aph and Electrical Subway Company, said that the persons interested in the various telegraph and telephone companies had organized a company under the title of the Empire City Subway Company. He said the objec of this new company was to take charge of all the low tension subways in the city. Mr. Lauterbach mentioned the efforts made by the Standard Company to get part of the subways, and the failure of the company to comply with the conditions imposed by the Supreme Court. He promised that the new company would work legally and properly. He said that the business had grown so that it was now too large for one company to manage, and that the company he represented was willing that the new company should take charge of the low tension subways, while the arc-light subways should be controlled by the old consolidated company. Mr. Lauterbach asked the Board to give its consent to the scheme of surrendering the control of the low tension subways to the new company, under proper restrictions and guarantees. He submitted forms of contract. The Board promised to consider the matter.

ELECTRICAL NOVELTIES FOR THE HOLIDAYS.—Some enterprising electrical houses have in recent years introduced a feature into their trade that a casual observer would naturally think there was no call for. We refer to holiday goods for young people. Many interesting apparatus have been devised depending upon electricity for their operation. In one window we noticed the other day a diminutive buzz saw, a grind stone, a trip hammer, and other small machines in operation, driven by a small electric motor. The holiday trade in these goods we learn is growing larger and larger every year. These novelties are so well received and appreciated, that every manufacturer of electrical goods can well afford to keep an eye on this class of trade, and cudgel his brain to evolve something new each year.

WHAT THE TELEGRAPH HAS DONE.

In his remarks at the Magnetic Club dinner on November 19th, President Norvin Green, of the Western Union Telegraph Company, made the statement that the telegraph had made the millionaires of to-day. It needs but little reflection to understand how this is Before the days of the telegraph, to use Dr. Green's own language, "if a man wanted to buy a thousand bales of cotton and have it shipped to Liverpool, he had to write a letter to New Orleans, which by the stage and slow steamboat process took up thirteen days, and to get his answer that the cotton was shipped, would consume an equal time, or from twenty-six to twenty-eight days after giving the order. Now the cotton is purchased by telegraph, shipped, billed for Liverpool, bill of exchange drawn and the whole transaction completed in one day. In the ordinary period of one lifetime," he continued, "no man could have built the fortunes that now exist but for the telegraph. It has condensed time; it has annihilated space."

The truth of these propositions is impregnable. The telegraph, however, has not only enabled men to amass fortunes but it has and continues to fulfill a much higher mission. It has made the world at large much wiser and happier, and it has shed the light of knowledge in dark and remote corners. The world would indeed be a tame place without the telegraph as compared with what it is.

CIVILIAN ELECTRICIANS IN WARFARE.

The recent lecture of Lieut. Fiske, before the New York Electrical Society, in which he suggested the advisability of organizing corps of electricians to be ranked as auxiliaries of the engineer corps of our army and navy, has proved to be of timely interest. The matter has been promptly taken up by our own government, and the Secretary of the Navy, in his annual report, recommends that the plan suggested by Lieut. Fiske be carried out. The subject has created considerable interest not only in this country but also in others.

Our London contemporaries perceived at once the importance of the plan as outlined, and are now urging the British government to make a similar move.

That electricity would play an exceedingly important part in war operations between any two of the leading nations no one doubts, and in the event of the breaking out of war between two such powers it would indeed be a momentous question as to how the vast electrical operations could be efficiently carried on unless a reserve force of electrical engineers could be called upon. The London *Electrical Review* prints a long editorial on this subject and goes over the ground very thoroughly. It urges those interested to use their influence and bring it to bear on the subject to the end that the English naval and military authorities may be moved to take proper action in the premises.

AWARD OF MEDALS.—Several well-known electrical concerns are just now particularly jubilant. A good reason for this manifestation of emotion is found in the fact that they have received American Institute medals on their respective exhibits. In order to obtain a medal the goods of the successful competitor must have some merit over others of like class, and it is gratifying to know that the gentlemen connected with the American Institute whose duty it was to properly award the medals made a personal and careful investigation into the merits of the various instruments and devices exhibited, so that their judgment might be fair and impartial.

ELECTRIC CLUB DINNER.—The parlors of the Electric Club were brilliant and attractive on the night of December 4th, the occasion being the first of a series of dinners to be indulged in on the first Thursday of every month, alternating with the regular monthly lectures of the club, which are held on the third Thursday of each month. About seventy members and guests sat down to the tables, and after the feast, the rest of the evening was spent in listening to music and speechmaking. Speeches were made by Erastus Wiman, Capt. E. L. Zalinski, W. D. Sargent, and T. C. Martin. President O. E. Madden occupied the chair.

THE CO-EFFICIENT OF SELF-INDUCTION.—The London *Electrical Review* observes with satisfaction the introduction of the term "Henry" into the electrical nomenclature in America, to signify the coefficient of self-induction. Probably, says that paper, it will not be long before it will be disseminated throughout the scientific world as the accepted term for that coefficient.

THE ELECTRIC LIGHT IN JAPAN.—There are now eight electric light stations in Japan, supplying an aggregate of 223,000 lights, and that number is being increased at a quite phenomenal rate.

ATLANTIC CABLES.

As one stands and watches the operation of the receiving instrument of an Atlantic cable it is indeed a fascinating thought that the cause of its nervous movements is the touch of a human being thousands of miles away. Somebody's thoughts are expressed in those oscillations, but it requires a trained mind to translate them into writing, and if we are in a reflective mood our thoughts will carry us on a strange journey. Starting from the instrument before us we follow the small copper wire in its insulating sheathing down the beach to the water's edge. Here the strand disappears and is not seen again until it emerges from the deep, three thousand miles away, where it threads its way up to the cable station on the other side.

The home of an Atlantic cable is indeed a desolate one. As we follow the strand from where it enters the water we descend a gradual slope to the submarine valley. Then we begin our ascent of gigantic mountains. In our course we meet with many difficulties. We find the cable bridging frightful chasms, and leaping over awful precipices. But nothing daunted, it continues its journey, and soon descends to the silent valley on the other side. Here absolute silence reigns supreme, but still the life throbs of the tiny cord within the iron clad cable go on their way uninterrupted. They climb mountains, descend into valleys, jump chasms, and leap over plains with the speed of lightning, and emerge on the other side of the ocean much in the same manner as they entered it.



SHORE END OF SUBMARINE CABLE.

So much for the poetical side of the cable. Now for some facts.

Our illustration gives an excellent view of an ocean cable as it emerges from the water. Snags and ruins abound, which gives a fair idea of what the bed of an ocean cable probably is, to a great extent The picture we give was taken when the tide was at its ebb, and the stumps and snags are some of the remains of ancient forests. Most cables, however, enter the ocean under better circumstances. A rocky and chaotic landing is by no means essential.

On August 5th, 1858, the laying of the first Atlantic cable was completed, but owing to defects in the manufacture, increased by the injudicious use of powerful induction coils and batteries it failed on September 1st after having worked but twenty-three days. Here we got our first practical lesson of the action of powerful currents in developing and increasing defects in insulation.

During the period above mentioned 1,474 words were received at the American station, and 2,885 words sent to the opposite side. Seven years passed before another attempt was made to connect the two countries by cable. In 1865 the "Great Eastern" started out to lay the second cable, and after 1,200 miles of it had been laid, the strand broke, and the ship returned to England.

The following year the Anglo-American Company was formed, and laid a cable which was opened to the public on the 29th of July, 1866, with a tariff of £20 per message. They also succeeded in picking up and finishing the 1865 cable and had therefore two complete lines. Since that time nine cables have been laid from Europe to America, and so rapid had been the improvement in perfecting the modern cable that the resistance to the electric current had been reduced to one quarter what it was twenty years ago, while the duplex system doubles the capacity of every new cable laid.

The first words received on the 1858 cable at Valentia were by means of Sir Wm. Thomson's mirror galvanometer, the power used at Newfoundland being very large induction coils, over five feet in length; and so strong was the current that those who had the misfortune to touch the cable when the current was discharged from the coil received a severe shock that they were almost ready to faint from it. They also used 480 Daniell cells, but this number was reduced to 50. The battery at present used is but a fraction of the original. The speed attained on the first cable did not exceed two words per minute.

Of the eleven cables crossing the North Atlantic ocean four belong to the Anglo-American Company, with a total length of 8,656 nautical miles; two to the Commercial Cable Company, with 4,738 nautical miles; one to the Direct United States Company, with 2,983 miles; two to the French Cable Company, with 6,800 miles, and two to the Western Union Telegraph Company, with 5,107 miles. The total mileage between America and England is over 30,000 miles. These, of course, are but a few of the cables now in use The total cable mileage of the world is 120,079 miles, of which 12,524 miles are operated by various governments, and 107,555 miles by private companies.

TANGENT GALVANOMETER.

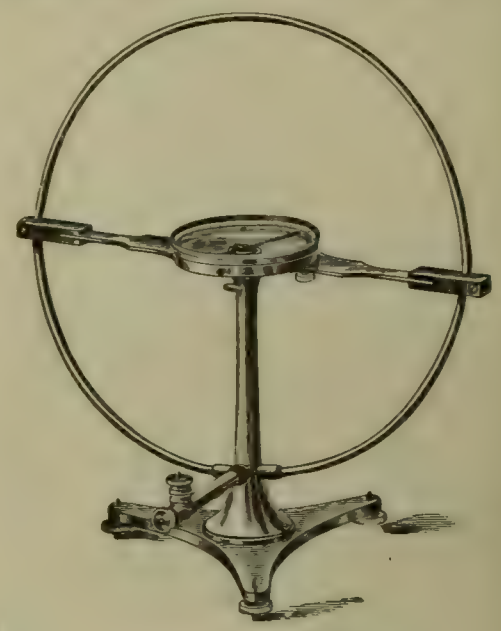
Among the excellent electrical instruments manufactured by The E. S. Greeley & Co., of 5 and 7 Dey street, New York, the galvanometer described and illustrated herewith attracts much attention by its handsome appearance and superior finish. It is not only a thing of beauty but also one of great practical value; it is as accurate in its readings as it is possible to make it, and the workmanship and care bestowed upon it in its manufacture cannot be surpassed. The same, however, may be said of all instruments turned out by this company.

This particular instrument is known as the "Half Meter Ring Tangent Galvanometer." There are two sizes of this style, known as type "C 3" and type "C 4."

The ring on these galvanometers, through which the current passes, consists of a thick copper wire, bent in the form of a circle, of practically zero resistance, and having a diameter of one-half and one meter, respectively.

The two ends of the ring are fastened to terminals in the form of tubes, projecting at right angles to the plane of the ring, one tube being outside the other and insulated from it. This ring is mounted on a brass column, which rotates on a suitable base provided with leveling screws.

A small magnetized needle is placed in the centre, moving in a graduated circle. As the needle is small compared with the diameter of the circle, it may be assumed that the needle always moves in a magnetic field of uniform strength. This being the case, the strength of the current circulating in the ring is practically proportional to the tangent of the angle of deflection of the needle. The angle of deflection is reckoned from the plane of the ring, which must be placed parallel to the magnetic meridian.



TANGENT GALVANOMETER.

As it would be difficult to read off the angular deflection of the needle from the needle itself, a long aluminum pointer is attached at right angles to it, which moves over a graduated scale. This scale is graduated in ½ degrees.

THE BROOKLYN INSTITUTE.

On Friday, December 12th, the members of the Department of Electricity of the Brooklyn Institute will visit and inspect the works of the Citizens' Electric Illuminating Company, on De-Kalb and Hudson avenues, between 7.30 and 10 P. M.

On Friday, December 19th, a lecture on some electrical subject, to be announced later, will be delivered before the members of the same department.

On Friday, December 26th, an exhibit of electric lighting appliances will be made.

LEAKAGE.—Since the energy lost in motors by leakage increases with the counter electro-motive force, whilst the energy actually given out by the motor at first increases with the counter electro-motive force up to a certain point, but beyond it decreases again, it is clear that efficiency cannot be obtained by allowing the counter electro-motive force to approach too near the electro-motive force of the generator.

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part XVII.—Arc Lamps (Concluded.)

319—How are the carbons of an arc lamp placed with reference to each other?

Usually vertically, one above the other.

320—Is there advantage in placing the carbons one above the other?

Yes; by this arrangement the feeding of the upper carbon is greatly facilitated

321—How is the feeding of the carbons accomplished?

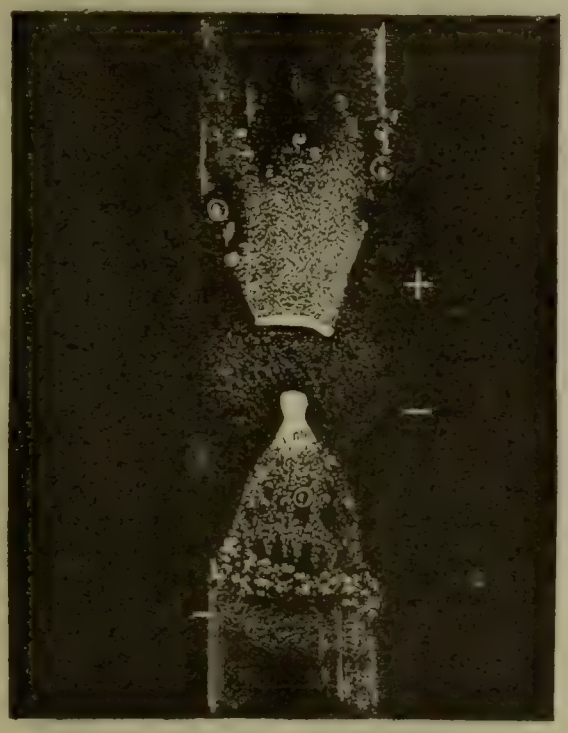
By the aid of various feeding devices, which usually consist of trains of clock work, a break wheel or clutch, operated by an electro magnet or arc, or they are operated by the simple action of a spring, gravity or a solenoid.

322—How are the carbons held in place?

By carbon holders, consisting of clutches or clamps attached to the ends of the lamp rods.

323—Is the consumption of the carbons at the arc ends even?

No; the arc consumes the carbon in a characteristic manner. The lower [negative] carbon becomes pointed, as shown in the figure, while the upper [positive] carbon takes the form of a blunt point. At this point is what is called the "crater."



THE VOLTAIC ARC.

324—What is the crater?

The crater is the slight cavity formed on the arc end of the upper, or positive carbon (see figure.)

325—Does this crater affect the light in any way?

Yes; it has the effect of radiating the light downward from the upper carbon, where the light is most intense.

326—What proportion of the total amount of light is radiated from the upper carbon?

About sixty-five per cent. of the whole.

327—Does an alternating current arc light produce a crater on the upper carbon?

No; no crater is formed on either carbon.

328—Then is such a light as brilliant as one produced by a direct or continuous current?

All things being equal it is just as brilliant, but it lacks the feature of being reflected downward, by the absence of a crater; the rays are scattered more.

329—Is the carbon consumed quicker with alternating or continuous currents?

Experiments have proved that the carbons are consumed faster by the alternating current.

330—Are carbons made only in one shape—that of a pencil?

No; some are made flat, and in certain lamps round discs of carbon have been used.

331—How are arc lamps connected in the circuit?

Usually in series.

332—In case one lamp becomes extinguished, or for any reason fails to act, do the other lamps on the same circuit go out too?

No; arc lamps are provided with an automatic short circuiting device which cuts the lamp out of the circuit in the event of any derangement, so that the current continues to flow to the other lamps

333—In what part of the lamp is the feed mechanism located?

In the metal case above the top of the globe.

334—How strong a current is necessary to maintain an arc light?

It is usual to allow about 50 volts per lamp.

(To be continued.)

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NEW PUBLICATIONS.

ELECTRICITY IN DAILY LIFE: A Popular Account of the Applications of Electricity to Every Day Uses. By Cyrus F. Brackett, Franklin Leonard Pope, Joseph Wetzler, Henry Morton, Charles L. Buckingham, Herbert Laws Webb, W. S. Hughes, U. S. N., John Millis, U. S. A., A. E. Kennelly, M. Allen Starr, M. D. 125 illustrations; pp. 288. New York: Charles Scribner's Sons. Price, $3.00.

It will be remembered that during the past year or two there were published in *Scribner's Monthly* a series of articles on various electrical subjects. Each article was complete in itself and was written in plain, untechnical language, the idea being to give a popular exposition of the wonders of electricity and the valuable uses to which the force is put. Each article was written by a recognized authority on the subject specifically treated. The titles of the articles and the authors were as follows: "Electricity in the Service of Man," by Prof. C. F. Brackett; "The Electric Motor and its Applications," by Franklin Leonard Pope; "The Electric Railway of To-day," by Joseph Wetzler; "Electricity in Lighting," by Prof Henry Morton; "The Telegraph of To-day," by Charles L. Buckingham; "The Making and Laying of a Cable," by Herbert Laws Webb; "Electricity in Naval Warfare," by Lieut. Walter S. Hughes, U. S. N.; "Electricity in Land Warfare," by First Lieut. John Millis, U. S. A.; "Electricity in the Household," by A. E. Kennelly, and "Electricity in Relation to the Human Body," by M. Allen Starr, M. D.

These integral parts have been united under one cover with the result of a volume of exceeding interest, and no doubt the book will find a large sale because there is a large demand for a popular work on the applications of electricity.

Electricity, or rather the effects of electricity, are so familiar to every one these days that there is a strong and growing desire on the part of the people to know something about this wonderful force about which so much is said, and how it is harnessed to perform work in so great a variety of ways. These articles were published to meet this demand, and they accomplished their purpose admirably, as the language used in each is so totally devoid of technicalities that any young child can understand the subject treated.

The various subjects are profusely illustrated with excellent pictures, which lend much additional interest to the reading of the book. Of the illustrations, of which there are 125, we will mention a few to give an idea of how well the ground has been covered. Thomson's electrometers for measuring difference of potential; electric motors and electric street cars; showing method of stringing overhead wires for electric railways; telepher lines; the Hoosac tunnel lighted by electricity; process of exhausting the air from the bulbs of incandescent lamps; W. U. operating room before the fire; the quadruplex; telegraphing to and from moving trains; method of laying ocean cables, and landing shore ends; torpedo boats and electric search lights on war vessels.

This book is a most interesting one, and fills a great void. It will be of value to the practising electrician as well as to the layman, as it is full of historical data. The information that is contained within the covers is exceedingly cheap for the price of the book, and we predict that when its existence gets to be generally known, "Electricity in Daily Life" will be found in almost every man's library.

The publishers displayed considerable ingenuity in getting up the cover for this book. The design is quite unique and appropriate.

We are in receipt of a copy of "Bibliography of Books on Electricity," compiled and published by Mr. H. E. Haferkorn, No 367 Fourth avenue, Milwaukee, Wis. This is one of a series of catalogues of technical literature, embracing the useful arts and sciences, and will be found of great value to students of electricity It is a complete catalogue of all electrical publications issued during the decade 1880–1890, and is compiled in a practical and time-saving way. Every one interested in the study of electricity and magnetism would find this work a great help and guide in their search for books in any special line, involving electricity or magnetism.

The price of this handy reference catalogue, which covers works on Electricity, Magnetism, Telegraph, Gas, etc., complete up to October, 1890, is 75c., bound in paper; $1.00 in cloth.

THE ELECTRIC CITY.

As we had predicted, the last enterprise of Dr. De Lery has proven successful far beyond his own expectation. This property called South Lakewood, being situated in a section where the wealth of the country at large congregates during the cold months of the winter, could not be anything but a great success. Although this new born Elberon of Lakewood is only three months old, one hundred and fifty lots have been sold, and designs of the most elaborate architecture are in the hands of the builders, and by next season we will see the pretty sight of a winter resort one and a half hour's ride from New York, lighted by the effulgent rays of the electric light. Some investors, who were lucky enough to purchase lots in the Electric City at the beginning of the enterprise, could not resist the temptation of profit making, and have sold and realized large profits. They now regret the hasty step and most of them have repurchased property in this beautiful winter resort for twice the amount that they had paid for their lots at first. Messrs. Alexander, Barney and Chapin are the contractors for the Electric Tower which is to be built in the Electric City, and Mr. F. Z. Maguire, 18 Wall street, has taken charge of the sale of the property.

NEW USE FOR LOCOMOTIVES.—The Edison General Electric Company has been putting in a new battery of boilers at their machine works, at Schenectady. This necessitated some temporary device for furnishing the immense works with steam. Superintendent Turner was equal to the emergency. He went to Albany and contracted with Superintendent Hammond, of the Delaware and Hudson Railroad, for a locomotive, which has been placed in the yard of the Edison Works, and steam pipes are now being run from the locomotive to the main steam pipes leading to the company's engines. The locomotive is expected to furnish auxiliary power sufficient to run the entire works and keep the force of 3,000 men at work. Old mechanics declare that this is the first time in their knowledge that a railroad locomotive has been put to such use.

TESTING THE CENTRALITY OF CABLE CONDUCTORS.

In our last issue we published an article under the title of "Temperature of Electrical Conductors," in which attention was called to the tendency of electric conductors imbedded in bituminous compounds to settle towards the bottom by means of the heating effect of the current. If the conductor continues to settle it will eventually come in contact with the substance of the tubing containing the insulating compound, and a short circuit will result.

Apropos of this subject, the following description from *La Lumière Electrique*, of an apparatus devised by Paul Le Geozion to test the centrality of conductors in submarine and subterranean cables will be of interest.

The draw-plate consists of four copper rods, 1, 2, 3 and 4 (Fig. 1), arranged on a wooden or ebonite disc B B', which is pierced with a hole at the centre. These rods are 10 to 15 centimetres long, and can slide backwards and forwards on the disc so that their ends can be made to press lightly against the insulation of the cable to be tested. In Fig. 2 we have a longitudinal section of the apparatus, from which it can be seen that a sort of funnel is screwed on to the back of the disc B B', in order to guide

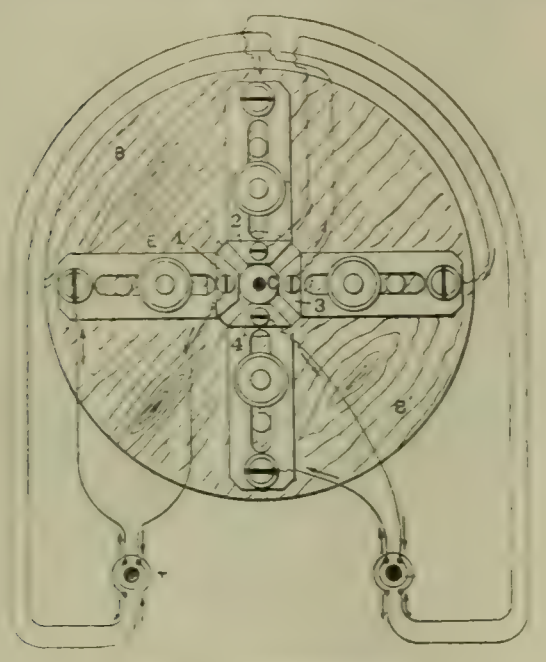


FIG. 1.—CROSS-SECTION.

the cable through the telephonic draw-plate. The calibre of this funnel is, of course, different for different sizes of cables. Water is sometimes poured into this funnel to prevent heating, and if it is of great importance to reduce friction to minimum the whole apparatus is placed in a vertical position.

Two different telephones, TT' (Fig. 1), are connected as shown, that is to say, the front and back portions of rod 1 are connected to one part of the telephone T', while the front and back portions of the opposite rod 3, are connected to the other coil of the same telephone, and so on. While the cable is being passed through the telephonic draw plate, a weak intermittent current is sent through its conductor. This intermittent current traversing the conductor of the cable induces Foucault currents in the copper rods. If the centrality of the cable conductor is perfect, it is obvious that the telephones will remain silent, but if the centrality of the conductor is imperfect, the rod nearest it has a stronger current generated in it than the opposite rod, consequently the particular telephone, the coils of which are connected differentially to these two rods, will be affected.

Fig. 3 shows clearly the different cases that may arise. If the conductor is well in the centre, as at *a*, nothing happens; if it is near rod 1, as at *b*, the coil connected to this rod is strongly affected acting on the telephone T. If the conductor is in the position shown at *c*, both the telephones T and T' will speak. In this last case the position of the conductor can be determined by lightly turning the disc B B' until the eccentric conductor has arrived at a position similar to that which it holds in *b*. In order to determine which rod the conductor is nearest to, it is only necessary to switch in a high resistance into the circle of one of the differential coils. If the noise in the telephone is weakened, the cable conductor obviously lies nearest to the rod into whose circuit the high resistance has been switched, and *vice versa*. The exact degree of eccentricity of the conductor can be determined by sliding back the rod nearest to the cable conductor. When the telephone is

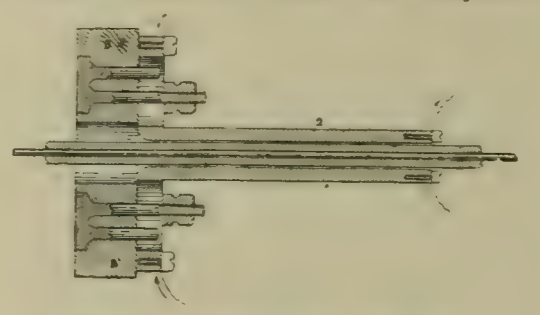


FIG. 2.—LONGITUDINAL SECTION.

silent the two rods are obviously at the same distance from the inducing wire. The distance traversed by the rod is then read off on a millimetre scale, which is engraved on the disc, and half this distance gives the distance of the conductor from the centre of the cable. This postulates that the dielectric constants of air and gutta percha are practically the same for currents of this order.

In carrying out this test in practice, the operator in charge has the telephonic receivers fixed to his ears in the ordinary manner, and whenever he hears a noise in either of the telephones he marks the cable as it passes through the draw-plate with a dab of paint, and the cable is subsequently re-examined more carefully at these marked points.

In order to avoid the necessity of constructing two differential telephones, two ordinary telephones may be used. In this case the connections are as follows: The front ends of rods 1 and 3 (Fig. 1) are joined to the terminals of the telephone, and their other ends are joined together, rods 2 and 4 being similarly connected up. The same result is obtained by the circulation of opposite currents in the same coil as by the use of two distinct windings. This arrange-



FIG. 3.—*a* *b* *c*

ment has, however, the inconvenience that if one wishes to determine exactly the degree of eccentricity of the cable conductor it is necessary to slide back one of the rods, which is a less rapid operation than merely switching in and out an additional resistance, as is done in the case of the differential telephones.

This little apparatus should prove of some use in testing the centrality of conductors of large cables. Up to the present the method employed somewhat resembles that of Alexander the Great when confronted with the Gordian knot: that is to say, the electrician charged with taking over the cable whenever he thinks the conductor is out of truth chops the cable in two; if his suspicions prove correct, the contractor pays for repairs; if the electrician is wrong, the purchaser pays.

PHILADELPHIA FIRE UNDERWRITERS.

At the annual meeting of the Philadelphia Fire Underwriters' Association which was held November 21 last, the president, in his report, touches on the electrical phase of the business as follows:

During the past year the business of inspecting electric light and power plants, heretofore carried on for the insurance companies by the inspectors of the fire control, has been discontinued by the control and assumed by this association. A department has been organized under the charge of Inspector Wm. McDevitt, who so long had charge of this work for the patrol. This department is supported by the electric light and power company by a *pro rata* contribution, according to the amount of business done by them in the city.

This new department, organized in January under McDevitt's supervision, has accomplished all that its most sanguine friends could have hoped for. Already many old plants, when reinspected, have been found so defective that a partial or complete rewiring of the premises has been necessary; while in new installations, many partially soldered joints and other defects have been discovered before any current has been turned on the wires, thus removing the danger of fires afterwards arising from these defects which would seem trivial had not dearly bought experience already proved them to be otherwise.

No insurance company will give permission for the "turning on" of the electric current in any building that is covered by its policy until the certificate of this department is produced, showing that the installation has been examined and approved by the electric department of the association. Such permit refers to the number of the electric certificate, which prohibits the changing of any portion of the plant without the inspection and consent of the association. We think that by our methods the property we protect is safely guarded against fires resulting from poor work in wiring the interior of buildings, but a greater danger now menaces us in the shape of the so called "Trolley System" of electric car propulsion. The city councils now have before them for consideration several ordinances granting permission to several companies to operate said system in different parts of the city. Your executive committee were of the opinion that the granting of the permission proposed would be highly detrimental to the interests of the citizens at large, because of the great probability of fires resulting therefrom, and therefore prepared a vigorous protest and instructed your secretary and electrical inspector to present the same to the committee of councils having the subject in charge.

AWARDED THE HIGHEST MEDALS.

The Clark Electric Company, Corbin Building, 192 Broadway, New York, received on November 29th, a special silver medal for their automatic safety device, awarded by the judges of the American Institute. The factory of the Clark Company was visited by them, and the safety device tested by cutting electric wires, and allowing them to fall on other wires, and in every instance the device proved its efficiency by removing all danger. The Clark Company have also received from the same source, a medal of superiority for their arc lamp, run from incandescent current, one of which was on exhibition at the American Institute Fair, and was much admired by visitors, being mounted in a very handsome and ornate fixture. The company are introducing this style of fixture for interior lighting for stores, theatres, public halls, &c. They have a lamp so mounted at present in their office, 192 Broadway, running from incandescent current.

Mr. Clark, the electrician of the company, is an indefatigable worker, and is a genius for inventing new and useful electrical apparatus.

AN HISTORICAL FACT.—The White House was lighted by electricity on November 28th for the first time in its history.

DISCOVERY OF TRANSMISSION OF POWER BY ELECTRICITY.

The discovery of the principle that mechanical energy may be transmitted over considerable distances by the employment of two dynamo machines and a conductor, is commonly ascribed to M. Hippolyte Fontaine, who has in a pamphlet given a detailed account of the way he was led to make the invention. Since the matter is now of historical interest an abbreviated translation of M. Fontaine's account is here given. M. Hippolyte Fontaine says:

"On the 1st of May, 1873, the International Exhibition in Vienna was formally opened, although the machinery hall, which was yet incomplete, remained closed until the 3d of June. I was engaged with the arrangement of a series of exhibits, then shown for the first time in public. There was a Gramme dynamo for electroplating, capable of delivering 400 amperes at 25 volts, a magneto machine which I intended to work as a motor from a battery, or from a Plante accumulator, in order to demonstrate that the Gramme dynamo is reversible. There was also a steam engine of my invention arranged for coke firing, and a small motor of the same type, but arranged for gas-firing; a centrifugal pump, which was intended to feed an artificial waterfall, and numerous other exhibits. To vary the experiments, I had arranged the pump so that it could receive motion either from the Gramme magneto machine or from my steam engine. On the first of June it was announced that the machinery hall would be formally opened by the Emperor on the 3d, at 10 A. M. Nothing was then in readiness, but those who have been in similar situations know how much can be got into order in the space of forty-eight hours just before the opening of an exhibition. In every department members of the staff, with an army of workmen under their orders, were busy clearing away packing cases and decorating the spaces allotted to the different nations. The staff visited all the exhibits in order to determine which of them should be selected for the special notice of the Emperor.

"M. Roulïex Duggage, the French commissioner, asked me to set in motion all the machinery on my stand, and on the 2d of June I was so far ready as to get the steam engines, the plating dynamo, and the centrifugal pump to work. I failed, however, to get the motor into action, either from the primary or from the secondary battery. This was a great disappointment, especially because it prevented my showing the reversibility of the Gramme dynamo. It puzzled me the whole of the evening and ensuing night to find a means to accomplish my object, and it was only in the morning of the 3d of June, a few hours before the exhibition was to be opened, that the idea struck me to work the small machine by a derived circuit from the large machine. Since I had no cable, I applied to the representative of Messrs. Manhes, of Lyons, who was kind enough to lend me a small quantity; and when I saw that the magneto machine when coupled to the plating dynamo was not only set in motion, but developed so much power as to throw the water from the pump beyond the reservoir, I added more cable until the flow of water became normal. The total length of cable in circuit was then over two kilometers, and this great length gave me the idea that by means of two Gramme machines it would be possible to transmit mechanical energy over long distances."

Another version of this discovery, as given by M. Figuier, is that it was purely accidental. He says that at the Vienna Exhibition in 1873, the Gramme Company had two machines exhibited.

One machine was in motion and the other standing still. A workman noticed some cable ends trailing on the ground, and thinking they belonged to the machine which was standing, placed them in its terminals. To the surprise of everybody the machine immediately began to turn of its own accord, and then it was discovered that it was being worked by the current from the other machine.

BRIDGING BELLS.

The London *Electrical Review* publishes the following letter from Mr. J. J. Carty, Electrician of the Metropolitan Telephone and Telegraph Company, which explains itself:

"My attention has been called to an editorial note in your issue of October 17th, referring to my remarks at the Detroit Telephone Convention, in which it is stated that I seemed to be unaware that the system of bridging bells invented by me has been in use for many years in the British Post Office telephone service, and that it is described in the *Telephone*, by Preece and Maier. I would call your attention to the fact that, as shown by the official report of the convention proceedings and all published accounts of my remarks, I did not claim any novelty for the bridging system *per se*, being well aware that it has been in use for years both in Europe and in America. My invention, however, relates to a specially designed bridging magneto bell, by means of which the talking and signalling on a line containing twenty stations equipped with this bell are equally as good as with a line containing only two stations. These results are not attainable with the ordinary form of magneto bell. The details of the construction of my bell were not described by me at the convention, as an application for patent rights was then pending in the United States Patent Office. So far from there being any description of a bridging system employing magneto bells in the *Telephone*, it is expressly stated in that work that the magneto bell has not been adopted by the British Post Office for telephone work, and there is no mention in the book of any method of connecting a number of stations with magneto bells by bridging the instruments across the circuit. In justice to myself, I must request you to publish this letter in your next issue, as, if your editorial statement as to the absence of novelty in my invention is allowed to pass uncorrected, it might unfavorably affect my interests in the matter of the disposal of the European rights to use the bridging magneto."

THE ELECTRICAL BEHAVIOR OF AMALGAMS.

A recent issue of the *Zeitschrift für Physikalisches Chemie* contains an interesting account of an investigation into magnitude of the polarization given by various amalgams in a solution of the corresponding chloride against zinc amalgam. The author is Mons. Le Blanc.

The apparatus employed in this investigation was of an extremely ingenious character; a prominent feature in it was a large tuning fork, which was so adjusted that its vibrations allowed the electromotive force of polarization to be measured while the primary current was, practically, flowing constantly.

A means of estimating the relative stability of the various amalgams was afforded by the rate of fall of the degree of polarization after the primary current was interrupted.

Le Blanc found that amongst the amalgams of the metals of the alkalies and alkaline earths, those of lithium and magnesium are the least stable.

A current of electricity from a battery of eight Leclanché cells was passed for about ten minutes in the case of a number of amalgams; with nearly all of them there was but a very slight disengagement of gas. With the amalgams of magnesium and lithium, however, there was a comparatively active evolution of gas.

It was found by Le Blanc that when a mixture of solutions of zinc chloride and hydrochloric acid were dealt with, a quantity of zinc amalgam was deposited at the negative pole; this, he considers, indicates that *atomic* hydrogen displaces the metal zinc in its salts.

A new light is thrown upon the vexed questio of ammonium and alkyl ammonium amalgams. Most of the text-books question the existence of ammonium amalgam. Let us take an instance and quote from a very well-known book. "When a solution of ammonium chloride is poured over sodium amalgam a soft slimy mass is formed, which swells up to many times the original bulk of the sodium amalgam. This curious substance has been termed an ammonium-amalgam, on the assumption that it was a combination of the radicle $N H_4$ with mercury. In reality, however, it is nothing but a mercurial froth inflated with a mixture of ammonia and hydrogen."

Ammonium-amalgam was discovered almost simultaneously by Berzelius and Pontin and by Seebeck. It can be readily obtained when a current from a galvanic battery is passed through aqueous ammonia or through an aqueous solution of an ammonium salt containing metallic mercury placed in connection with the negative pole. The same substance is formed when a globule of mercury is placed on a piece of moistened sal-ammoniac and connected with the negative side of a voltaic battery of very moderate power, the circuit being completed through a platinum plate upon which the sal-ammoniac rests; decomposition of the latter rapidly ensues, and ammonium amalgam is formed. Sir Humphry Davy described it as a butter-like mass of a grey metallic appearance, and much lighter than water. At ordinary temperatures it quickly decomposes into mercury, ammonia and free hydrogen, but at the freezing point it crystallizes in cubes, and according to Grove does not decompose spontaneously.

Endless discussions have taken place over this amalgam, and the balance of opinion has been fairly evenly divided. Le Blanc's work sets this question at rest, for the phenomena which he observed with solutions of the ammonium chlorides are quite comparable with those obtained when the metallic chlorides are employed. This goes to prove that the ammonium and alkyl-ammonium amalgams have an actual existence.

These amalgams, however, as might be supposed, are much less stable than the metallic amalgams usually are—a point which is well illustrated by the fact that the electromotive force of polarization falls off in a relatively rapid degree as the primary current ceases to flow.

Besides the interesting amalgam of the hypothetical radicle ammonium, Le Blanc investigated the following compound radicle amalgams:

Methyl-ammonium amalgam.
Ethyl-ammonium amalgam.
Di-methyl-ammoninm amalgam.
Di-ethyl-ammonium amalgam.
Tri-methyl-ammonium amalgam.
Tri-ethyl-ammonium amalgam.
Tetra-methyl-ammonium amalgam.

Of these the most unstable is tri-ethyl-ammonium amalgam, and it is rather doubtful whether it really exists. The tri-methyl and the di-ethyl-ammonium amalgams are also extremely unstable.

The formation of a mercury "froth" on the surface of the liquid during the process of electrolysis has hitherto been held to be a capital indication of the formation of an amalgam, but this view must be modified. Le Blanc's investigation shows that in the case of the ethyl-ammonium amalgam no froth rises to the surface, and yet the electrical behavior shows beyond a shadow of doubt that a definite and comparatively stable amalgam has been formed.

A French company has recently obtained a concession from the Russian government for the construction of a telephone system between St. Petersburg, Moscow, Warsaw and Berlin. The charge for the use of the telephone will be 8 francs for the first minute, and 4 francs each additional minute.

DRUM ARMATURE WINDING.*

A very important point that arises, especially in connection with heavy current windings, is the liability of the conductor bars to heat by reason of "Foucault" or "eddy" currents generated within them individually, apart from the main current. In some kinds of dynamos other than those with drum or Gramme armatures, such, for instance, as those used for alternating currents, the coils, instead of being *revolved* in a field, are *translated* across a field edgeways. In other words, the coil is so placed that its plane is perpendicular to the lines of force of the field; being still kept in this plane, it is moved across the lines of force, and so cuts them. A current is thus set up in the coil. Now if instead of a flat coil, a flat metal plate were used, and were made to cut through the field edgeways in a similar manner, a current would be caused to circulate in the plate in a plane perpendicular to the lines of force, this, indeed being much the principle of Faraday's first disc dynamo. If the plate were turned so that its plane were parallel with the lines of magnetic induction, and then

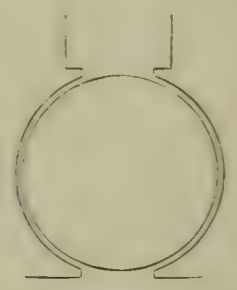
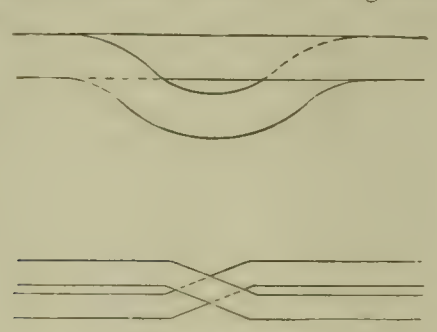


FIG. 1.

moved through them, no current, comparatively speaking, would be generated within it. This point is important. Now if, again, instead of the plate, a single metal bar be moved sideways across the field in a plane normal to the lines of induction, a current will arise within the bar; and this current will circulate within the bar in planes perpendicular to the lines of force, running along one of the sides parallel with these lines, and returning by the other. Thus it is obvious that as a current will produce heat, if the experiment with either the coil, the plate, or the bar, be carried out to any great extent, and they be moved rapidly and continuously through a sufficiently strong field, they may be made red hot; and the fact remains, that if a single insulated



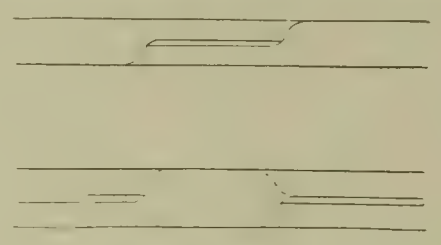
FIGS. 2 AND 3.

bar be laid along the periphery of an armature parallel with its axis of rotation, or held in a frame, and then revolved in an ordinary magnetic field, such as used for drum or Gramme dynamo, it will get hot from these internal currents alone. But in dealing with large "bars," however, there may also be borne in mind their capability of cooling as compared with wire, or bars of small section. It will be noted that whereas the transverse sectional area of a bar increases with the *square* of its diameter if *round*, or as the *square* of the side if of square section, the circumference, or outer surface, increases only in proportion to its diameter or thickness. Now capability of cooling, whether by radiation or convection, varies with the surface. Hence, a bar, say six times the thickness of a small bar or wire of round or square section, while it will have $6^2 = 36$ times the sectional area if the smaller, and so may carry about 36 times the current, has only six times the cooling surface. Hence large bars as compared with small ones, besides being heated by the main current and by eddy currents, are still further handicapped, so to speak, by their greater difficulty in cooling. The eddy currents in wires, it may be mentioned, are so trifling as to be negligible. In ordinary drum or Gramme-wound dynamos, where the field is bored concentric with the axis of the armature, these Foucault currents arise principally, if not entirely, when the bars pass under the trailing horns of the pole-pieces where the induction lines are particularly dense. By "trailing" horn is meant the last horn of a pole-piece which the bars leave or recede from as they revolve.

We may now proceed to consider the matter of mechanical construction, and see how all the various points we have enumerated are, and have been, dealt with in practice.

As we have just been touching on the subject of conductor bars, it will be convenient if we at once commence with these, and consider some of the ways in which this heating difficulty has been surmounted. The methods may be divided under two heads. Under the first, the difficulty is met by removing the principal cause of the evil; while under the second, the cause remains, but its effects are prevented from occurring by some counter arrangement.

The plan adopted by Messrs. Mather and Platt comes under the first head. They avoid the difficulty by making the air space between the armature and the pole-pieces greater as it nears the horns either way, as shown in fig. 1. Thus the principal cause of the heating is removed, inasmuch as the magnetic induction does not get so intense at the horns as it is wont to do when the air space is of even thickness.



FIGS. 4 AND 5.

But it is under the second head that we may look for the most variety. The eddy currents may be prevented by so making or arranging the bars that a current *cannot* circulate within them. One method, instead of making the bar of one solid piece, is to compound it of several insulated wires or strips, in such manner that there shall be no internal circuit open to the current. Thus, Messrs. Siemens Brothers make their conductor bars of stranded copper wire cable, each wire separately insulated by varnish, and the whole brought into a rectangular section by hydraulic pressure, or by drawing through a die, or otherwise. As the Foucault currents will only circulate in an unbroken circuit lying in a plane normal to the lines of force, as already explained, it will be seen that no such circuit open in the cable arrangement; consequently, the currents are not set up. Another method, somewhat similar, is to make the bar of insulated wires laid parallel, and soldered together at the ends so as to form a compound bar of rectangular section, to give the bar a half twist in the middle, and then to press or hammer the twisted portion in an iron mould so as to bring it to the same section as, and alignment with, the untwisted portions of the length. Yet another method is to make the bar of insulated copper strips or tape laid edgeways on the core in radial planes and soldered together at the ends. The strips, thus laid, being in planes, for the most part approximately parallel to the lines of force they cut, will not, as we have already pointed out, be individually appreciably liable to eddy currents. But as they are in metallic connection at the ends, an internal circuit is open along the side strips and across both ends, which must be broken. Hence, this kind of bar also needs a half twist in the middle, and to be hammered in a mould like the last. By means of the half twist, the current coursing along one side of the bar in each separate wire or strip is at the twist conducted to the other side, where it meets an opposing current, and so both are neutralized. It will, of course, be observed with regard to the strips, that if these be laid flat on the periphery of the drum eddy currents could set up in each one separately.

A further method remaining to be mentioned, and still similar in principle, is one patented by Messrs. Crompton and Swinburne. This is illustrated, figs. 2 to 5. The conductor bar here is simply made double; but at the middle of its length each half is so bent that it continues on the centre line of, and in alignment with, the other half. Figs. 2 and 3 show elevation and plan respectively, where one bar is bent to one side, and the other bent with a half loop downwards, and also to one side, so that they thus cross each other. A groove is turned in the core to receive the half loops. Figs. 4 and 5 show an arrangement wherein the two bars are flattened merely, and so cross each other without the necessity of a groove in the core. Thus, the circulation of a current within the double bar is stopped by the tendencies in each half being opposed at the middle crossing, similarly as in those already described.

*F. M. Weymouth, in *London Electrician*.

A REJOINDER.

To the Editor of the ELECTRIC AGE:

SIR: I have before me a copy of your issue of the 15th November, in which a correspondent, signing himself "A Well Posted Cabler," attempts to show a small representation of a telegraph office, inferring that the elaborate showcard issued by The Direct U. S. Cable Company is a copy of this Lilliputian production. An idea more absurd than this it is impossible to conceive, and it reminds one of the elastic notions of the boy, who, in his wonderment at what he had seen at a show, likened the elephant to an overgrown mouse. The matter needs no comment, and would be passed over for judgment of unbiassed minds to decide upon, after seeing the two productions, if it were not for a misstatement which is a part of this insincere criticism. He states The Direct U. S. Cable Company does not work the siphon recorder on any of their lines. I may tell him, for his information, that this instrument has been in use in the service of this company for some time, his statement to the contrary notwithstanding. Kindly give these remarks space in justice to The Direct U. S. Cable Company and oblige A BETTER POSTED CABLER.

CAUSE OF BUCKLING.—Buckling is a result of the formation of sulphate in discharging, producing unequal expansion. If it were possible to obtain perfect uniformity in the material of the plates and in the solution, so that the expansion in discharging, and the contraction which follows in charging, should be uniform, buckling could not occur. But, like every other species of warping, it is a result of want of uniformity, either in the material, or in the action to which it is subjected, or in both. The acid, from gravitation, becomes denser in the lower part of the cell, and this affects both the chemical reaction and electric conductivity, both of which are greatest when the acid is most dense; and observation on buckled plates shows a curving from top to bottom, steadily increasing downward. But buckling does not interfere with the action of the cell until it has proceeded far enough to produce short circuiting, by bringing plates into contact, or displacing plugs of paste.

GELATINOUS ELECTROLYTE FOR STORAGE BATTERIES.*

REPORT BY PROF. W. KOHLRAUSCH.

During the last year an experimental research both of a theoretical and practical nature has been made by Prof. Dr. W. Kohlrausch, of the University of Hanover. The following is a translation of the opinion of this electrician :

Since April 21st of this year I have made experiments with accumulator cells of the "Mashinenfabrik Oberlikon" (Dr. P. Schoop's patent)-the result of which I have the honor to communicate to you.

The tests were made with a view to ascertain the behavior of the accumulators if subjected to rough usage. For this reason severe tests were followed by regular tests with ordinary currents, in order to get an opinion as to the damage actually done by the severe handling. After a series of regular charges and discharges the cells were finally charged, and remained idle for a month. In charging the cells again 52 ampere hours were absorbed, but a strong development of gases occurred at the end of the charging period. The whole capacity (in charging with 10 amperes) being 73 ampere hours, it is obvious that about five sevenths of the former charge seems to have disappeared during the rest of thirty days. Probably a part of this lost energy has been used up in a certain chemical or physical transformation of the active material, perhaps to the advantage of the accumulator.

A normal discharge and charge were now made, and it proved that the cells were in good working order. The discharge amounted to 72 ampere hours, indicating an increase of the capacity, the former trials having given only 65 ampere hours in the average. (The makers claim 70 ampere hours as a normal discharging capacity.)

Again, the same cells were discharged with the normal rate of current to, say, 9 amperes. After the discharge of about 73 ampere-hours, the current decreased and could only be maintained by decreasing the external resistance of the circuit ; at last the cells were short-circuited in order to get the last energy out of the accumulators. In this way, again, 36 ampere-hours were drawn out, and the whole discharge was 100 ampere-hours. The cells were now charged with only 6 amperes (too weak a current) until gas bubbles were developed, and soon afterwards (after 1½ hours' rest) discharged with a current of 50 amperes—that is to say, five times the normal rate of discharging current.

The capacity was 41.6 ampere-hours, about four sevenths of the normal capacity. It is a well known fact that the capacity increases if the discharging current increases.

Again, the accumulators were charged at the normal rate of current, and discharged with the normal current, 68 2 ampere-hours ; charging and discharging was in every sense normal.

The discharged cells were now charged in the reversed direction of the current with 124 ampere-hours ; the electro-chemical reactions on the plates were exchanged to, say, the former cathode was anode, and the former anode had become cathode ; at the end of the pressure of the cells was again two volts, but in the reversed sense of current.

During this trial at first 68.2 ampere-hours had passed the plates "voluntarily" in the direction as the discharging current, afterwards 124 ampere hours had passed "involuntarily," together 102 ampere-hours.

Now, the accumulators were again charged with 9 amperes (in the former right sense), and after 223 ampere-hours the cells were again fully charged, and began to develop gases. During this forced charging and discharging the efficiency was still 86 per cent. (the efficiency under normal conditions being 89 per cent.) in ampere hours.

The following discharge with 9 amperes yielded 68.3 ampere hours ; it is obvious that this series of abnormal tests did not at all decrease the working and capacity of the cells ; the capacity increased rather a little. I think that during the long rest of the cells, probably also during this abnormal treatment, parts of the active material have been powerfully excited ; parts which had before not worked electrically have been transformed into true active material.

One of the cells was now taken to pieces, and I saw that with the gelatinous electrolyte the whole construction of the cell was of a remarkable rigidity and constancy. The two sections of plates could only be separated with considerable force after a previous softening of the gelatine. After the plates had been fully cleaned from the gelatine it looked perfectly normal, just as before the trials. The grids are very thin and soft, but it is for this reason that I think it "improbable that plates can buckle." The stiff gelatine could not easily be removed by those soft plates in order to touch each other (short circuiting), an inconvenience too often observed in other cells with thin plates and narrow distances between the plates. Falling or dropping of the active material off the plates is made impossible by the gelatine ; also it is improbable that active material could penetrate through this gelatine.

The most important question now is that of the durability of those cells. Of course it is only possible after a longer time, at least a year or two, to give an opinion. How long will the thin grid of lead resist the combined action of the electrical and chemical changes within the electrodes? How long will it take to have the metallic support eaten up by a daily action of the cells, until the whole grid is converted into the same active material, which does only practical working, if embedded in a perfect metallic conductor? I have observed on other systems with thin plates, that often the grid becomes brittle and breaks ; again, a practical trouble with accumulators. I would say that the grids of the plates may last a year or two in daily use, but it is possible that the cells will only cease to give daily practical service after three to five years. I hope to have a more exact opinion in this direction after I shall have used the cells for another longer time, say a year or two. The present trials have shown that these cells endure an abnormal and very bad treatment in a very satisfactory manner indeed, and that this accumulator is a practical apparatus.

APPENDIX BY DR. PAUL SCHOOP.

The following data about the tested cells may be added :

Number of plates.....	17	
Weight of plate.....	8ko.	Total weight 11.7ko.
" of electrolyte.....	3ko.	
" of ebonite box...	0.7ko.	
Box—Length.....	125mm.	
" Breadth.....	160mm.	
" Height.....	205mm.	
Total height of cell.....	250mm.	
Capacity (in discharging)	70 ampere hours.	
Strength of current.....	9 to 10 amperes.	

This cell represents the smallest type of cells, made especially for particular work, electric cars and railway lighting.

NEW CORPORATIONS.

Jacksonville Electric Railway Company, Jacksonville, Fla. ; capital, $100,000. This company will build a road from Fairfield to La Villa, of the city of Jacksonville.

Adjustable Incandescent Light Joint Manufacturing Co., Chicago. Capital, $50,000.

United States Electric Car Co, Chicago. Capital, $3.000.000. This company will manufacture and operate electric cars and motors.

Northwestern Electric Motor Co., Chicago. Capital, $1,000,000, for the manufacture of motors, etc.

Elyria Electric Light Company, Elyria, O. Capital, $25.000.

Mahanoy City, Ashland and Shenandoah Electric R'y Co., West Chester, Pa. Capital, $100,000.

Hubbell Electric Light and Power Co., Alexandria, Va. Capital, $100,000

Houston Electric Light Co., Houston, W. Va. Capital, $25,000.

Columbus Electric Light and Power Co., Columbus, Wis. Capital, $20,000.

ELECTRO MAGNETS.

In his Cantor lectures on the electro-magnet, before the Society of Arts (London), Prof. Sylvanus P. Thompson made the following remarks with reference to the effects of the size and position of coils :

Seeing that the magnetizing power which a coil exerts on the magnetic circuit which it surrounds is simply proportional to the ampere turns, it follows that those turns which lie on the outside layers of the coil, though they are further away from the iron core, possess precisely equal magnetizing power. This is strictly true for all closed magnetic circuits ; but in those open magnetic circuits where leakage occurs it is only true for those coils which encircle the leakage lines also. For example, in a short bar electro magnet, of the wide turns on the outer layer, those which encircle the middle part of the bar do enclose all the magnetic lines, and are just as operative as the smaller turns that underlie them ; whilst those wide turns which encircle the end portions of the bar are not so efficient, as some of the magnetic lines leak back past these coils.

Among the other researches which Du Moncel made with respect to electro-magnets, was one on the best position for placing the coils upon the iron core. This is a matter that other experimenters have examined In Dub's book, "Electromagnetismus," to which I have several times referred, you will also find many experiments on the best position of a coil ; but it is perhaps sufficient to narrate a single example. Du Moncel had four pairs of bobbins made of exactly the same length, and with 50 metres of wire on each, one pair was 16 centimetres long, another pair 8 centimetres, or half the length, with not quite so many turns, because, of course, the diameter of the outer turns was larger, one 4 centimetres in length and another 2 centimetres. These were tried both with bar magnets and horse shoes. It will suffice, perhaps, to give the result of the horse shoe. The horse shoe was made long enough—16 centimetres only, a little over 6 inches long—to carry the longest coil. Now, when the compact coils 2 centimetres long were used, the pull on the armature at a distance away of 2 millimetres (it was always the same, of course, in the experiments) was 40 grammes. Using the same weight of wire, but distributed on the coils twice as long, the pull was 55 grammes. Using the coils 8 centimes long, it was 75 grammes ; and using the coils 16 centimetres long, it was 75 grammes ; and using the coils 16 centimetres long, covering the length of each limb, the pull was 85, clearly showing that, where you have a given length of iron, the best way of winding a magnet to make it pull with its greatest pull is not to heap the coil up against the poles, but to wind it uniformly, for this mode of winding will give you more turns, therefore more ampere turns, therefore more magnetization. An exception might, however, occur in some case where there is a large percentage of leakage. With club-footed magnets results of the same kind are obtained. It was found in every case that it was well to distribute the coil as much as possible along the length of the limb. All these experiments were made with a steady current. It does not follow, however, because winding the wire over the whole length of core is best for steady currents that it is the best winding in the case of a rapidly varying current ; it is not.

* London *Electrician*.

LUMINOUS POWER OF ARC LAMPS.

We have long protested, writes the editor of *L'Electricien*, against the use of unsuitable or inaccurate terms, and vain designations which are only kept in use by custom and prejudice. By dint of repeating our assertions we may perhaps succeed in getting the matter taken up by others who are not the slaves of custom; we shall therefore not fail to call attention to abuses of this kind whenever occasion presents itself. We will therefore now discuss the (in our opinion) deplorable custom of characterizing arc lamps by their more or less nominal photometric power.

In order to show how meaningless such designations are, we have drawn up a table from the books, catalogues and prospectuses of the chief industrial celebrities of both worlds, placing opposite each intensity of current feeding a given arc lamp, its corresponding nominal photometric power. In order to facilitate comparison we have reduced all the intensities expressed in carcel burners to decimal candles, considering the carcel burner to be equivalent to 10 decimal candles, although really, according to M. Violle, 20 decimal candles = 2.08 carcel burners; there is, consequently, a difference of 4 per cent. between the decimal candle and the tenth of a carcel burner, but our estimate will be sufficiently accurate for our purpose.

A table is then given showing the nominal intensities of the arc lamps according to the construction, and the article continues:

The figures in this table show that a constructor, describing his machine as producing so many arc lamps of so many candles each, gives it a designation which may perhaps facilitate its sale, but which is practically meaningless, since, with a given current, the quality of the carbons, the distance between them, their diameter, &c., may cause their luminous intensity to vary considerably, its value being in some cases even more than doubled. And we must not lose sight of the fact that in arc lamps mounted in derivation, the available potential at the terminals of the lamp being from 43 to 45 volts, some installations work at 80 effective volts, others at 75, 70 or 65, the difference being absorbed at an utter loss in a rheostat.

The same objections may be raised to the mode of designating dynamos and transformers by the number of incandescent lamps that they can feed. Some constructors mean lamps of 30 watts, others lamps of 40, 50, 56 or 60 watts.

A dynamo or transformer should never be designated in any other way than according to the number of available watts it can produce at a maximum nominal charge.

Lastly, as regards accumulators, the statement of the weight of the plates conveys no meaning to us. We should like to see accumulators designated according to their maximum normal output, in amperes or in watts, and according to their effective capabilities in ampere-hours or watt-hours for these are the principal essentials, which, together with their price and duration, enable us to calculate quickly the number and the coupling of accumulators required for a given installation, much more accurately than the weight of the plates.

HYDRAULIC COMPARED WITH ELECTRIC TRANSMISSION OF ENERGY.

The hydraulic transmission of energy presents many points of resemblance with the electric transmission. We have at the generating station a force pump which delivers water under high pressure into a pipe leading to the receiving station where part of the energy is recovered by a water motor. To minimize the loss of energy due to the friction of the water against the pipe, the velocity of flow should be as small as possible, or, in other words, the diameter of the pipe should be as large as possible. In thus trying to increase the economy of the system, we incur a larger capital outlay; and applying Sir William Thomson's rule to this case we find that there exists for every given set of conditions one particular diameter of pipe for which the sum of the annual value of energy wasted, and the annual interest on capital outlay becomes a minimum. So far the analogy with the electrical system is perfect. But there enters another element into the calculation which to a certain extent modifies the law. It has been shown that the most economical size of a copper wire depends only on the current, and not directly on the pressure. It depends on the pressure indirectly, inasmuch as with an increased pressure a given amount of energy can be transmitted by using a reduced current, and this again involves a reduction in the size of the conductor. But if the current be a fixed quantity, an increase of pressure does not entail a greater outlay for conducting material. It might very slightly increase the cost of the installation by necessitating a more careful insulation: but the difference in expenditure for a good and perfect insulation is not a great item. With hydraulic transmission the case is different. An increase of pressure does entail a greater outlay for conducting material, because the thickness of metal in the pipe must be increased as the pressure is increased: therefore the cost of the conductor depends not only on the quantity of water to be transmitted, but also on the pressure. A natural limit is thus set to the increase of pressure by financial considerations, which are absent in the case of electric transmission. The pressure is also limited by technical considerations. In the first place the water motor is an engine with bearings and other moving parts, which can only work satisfactorily, and without heating or undue wear, if the pressure between the moving surfaces in contact remains within reasonable limits; the same as in any other engine. In the second place, if the pressure be increased beyond a certain limit depending on the tensile strength of the material of the pipe or working cylinder, no increase in the thickness of metal can save these parts from bursting as every engineer knows. Such a limit to electric pressure does not exist in dynamo machines or electromotors. It is perfectly conceivable to employ any desired pressure provided we increase the thickness of insulation sufficiently.

Another point where there is a vital difference between electric and hydraulic transmission of energy is that the electro-motor has nearly the same commercial efficiency, whether fully loaded or not, whereas the water-motor when working light has a very much smaller efficiency than when fully loaded. Hydraulic transmission can, therefore, only be employed where the question of efficiency is of secondary importance, or where the amount of energy to be transmitted is not subject to variations.—*Kapp*.

A NOVEL MEASURING INSTRUMENT.

M. F. Leconte, in a recent issue of *La Lumière Electrique*, gives an account of some experiments carried out by him at the Liège University with a view of testing a curious form of electrical measuring instrument. A description of this instrument and the result of M. Leconte's experiments will no doubt be of interest to many of our readers. M. Leconte's idea is to make a pile of circular iron discs, interposing some springy substance, between each disc, and to place this pile inside a solenoid. When the solenoid is traversed by a current, the pile of discs tends to contract owing to the formation of unlike magnetic poles at the opposing surfaces of the discs. This contraction is resisted by the springs and by means of a suitable magnifying device the movement of a pointer along a suitably graduated scale enables one to read off the volts or the amperes. M. Leconte employed discs ranging in number from 18 to 60, in diameter (1 mm. = 40 mils) from 20 mm. to 65 mm., and in thickness from 2 mm. to watch-spring steel, blotting paper, packing paper, ordinary paper, flannel and black indiarubber. The tendency of the discs to move sideways was checked by punching holes through them and slipping them over vertical glass rods. The sensitiveness of such an apparatus can be increased either by adding to the number of the discs, augmenting the surface, or by providing the solenoid with a core of iron wire. M. Leconte gives curves of the scale readings obtained with a voltmeter arranged with 18 cast iron discs, 8 mm. thick, and 65 mm. in diameter, and provided first with indiarubber springs and then with steel springs. The curve in the first case was fairly regular between 27 and 53 volts, with steel springs the curve was very irregular, with indiarubber springs the deviation of the scale index was only 18 mm. for 57 volts, and the actual contraction of the column of discs was only 2 mm.: with steel springs the index deviation was only 8 mm. for 50 volts.

FOREIGN NOTES OF INTEREST.

An electrical section is being formed in the international exhibition, which is to be opened in Bordeaux in May next.

A Magdeburg firm will shortly make experiments on the Finow canal with boats and timber rafts worked by electricity.

The trunk telephone line between the London, Manchester, Liverpool and Birmingham Exchanges is now open to the public.

The Belgian town of Ninove, situated about 15 miles to the westward of Brussels, is the first in that country to adopt the electric light.

The theatrephone is about to be installed in several of the Paris clubs, notably in that of the Union Artistique, where it will shortly be at work.

The horse tramway at Halle, Saxony, has been transformed into an electric tramway on the Sprague system by the Allgemeine Elektricitas Gesellschaft. The line, which is single, is four miles in length.

Sealed tenders will be received by the Municipal Commissioner for the city of Bombay up to 1 p. m. on February 16 h for experimental lighting by electricity of certain streets of the city of Bombay for two years. Forms of tender and schedule of conditions, and a sketch of the portion of the city, showing the streets to be lighted, may, on payment of £1 sterling, be obtained from Messrs. E. W. and R. Oliver, 1 Corbet Court, Gracechurch street, London, E. C., who will, on application, give any further information that may be required.

The results obtained with the underground telephone circuits in Berlin have been so satisfactory that the Imperial Post Office authorities are now making experiments with long-distance underground wires. There are already in operation a telephone cable between Berlin and Küstrin, a distance of 57 miles; and a line from Berlin to Hamburg, 60 miles being overhad and 25 miles underground, whilst shortly the latter will be extended to 186 miles in length. The results with these long-distance wires are said to be very favorable.

Twenty-eight towns in the departments of France have acquired, through their municipalities, a telephone service. In eight other towns the telephone lines are in construction, and will be completed in two months' time. Plans are being got out and surveys made for supplying 13 more towns with telephone systems. Of interurban systems there are only two actually working; there are seven in construction and ten under consideration. Seven towns are connected with Paris by the telephone, and there are four more in course of being joined to the capital. In Algeria, the only two towns possessing the telephone are Algiers and Oran.

THE NEW BAIN INSULATOR.

We present this week a cut of the new High Resistance Glass Insulator, the invention of Mr. Foree Bain, of Chicago.

The insulator is made extra strong, and is especially adapted to h avy work, such as carrying large primary wires. particularly feeder wires for electric railroad work. The corrugations which are made both outside and inside of the apron increase the distance from the wire to the pin fully 100 per cent., and it is claimed that water will, in passing over the edges of the rings, become thin and broken, and on reaching the inside of the glass will drop off rather than creep over the inner obstructions to the pin.



NEW BAIN INSULATOR.

Another point in favor of this form of insulator is that the many surfaces will reflect the light under the glass in such a way as to keep insects out, obviating a source of much annoyance where plain dark glass is employed.

This insulator will cost a litt'e more to manufacture than the ordinary plain glass insulator, but the inventor claims that an advance of a few cents per mile in the cost of construction will not be any objection where a high class of work is desired.

Mr. Bain has assigned his patent to the Central Electric Company, of Chicago, who are now the sole owners, and by whom the article is being placed upon the market.

THE ALLEGHENY CITY ELECTRIC LIGHT STATION.

There is perhaps no other electric lighting plant in this country where an equal number of lights are operated from such a small central station building, as is done in the plant of Allegheny City, Pa.

The plant is owned by the city and it operates the alternating system exclusively, both for incandescent and arc lights, and it is mainly for this reason that the company is enabled to run such a large capacity of lights from a comparatively small power house.

The plant has a capacity of 4,500 incandescent and 540 arc lights. It was established last spring, and the contract for the installation of the electric light system was awarded to the Westinghouse Electric and Manufacturing Co. after the severest competition on the part of the largest companies in the country.

The power house is a very handsome brick building situated near Braddock street and the tracks of the Pittsburg, Fort Wayne and Chicago Railroad. The roof of the building is graced by a beautiful tower from which the main wires are distributed.

The boiler room is in the rear of the building containing a battery of six tubular boilers, each measuring 16 feet in length with a diameter of 66 inches. Slack coal is utilized as the fuel under the boilers and each of the latter are also fitted with a Roney patent stoker. The utility of this appliance has manifested itself in this plant to a very great extent from an economic point of view.

From the boiler room a small door leads into the power house proper, the dimensions of which are 50 x 56 feet, and in this space the engines and dynamos for the operation of the complete plant are confined as follows: there are seven 160 H. P. Westinghouse compound engines, one 85 H. P. compound engine, two 15 H. P. automatic engines, three 1,500-light alternating current incandescent dynamos, two exciters and nine 60-light alternating current arc machines.

The switchboard of both the incandescent and arc light circuits occupies the greater portion of the north side wall in this room, containing all the switchboard appliances used in connection with the Westinghouse system of electric lighting.

The plant has been in operation since the 15th of July last, and since that time there has never been any interruption in the service, either in the incandescent or arc light supply.

The working of the central station is superintended by Mr. David Hunter, Jr., and Mr. Maurice Coster acts as chief engineer.

The arc lights are used to light up the streets of the city. All the construction work in this direction was done by the North American Construction Company.

The lights are distributed by mast arms and towers. Of the latter, the city has put up 53, with five lights on each, and the rest of the lights are on mast arms.

The lights have given every satisfaction to the people of Allegheny City, and the effects of the illumination from the towers is very brilliant. Since the plant has been in operation the city has realized that the present capacity of the station is hardly sufficient to meet the demands of the entire place and an extension is already contemplated.

TRADE NOTES.

The Crosby Electric Company of this city, have purchased the business of the Federal Electric Company, heretofore carried on at No. 10 Cedar street, New York, together with the stock and patents under which their goods are manufactured. They are prepared to fill all orders for their goods.

The Crosby Electric Company also announce that they have received the highest award given by the American Institute Fair, just closed, for all the batteries manufactured by that company.

W. H. Gordon & Co. have made an important addition to their business. They have taken the general selling agency for the Star Electrix switches, sockets, cut-outs, etc., and are prepared to quote and supply these goods to dealers and consumers. Mr. Gordon has recently spent a week in the West where he made some large sales of simplex wire, for which he is the New York agent. Enterprise and energy are essential these days to successfully carry on business, and this firm possesses an abundant measure of these qualities. Their business has wonderfully increased during the past year, owing largely to their enterprise and promptness in filling orders.

The Westinghouse Electric and Manufacturing Company completed during November a month of business which has been one of the largest in the history of that corporation. The company shipped an aggregate of incandescent alternating current light machines of 30,000 sixteen candle-power lamp capacity. Among the places where the Westinghouse system has been installed are: Philadelphia, Pa., 750 incandescent and 300 arc lamps; South Omaha, 750 lights; Ballston, N. Y., 750 lights; Lima, O., 1,500; Aspen Colorado, 650; Wellsburg, W. Va., 500 incandescent and 20 arc; Charleston, W. Va., 750, increase; Portland, Oregon, 100 arcs.

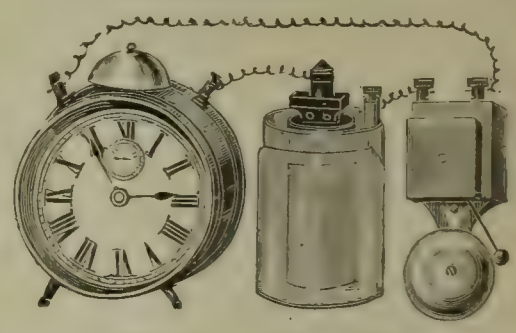
NEW YORK ELECTRICAL SOCIETY.

The 134th meeting of the New York Electrical Society will be held in the lecture hall of the Mechanical Engineers, 12 West 31st street, at 8 P. M., December 10. Mr. Edward P. Thompson, a well-known patent solicitor of this city, will deliver a lecture on: "How to make Good Inventions; or the Science and the Art of Inventing."

ELECTRIC ALARM OUTFIT.

An ingenious apparatus for the purpose of automatically ringing an alarm or bell at any given distant point, at any stated hour, has been invented by Mr. S. C. Wood, of the firm of S. C. Wood & Co, No. 174 Centre street, this city, and the firm are now putting the goods on the market.

Reference to the accompanying cut will show the general arrangement of the parts; the electrical mechanism on the clock itself, however, needs a little explanation. The binding posts are in fact placed on the back of the clock case, and not on top as shown in the figure. One of the binding posts is insulated from the clock case, while the other is in metallic contract therewith. One post is placed near to the winding key of the alarm, on the back of the clock, and the other post is placed on the opposite side of the key, the three being in a line. Attached to the alarm winding key is a metal finger which, when the alarm rings at the hour at which it isset the revolution of the winding key carries around with it the finger to the left. The finger continues its movement around the circle until it comes in contact with the projecting binding post, thus closing the electric circuit. The binding post just referred to is the one that is insulated from the clock case, and as the metal finger represents the terminal of the opposite wire, it is evident that when the finger comes in contact with the insulated binding post the circuit is closed.



ELECTRIC ALARM OUTFIT.

It is understood, of course, that when the alarm is wound the position of the finger is on the side opposite to the insulated binding post. This electric alarm can be put to many valuable uses. For instance, the electric gong, may be placed in the servant's room while the alarm clock is kept in the master's apartments, and he can wake the servant at any hour simply by setting the alarm in the usual way.

As we stated at the beginning, the electric bell can be sounded at any distant point, at any predetermined hour, and this by the use of an ordinary alarm clock with this electrical attachment.

This useful device ought to find a large sale, as it can be applied to so many useful purposes.

WELDING.—The welding of the spokes of a wheel into the hub at one operation by means of electricity, is now reported as being an accomplished fact.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Dec. 4, 1890.

The Selectmen of Winthrop have given a hearing on the petition of G. L. Parks and others for an electric street railway location in Winthrop.

The Selectmen of Beverly last Saturday evening, by a vote of 8 to 2 refused to grant the Naumkeag Street Railway Company permission to erect the overhead system.

The property of the Union Electric Traction Co., was attached by Deputy Sheriff Cronin, December 2, in the interest of Pettingill, Andrew & Co., of Boston, in the sum of $2,000.

A manufacturer of electrical appliances has been looking over the buildings of the Brayton Petroleum Engine Company, at East Bridgewater, Mass., with a view to possible location.

Capt. E. S. Whitney has resigned his position at the head of the Manchester, N. H. Electric Light Company to accept the superintendency of the new electric company which is putting in its dam at Kelley's Falls.

Articles of incorporation have been granted to the Whitinsville Street Railway Company, to conduct an electric railway at Northbridge, to extend to Whitins station, a distance of 1½ miles; capital, $20,000. J. M. Lacell, treasurer; W. E. Johnson, clerk.

An electric road from Thomaston, Me., to Camden is being projected. The capitalists interested are the ones who built the electric railroad from Hallowell to Augusta. They have looked over the proposed route very carefully and are pleased.

The West Haven, Conn. Horse R. R. Co. has bought a piece of land in West Haven, with the intention of locating an electric light plant. The company's petition to the Common Council for permission to use the overhead trolley system has been signed by over 200 citizens.

A 1,200 gallon fire pump has been placed in the new oil house building of the Thomson Houston Company. It will be used with a system of stand pipes and sprinklers, and with either the city water or from a large cistern over which it stands. Five hundred feet of additional electric railway have been built about the factories, from factories L and K to C, and from the tower of A to connect with old tracks.

C. J. Van Depoele has been granted a patent for a generator for pulsating currents, for generating rising or falling currents, comprising a revolving armature of the continuous type, rotating in a suitable field of force, and means for causing the magnetism of said field of force to rise and fall, reacting upon the armature to produce rising and falling currents therein.

A syndicate of wealthy gentlemen who have purchased the Bridgeport, Conn., Horse Railroad Company, will at once begin a great improvement in the plant. They will increase the lines from 7½ miles to 15, expending $1,500,000. Electricity will be used. The purchasers of this road own lines in Rochester, Buffalo, Newark, Paterson, N. J., and other cities.

The electric power station of the Holyoke Water Co., at Holyoke, will be equipped for furnishing light and power on a very large scale. Four water wheels of 250 h. p. each will be used. These will be interchangeable. There will be boilers to the amount of 1,500 h. p. Two 400 h. p. engines are to go in. Besides these the company has a reserve force of another 350 h. p. engine.

General Manager Minks, of the West End Railway, has issued the following order to motor men on electric cars: You are hereby notified that you must not hold conversation with any passenger while on duty on your car. If passengers wish to engage in conversation with you, tell them politely, you are not allowed to talk with them as your time and attention must be fully occupied in the careful operation of the car.

A company is to develop the water power at Kelley's Falls on the Piscataquog River, for the purpose of operating a new electric light plant, to be devoted wholly to incandescent lighting. A 12-foot dam has been built, and two large Rodney-Hunt turbine wheels have been put in, leaving room for two more. An effort will be made to bring new industries to the section to be supplied with electric power. Wires will be strung in this city.

H. E. Bradford the Electrician and Master Mechanic of the Marlboro Street Railway is constructing a new snow plow for use on that road. This plow which was designed by Mr. Bradford will, when completed, weigh ten tons and will be driven by two fifteen horse power Edison motors. This road was started one year ago last July and has not missed a trip from any cause since that time. This pleasing result is owing largely to the efforts of Mr. Bradford who when the road was first talked of hardly knew a volt from an ampere, but by hard work and earnest study he has attained a position which enables him to give points to many who have had a longer and larger experience.

The Concord, N. H., Electric Light Company recently took down a Thomson-Houston arc lamp which had received no repairs since it was hung, over four years ago, and aside from being quite dusty it appeared in as good condition as when put in. This company has recently completely overhauled and changed its circuits preparatory to carrying them into the new station. The new station will be one of the finest in the State, and fitted with Thomson-Houston Electric Company's generators for arc and incandescent lights and power, fully equipped with lightning arresters, slate switchboard, etc. The steam plant will be of more than 250 horse power capacity, make and style not yet decided upon. The chimney is the tallest in the city and the handsomest in the State.

C. J. Van Depoele has patented a system of electrical transmission of power, the combination, in an electric railway, of a supply circuit extending along the line and carrying current of substantially constant potential, a motor car making a tracting connection with the supply circuit, a momentum generator upon the car and in circuit with the main line and consisting of an electro dynamic machine connected in series and having a field magnet of normal capacity, and a series of supplemental field magnet coils in a series of insulated contacts, a movable contact device, and means for actuating it, the position of the commutator brushes to change the machine from a motor, when not performing work, to a momentum generator actuated by the momentum of the vehicle.

The Concord, N. H., Gas and Electric Light Company is making use of an ingenious appliance by which they use up all the short pieces of arc lamp carbons. The trimmers bring in every piece of carbon from the lamps and they are assorted and laid end to end, to make about eight inches in length. (They are only used for negative carbons.) They are then placed in a machine which makes a dowel on one piece and a socket in the other, after which they are joined together with a conducting heat-proof cement of very low resistance. This company has been using these spliced carbons for a year or more, and have fully proved their success. Very gratifying reports have been received from several places where a few samples have been sent. Mr. Richmond, the superintendent and electrician, and N. R. Stevens, machinist, contemplate putting the machines and cement on the market soon; but the fire which occurred last July delayed the work on them considerably. The saving in carbons, by this method, is said to exceed thirty per cent. W. J. P.

NEW YORK NOTES.

Among the passengers arriving at this port on the Teutonic, on the 4th inst., was Captain A. de Khotinsky, a Russian electrician.

Shibuyo Jugiro, the Japanese murderer, has been sentenced to die by electricity during the week beginning January 19, 1891.

Mr. E. T. Barberie has been appointed electrician of the Cobb Vulcanite Wire Co., of Wilmington, Del. Mr. Barberie is now engaged in underground cable work in Buffalo.

The Edison-Lalande battery is now used by the Brooklyn Fire Department, the National Automatic Fire Alarm Company, and the Automatic Fire Alarm and Extinguishing Company, and is giving extreme satisfaction in each case.

On December 2 a fire occurred in the factory of The Shaver Corporation, Nos. 78 and 80 Cortlandt street, causing a damage to the extent of $3,000, involving principally telephones and Gillette magneto bells. The premises at 50 Cortlandt street have been leased and will be fitted up as a new factory. The company will be ready to resume the delivery of their goods in about ten days.

Mr. E. T. Greenfield, Electrician of the Interior Conduit and Insulation Co., was granted, on December 2, patents on a tubular paper elbow, or bend; a conduit for electric conductors; attaching device for electric conductors; a process of impregnating porous bodies, and an underground conduit for electric wires, all of which he has assigned to the company of which he is the electrician.

The exhibit of Mason batteries at the American Institute Fair, just closed, was awarded a medal of bronze for merit. It is a noteworthy fact that this is the first time a medal has ever been awarded on an exhibit of primary batteries. This refers not only to this Fair, but to all other exhibitions. Mr. James H. Mason, the manufacturer of these excellent goods naturally feels very proud over the distinction given his battery.

Six bids, from as many companies, for lighting the city by electricity, were opened December 4 at a meeting of the Gas Commission. The bids averaged about forty-four cents a lamp a night, which was considered excessive. A resolution offered by Comptroller Myers, that the bids be rejected because of the high rates, was discussed, but it was concluded to wait until the bids are tabulated. Each bid is from two to three cents higher than last year's. The companies assert that the use of the subways entails extra expense.

Among the list of awards granted at the 59th annual exhibition of the American Institute, we find that bronze medals have been awarded to the Clark Electric Company on automatic safety devices; the Schuyler Electric Company, electric light dynamos; the Mather Electric Company, electric dynamos, etc; Clark Electric Company, electric arc lamp; Metropolitan Electric Signal Company, signal apparatus; Crosby Electric Company, electrical goods, etc.; Himmer & Anderson, dry battery cells, etc.; Andrew H. Brown, electric leak detector; Munsie & Cole, electrical conduits. R. J. G.

PRIMARY AND SECONDARY CELLS.—The electrical energy of secondary cells, like that of primary, is dependent upon chemical reaction, the difference being, that in the primary cell chemical reaction with generation of electricity, takes place constantly on the completion of the circuit, and continues indefinitely; while in the secondary cell the electric energy must first be supplied from an external source, and the action both chemical and electrical is limited and definite, dependent on the amount of electric charge given.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED DECEMBER 2D, 1890.

441,665. Regulator for Electric Motors. Walter E. Hyer, Newburg, N. Y. Filed Oct. 10, 1889.

441,695. Brush Holder for Electric Motors or Dynamos. William S. Patterson, Allegheny, Pa. Filed August 20, 1890.

441,703. Electric Signaling System. Joseph W. Riggs, Minneapolis, Minn., assignor to the Riggs Electric Travelling Danger Signal Company, same place. Filed Sept. 12, 1889.

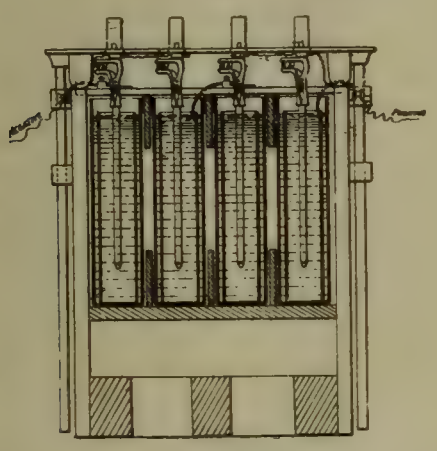
441,764. Trolley Covering for Electric Railways. Hiram Jones, Detroit, Mich. Filed Sept. 13, 1890.

441,771. Gearing and Motor Supporting Mechanism for Electric Locomotives. Frank Mansfield, New York, N. Y. Filed Apr. 8, 1890.

441,773. Automatic Electric Railway Signal. Robert O. Owens, Lynchburg, Va. Filed Mar. 18, 1890.

441,793. Dynamo Electric Machine. Walter K. Freeman, Brooklyn, N. Y., assignor to William S. Hadaway, Jr., trustee, Boston, Mass. Filed Sept. 20, 1890.

441,794. Regulator for Dynamo Electric Machines. Walter K. Freeman, Brooklyn, N. Y., assignor to William S. Hadaway, Jr., trustee, Boston, Mass. Filed Sept. 20, 1890.



NO. 441,893.—APPARATUS FOR ELECTRO-PLATING.

441,800. Trolley Wire Hanger or Support. Edward H. Kitfield, Lynn, assignor of two-thirds to Herbert C. Wirt and James L. Kimball, both of Boston, Mass. Filed Mar. 12, 1890.

441,807. Motor Regulator. David Pepper, Jr., Philadelphia, Pa., assignor to himself and Harry G. Clay, Jr., same place. Filed Oct. 1, 1890.

441,817. Electro Thermostatic Valve. Louis Bell and Frank H. Root, Chicago, Ill. Filed July 5, 1890.

441,818. Electrode for Secondary Batteries. Joseph Y. Bradbury and Frank J. Stone, Lowell, Mass. Filed Nov. 16, 1889.

441,828. Electro Magnetic Traction Increasing System. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed Aug. 25, 1890.

441,836. Tubular Paper Elbow or Bend. Edwin T. Greenfield, New York, N. Y., assignor, by mesne assignments, to the Interior Conduit and Insulation Company. Filed Dec. 14, 1889.

441,837. Conduit for Electric Conductors. Edwin T. Greenfield, New York, N. Y, assignor, by mesne assignments, to the Interior Conduit and Insulation Company. Filed Dec. 14, 1889.

441,838. Attaching Device for Electric Conductors. Edwin T. Greenfield, New York, N. Y., assignor, by mesne assignments, to the Interior Conduit and Insulation Company. Filed Mar. 3, 1890.

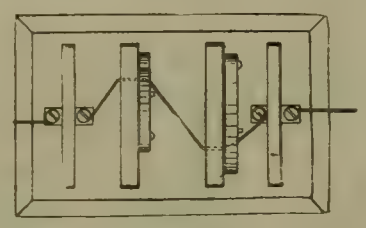
441 839. Process of Impregnating Porous Bodies. Edwin T. Greenfield and Julius Nagel, New York, N. Y., assignors, by mesne assignments, to the Interior Conduit and Insulation Company. Filed May 9, 1890.

441,840. Underground Conduit for Electric Wires. Edwin T. Greenfield, New York, N. Y., assignor by mesne assignments to the Interior Conduit and Insulation Company. Filed May 27, 1890

441,843. Galvanic Battery. Albert H. Hoy, Racine, Wis. Filed May 26, 1890.

441,847. Telegraph Circuit. Francis W. Jones, New York, N. Y. Filed June 24, 1890.

441,849 Electric Line Hook. Fred M. Locke, Victor, and John Lapp, Rochester, assignors of one-third to Theodore N. Norton, Victor, N. Y. Filed September 8, 1890.



NO. 441,933.—THERMAL CUT OUT.

441,855. Thermostat. Arthur G. Sargent, East Tilton, assignor of one-half to the Laconia Car Company, Laconia, N. H. Filed April 14, 1890.

441,856. Thermostat. Arthur G. Sargent, East Tilton, assignor of one half to the Laconia Car Company, Laconia, N. H. Filed April 24, 1890.

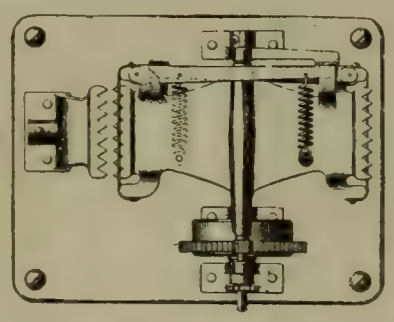
441,892. Apparatus for Electroplating. Wm. J. Possons, Cleveland, Ohio, assignor to the Brush Electric Company, same place. Filed October 18, 1889.

441,893. Apparatus for Electroplating. Wm. J. Possons, Cleveland, Ohio, assignor to the Brush Electric Company, same place. Filed October 21, 1889

441,894. Apparatus for Electroplating Carbons or Other Articles. Wm. J. Posson, Cleveland, Ohio, assignor to the Brush Electric Company, same place. Filed October 17, 1889.

441,908. Electric Clock Alarm. Matthias W. Tiedemann, Brooklyn, N. Y. Filed June 27, 1889.

441,918. Rheostat. Timothy K. Ames, Wilmington, Del., assignor of one half to James D. Carter, same place. Filed September 15, 1890.



NO. 441,999.—LIGHTNING ARRESTER.

441,919. Electric Wire Coupling. Wm. B. Banta, Springfield, Ohio. Filed June 11, 1890.

441,920. Electrotype. Wm. T. Barnum, New Haven, Conn. Filed May 5, 1890.

441,933. Thermal Cut Out. David J. Cartwright, Boston, Mass., assignor to the Electrical Safety Company, Portland, Me. Filed April 26, 1890.

441,953. Electric Motor. Henry Groswith, Philadelphia, Pa., assignor, by direct and mesne assignments, to the Kennedy-Groswith Electric Company, same place. Filed August 13, 1889.

441,954. Method of Operating Electric Motors. Henry Groswith, Philadelphia, Pa., assignor, by direct and mesne assignments, to the Kennedy-Groswith Electric Company, same place. Filed March 5, 1890.

441,958. Secondary Battery. Charles W. Kennedy and Henry Groswith, Philadelphia, Pa., assignor to the Kennedy-Groswith Electric Company, same place. Filed April 7, 1890.

441,959. Electrode for Secondary Batteries. Charles W. Kennedy, Philadelphia, Pa., assignor, by direct and mesne assignment, to the Kennedy-Groswith Electric Company, same place. Filed June 23, 1890.

441,967. Galvanic Battery. Cándido G. de Peralta. Havana, Cuba. Filed May 23, 1890.

441,972. Electrical Indicating Apparatus for Linear Measure. John Rapieff, New York, N. Y. Filed Mar. 13, 1889.

441,973. Electrical Location and Range Finding Instrument. John Rapieff, New York, N. Y. Filed Mar. 10, 1890.

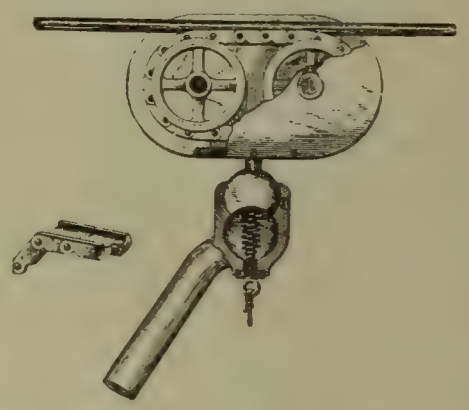
441,974. Method of Finding the Range of distant Objects. John Rapieff, New York, N. Y. Filed Mar. 10, 1890.

441,975. Indicator for Range-Finders. John Rapieff, New York, N. Y. Filed Mar. 10, 1890.

441,999. Lightning-Arrester. James J. Wood, Brooklyn, N. Y. Filed July 14, 1890.

442,002. Moving Contact for Electric Railways. Arthur W. Adams, Kansas City, assignor of one-half to Francis E. Nipher, St. Louis, Mo. Filed Dec. 23, 1889.

442,018. Electric-Arc Lamp. Thomas P. C. Crampton, London, England, assignor of one-half to Albert Essinger, same place. Filed July 14 1890. Patented in England, Belgium and Italy.



NO. 442,002.—MOVING CONTACT FOR ELECTRIC RAILWAY.

442,029. Annunciator. Frank E. Fisher, Detroit, Mich. Filed July 7, 1890.

442,030. Electric Switch. Frank E. Fisher, Detroit, Mich. Filed July 7, 1890.

442,071. Guard for Incandescent-Electric-Light Globes. Joseph Mino, Denver, Colo. Filed Feb. 27, 1890.

NOISE OF ELECTRIC RAILWAY MOTORS.

In his annual report, President Henry M. Whitney, of the West End Street Railway Company of Boston, made the statement that "the noise of the motors seemed to be the greatest objection." This objection is entirely overcome by the use of raw-hide pinions, and these goods manufactured by the Electric Merchandise Company of Chicago are giving excellent satisfaction wherever used.

In a recent letter from E. G Connette, superintendent of the United Electric Railway, Nashville, Tenn., to the Electric Merchandise Company that gentleman says:

"We have used your raw-hide pinions and are very well satisfied with them; while the life of a raw-hide pinion is not quite so long as a good bronze pinion the saving on the iron gear makes them quite economical. You will remember we purchased some of your pinions about five months ago, some of which are still in service. I have to-day sent you an order for four dozen."

This letter voices the sentiment of all the roads who have used these raw-hide pinions.

NEW OFFICES OF THE OKONITE COMPANY, LIMITED.

The new factory of the International Okonite Company (Limited), at Passaic, N. J., being practically finished and in tip-top running order, this enterprising and progressive concern have turned their attention to improving their New York headquarters, 13 Park Row, both in facilities, appurtenances and appearance. By the acquisition of three or four more rooms in addition to those formerly occupied by them, they have acquired every facil ty for the systematic and expeditious carrying on of their immense busine-s and have located themselves in quarters which should please the most fastidiously inclined.

The new offices of the company, while richly artistic in all their fixtures, have an air of refinement and propriety in their elegance. Everything is elegantly serviceable. The reception room is artistically and comfortably furnished. In the center is an immense table of finely carved oak, on which are the latest issues of all the electrical journals.

The offices of the Okonite Company, comprise six sections or departments, formed by partitions and artistic oak railings

The private offices of Captain Willard L. Candee, Mr. Geo. T. Manson, Mr. H. Durant Cheever, and sales agents' quarters are at the farther end of the reception room on its left. The general sales agent, Mr. T. McCoubray and assistants, occupy an oblong room which forms a sort of hall between the private and general offices. They are replete with every facility for the convenience of those here located; desks, chairs and incandescent light, in fact the offices of the company are lighted throughout by electricity.

To the left of this department and facing the busy thoroughfare, Park Row, are the private offices of Capt. Candee, Mr. Manson and Mr. Cheever. They comprise most of the space occupied by the old quarters of the company. These rooms are well lighted, equipped with desk, chairs and cabinets of finely carved and highly polished oak.

The financial or business part of the Okonite Company's offices is located at the farther end of the reception room, and on its right; a finely wrought oaken railing separating this department, of which Mr. Hodgkins is the head and leading spirit, from the rest of the office.

The International Okonite Company in their present quarters can safely lay claim to an office which in point of convenience and elegance, cannot be surpassed by any of its size in the city, and such an office as a firm of their commercial importance fully deserve.

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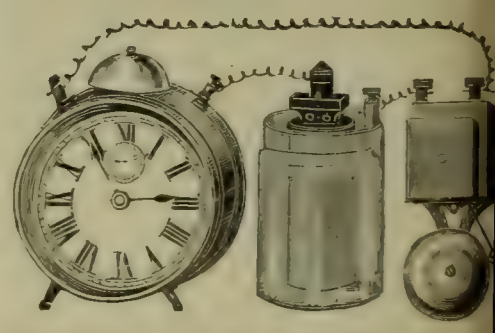
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NEW YORK, DECEMBER 20, 1890.

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BIDS FOR LIGHTING NEW YORK'S STREETS.—The periodical hostilities between the Gas Commission and the electric light companies of this city, have been renewed. The cause is the old, old story, the companies ask too much money to light New York's streets by electricity, at least so says the Gas Commission. The electric lighting companies recently put in bids for street lighting, but after some deliberation the Gas Commission decided that the figures were too high. Bids will, therefore, be again advertised for, and they will be opened at 1 P. M., December 23d. As the bids are to cover the year 1891, it is hoped that the two parties may arrive at an agreement, and that New York may enjoy the blessings of electric light for a whole year, at least, without any friction between the city authorities and the electric companies. The Gas Commission think that forty cents per lamp per night is about the figure the city would be wiling to pay.

THE PERFECTED GRAMOPHONE.—The great attraction at the next meeting of the American Institute of Electrical Engineers, on December 16th, will be the perfected gramophone. A good deal has been heard about this instrument but it has been seen but little, that is, by the public eye, and as this exhibition of the instrument will be the first one ever given in this city, no doubt the attendance at the meeting will be extraordinary. Invitations have been sent to other interested persons outside of the society's membership to attend the meeting in order that the perfected gramophone may be seen. An additional attraction will be the fact that the instrument will be exhibited and operated by its inventor, Mr. Emile Berliner. The ability of the instrument, as a sound recorder and reproducer, will be practically demonstrated, and Mr. Berliner will have something to say about it.

SUNDRY HUMBUGS.

It is a singular fact that many great things emanate from obscure sources. Humanity has, since Adam's time, we presume, suffered from cold feet in the winter time, and it remained for a cobbler to discover a cure for this very general discomfort. By an application of galvanism this is accomplished. This cobbler makes what is called the electric shoe, inside of which are placed along the shank small pieces of zinc and copper arranged alternately in a row. The inventor claims that the moisture of the foot sets up a current in the "battery," and the current thus generated passes through the foot and keeps it warm. The voltage of this current is not given. This humbug reminds us of another which was practiced some time since on some squatters on the Jersey meadows. These people live in hovels near the banks of the Hackensack, and there is quite a number of them near the bridge of one of the principal Jersey roads. On an evil day a lightning rod man swooped down on the place, and that he convinced the inhabitants thereof that their dwellings were in great danger of being struck by lightning is quite evident from the decorations to be seen projecting from the flat roofs of the shanties. There is an abundance of lightning rods on each structure, and the point of each emerges from a beautiful large silver ball. The general effect is rather startling, and the architectural points of the buildings are lost sight of in the splendor of the lightning rods and their accessories.

POPULAR EDUCATION IN ELECTRICITY.—There is no better evidence of the popular desire for electrical knowledge than the fact that many newspapers regularly devote a portion of their space to electrical news culled from the electrical journals. Some of these present the electrical news in a very creditable manner, and show that the compiler is a person having some electrical knowledge and ability. In other papers, however, the handiwork of the reporter with a largely developed imagination is seen in the alleged electrical column. When a fact starts the rounds of the electrical columns of these newspapers, it undergoes a change each time it is copied into another paper, and by the time it has run through half a dozen such columns it is difficult to recognize it. But so long as it makes a nice little story it is read with avidity. It would be well for these papers to make an effort to cling a little closer to the truth if they would have the people learn something about electricity.

MR. EDISON'S PAPER CARBON LAMP.—It is just past eleven years ago (December 11th, 1879), since Mr. Edison applied for a patent on the paper carbon which he then thought solved the problem of practical and successful incandescent lighting. At this later day it sounds odd to read in the specifications of his invention this declaration: "I make use of paper of the desired thickness as free as possible from foreign substances or adulterations, and for this purpose I prefer and use bristol board." This paper carbon lamp was indeed a poor affair compared with the incandescent lamp of to-day, but it was in the order of development that it should have an existence. It was really the parent carbon incandescent lamp.

PATENT DECISION.—The Attorney-General on the request of the Commissioner of Patents has rendered an opinion of special interest to inventors and patent attorneys. The effect will be to do away with the practice of postponing indefinitely the issuance of letters patent by neglecting to pay the final fees within the required six months, and then, before the expiration of two years allowed by law, applying to have the application renewed. This programme in some cases has been repeated for many years, thus materially extending the life of the patent beyond the seventeen years specified in the statutes. The Attorney-General holds that a patent cannot be allowed on any application for renewal not filed within two years after the allowance of the original application.

EXHIBITS AT THE NEXT ELECTRIC LIGHT ASSOCIATION CONVENTION.

Through the courtesy of Gen. C. H. Barney, chairman of the Committee on Exhibits, of the National Electric Light Association, we have received an advance proof of a circular in reference to the exhibits at the next meeting of that association, in Providence, R. I. The following is the full text of the circular:

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.
18 CORTLANDT STREET,

NEW YORK, Dec. 13, 1890.

In connection with the meeting of the National Electric Light Association, in Providence, R. I., on February 17th, 18th, and 19th, 1891, it is proposed to hold an exhibition of electrical apparatus and appliances, especially such as are used in the business of furnishing light and power. To this exhibition, all associate members are earnestly requested to contribute.

A suitable hall has been secured opposite the hotel, which will be the association headquarters, and, through the courtesy of the Narragansett Electric Lighting Co., all the electric current necessary will be provided. There will be run into the hall three circuits, viz.: 1st, an incandescent alternating current converted to 50 volts; 2d, a 500 volt direct current from T.-H. generators; 3d, an arc current of $6\frac{8}{10}$ amperes.

There will be *no charge for space or current to exhibitors* who *must*, however, *be associate members of the association.* The installation and care of exhibits will of course be at the expense of exhibitors.

As this meeting may be said to virtually mark the close of the first decade of electric lighting, commercially, it is suggested that as far as possible, efforts be made to show the progress in the art, by exhibiting the earlier forms of apparatus and appliances, together with those embodying the latest improvements.

The exhibition will open on Tuesday, February 17th, and close on Thursday evening, February 19th, and will be open day and evening. Exhibits may be installed on the Saturday and Monday previous, and removed on the following Friday.

It is expected that this exhibition will prove very attractive to the Providence public, as well as to the members of the Association. To exclude the street gamin element, a nominal admission fee (25 cents) will be charged, but it is intended to circulate complimentary invitations freely among the representative business men of the city, and exhibitors will be supplied with as many complimentary tickets as they may desire to exhibit.

As space is limited and will be allotted in the order in which applications are received, it is desirable that all intending exhibitors fill out the accompanying blank, and send it to the chairman of the committee prior to January 15, 1891, at which date all allotments of space will be made.

COMMITTEE ON EXHIBITS.

C. H. BARNEY, *Chairman*, 20 Cortlandt St., N. Y.
HENRY B. CRAM, Boston, Mass.
VAN A. THOMAS, Providence, R. I.
WM. J. HAMMER, New York City.
GEO. C. MAYNARD, Washington, D. C.
WM. A. KRIEDLER, Chicago, Ill.
LUKE LILLEY, Cincinnati, O.

BUCKLING.—If storage cells are discharged and be left to stand idle for any length of time, sulphating takes place rapidly, and causes premature buckling.

NOTES ON THE CHEMISTRY OF SECONDARY CELLS.*

By Prof. W E. Ayrton, Vice-President; C. G. Lamb, B. Sc., and E. W. Smith, Associates.

I.

In our paper on "The Working Efficiency of Secondary Cells," read at the meeting of this Institution in Edinburgh in July, it was stated that, "In spite of accumulators with pasted plates having been in use now for nine years, the chemical action that takes place during the different stages of the charge and discharge has only been conjectured, and, odd as it seems, no decisive experiment appears to have been made to settle this much-debated question. Various analyses have been made by different chemists of salts of lead acted on in certain ways with sulphuric acid, but apparently not of actual accumulator plates in action. We are therefore, now with the assistance of Mr. Robertson, making a complete investigation of the chemical state of the plugs of both the positive and negative plates at all stages of the charge and discharge of an 1888 E. P. S. type of accumulator in good condition." The present paper contains an account of the results thus obtained.

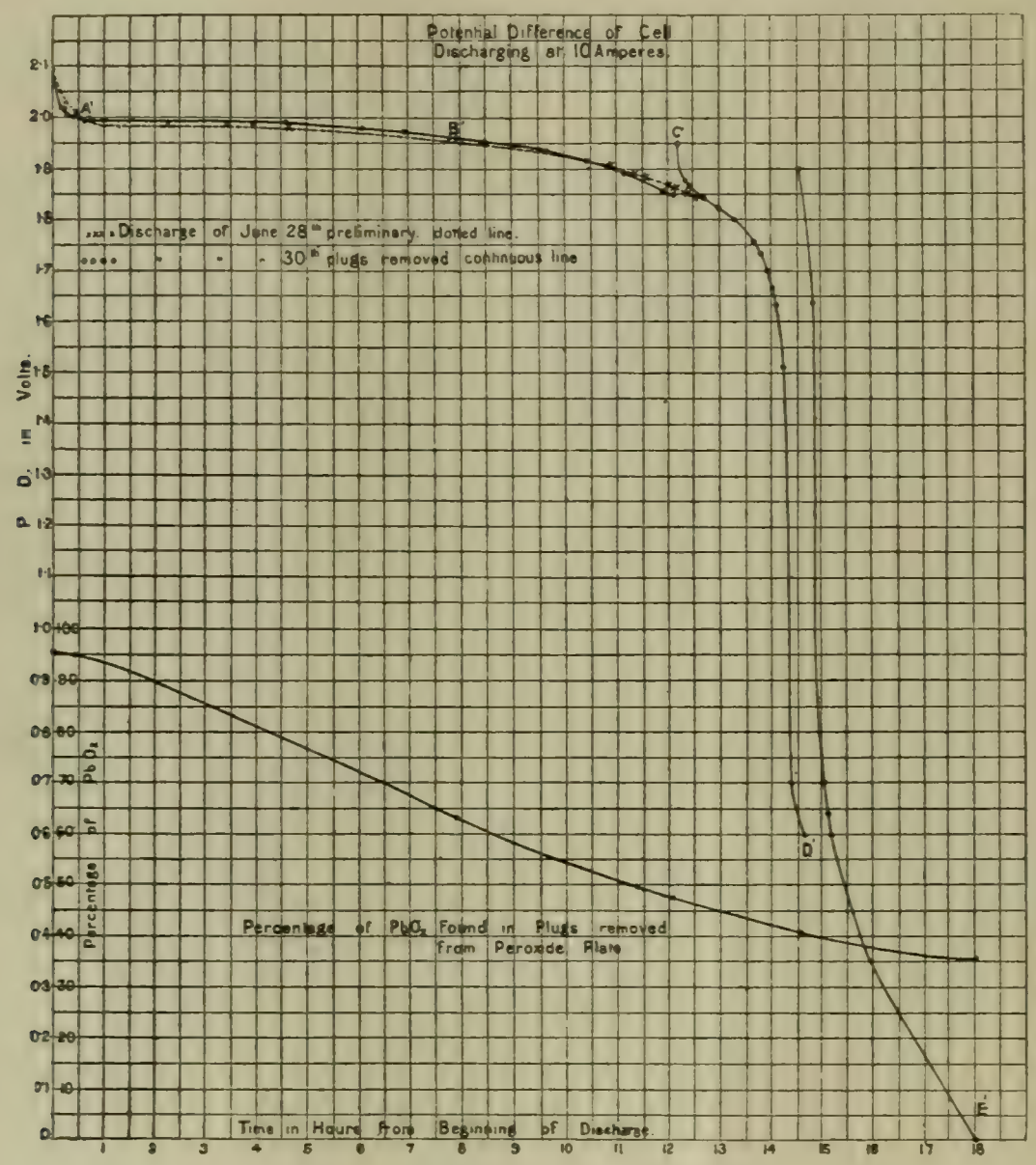


FIG. 1.—CHEMISTRY OF SECONDARY CELLS.

The cell selected to remove the plugs from had the same size as the cells employed in the investigations described in the previous communication, and was one of the batch of 50 purchased for the Central Institution about the middle of 1888. Since it first came into our possession it had never been overcharged, never been left discharged nor permitted to send more than the maximum current allowed by the makers for cells of this size—viz., 10 amperes—and consequently, at the beginning of the present investigation in June of this year, this cell was in excellent condition.

First the cell was several times charged with a current of 9 amperes, and discharged with a current of 10, without stopping day or night, so as to bring it into what we have called its steady "working" state. The dotted curves, figs. 1 and 2, show the large charge and discharge obtained on June 28th. During the next charge, indicated by the continuous curve, fig. 1, plugs were removed from both the positive and negative plates at the point marked A, B, C, and D, when the terminal P. D. of the cell was 2.134, 2.2, 2 234 and 2 4 volts respectively. In order to remove the plugs from the positive plates, these plates were bodily removed out of the liquid, but, to prevent oxidation, the negative plates were left in the liquid, and the plugs removed in a way that will be described later on. The time occupied in removing the plugs from the two sets of plates occupied about 15 to 20 minutes on each occasion. Immediately after the removal of the plugs the positive plates were put back in position in the cell, the resistance in the circuit rapidly adjusted, if necessary, to make the charging current exactly 9 amperes, and the time variation of the P. D. at the terminals of the cell noted. The interval that elapsed while the current was broken is not shown on the curve; that is to say, the P. D. observed immediately after replacing the positive plates in the liquid and closing the circuit is plotted directly under the P. D. that was observed just before the circuit was broken prior to the removal of the positive plates from the liquid.

We were afraid that the bodily withdrawal of the positive plates out of the liquid, combined with the removal of the plugs, on the several occasions, would produce so great a change in the conditions of the cell as to render the P. D. curve quite discontinuous. It was, therefore, as interesting as it was unexpected, to find that the terminal P. D., on restarting the normal charging current of 9 amperes, rapidly acquired the value it had before the withdrawal of the plates; so that, with the exception of the rapid rise of the P. D. on restarting the charging current, the P. D. curve obtained on June 29th was almost the same as the P. D. curve obtained on charging on the previous day.

After the cell had been charged until the terminal P. D. reached 2.4 volts, it was immediately discharged with a perfectly constant current of 10 amperes, and, as it was anticipated that the removal of the plugs would spoil the cell, it was allowed to discharge far below the normal limit. In previous discharges (the last one of which is shown by the dotted line, fig. 2), the discharge was stopped when the terminal P. D. fell to 1.85 volts. But in the discharge on June 30th, when the plugs were removed, the discharge current was kept at 10 amperes, by using auxiliary cells, until the E. M. F. of the test cell fell to nought, and even reversed. Plugs were removed from both the positive and the negative plates when the terminal P. D. was 2, 1.95. 1.85, 0.6, and nought volts, as indicated by the points A', B', C', D', and E'. The recovery of the E. M. F. on breaking the circuit was very marked, especially near the end of the discharge.

II.

METHOD OF OBTAINING SAMPLES OF THE PLUGS.

On the first removal of plugs corresponding with the point A', fig. 1, a curved pointed glass rod was used, as shown in fig. 3, with the idea of prising out the plugs; but by this method only the surface of the positive plugs could be removed, as they were much too hard to be loosened in this way. Indeed, one of the most striking things noticed in this investigation was the firm way in which the plugs were held in the plates of an E. P. S. cell that had been carefully used for two years. Before the next attempt was made to remove plugs corresponding with the point B, fig. 1, a straight piece of glass rod was pointed, and mounted in a wooden handle. This glass chisel was used to pierce and loosen the positive plugs, which were then driven bodily out of the grid by means of a hard wooden punch cut square to fit the holes in the grid, and which was tapped with a small mallet. The plugs on being driven out of the grid were caught in a long wooden scoop (shaped so that it could be just slipped in between the plates), and then washed by Mr. Robertson into wide-mouthed bottles containing three or four hundred c. c. of distilled water. As soon as the water cleared it was decanted off and fresh added.

As several glass chisels were broken, and the wooden punches worn down in the removal of the plugs, the method has the disadvantage of mixing with the specimens to be analyzed splinters of glass and wood, which were found difficult to remove afterwards. On the other hand, the method had the advantage of enabling specimens of the positive plugs to be removed in a comparatively short time on each occasion from the top, the middle, and the bottom of the plates.

As the negative plates were never removed from the acid, the only way to remove the plugs was by working them loose under the liquid by means of long curved glass rods pointed at the end, and by catching the plugs in a narrow wooden scoop with a long handle, as shown in figure 4. It was possible to use this method throughout for the removal of the negative plugs, as they were softer and more easily removable than the positive ones. The scoop held sufficient liquid to enable the negative plugs to be dropped into wide-necked bottles containing water without the plugs being even momentarily exposed to the air. The water in these bottles Mr. Robertson had washed free from dissolved oxygen by previously bubbling hydrogen through it for a considerable time. After the negative

*Read before the English Institution of Electrical Engineers, November 13th.

plugs had been put into the bottles and water was gradually decanted off from time to time, and fresh added until the liquid in the bottle was quite free from acid.

Both in the case of the positives and the negatives the top samples were removed from the corner of the plates nearest the lug, and the bottom samples from the corner diametrically opposite, so as to obtain evidence, if possible, of any difference of current density which might exist at different parts of the plates in charging and discharging.

The plugs from the top, the middle, and the bottom of each set of plates were at each of the removals of plugs put into six separate bottles.

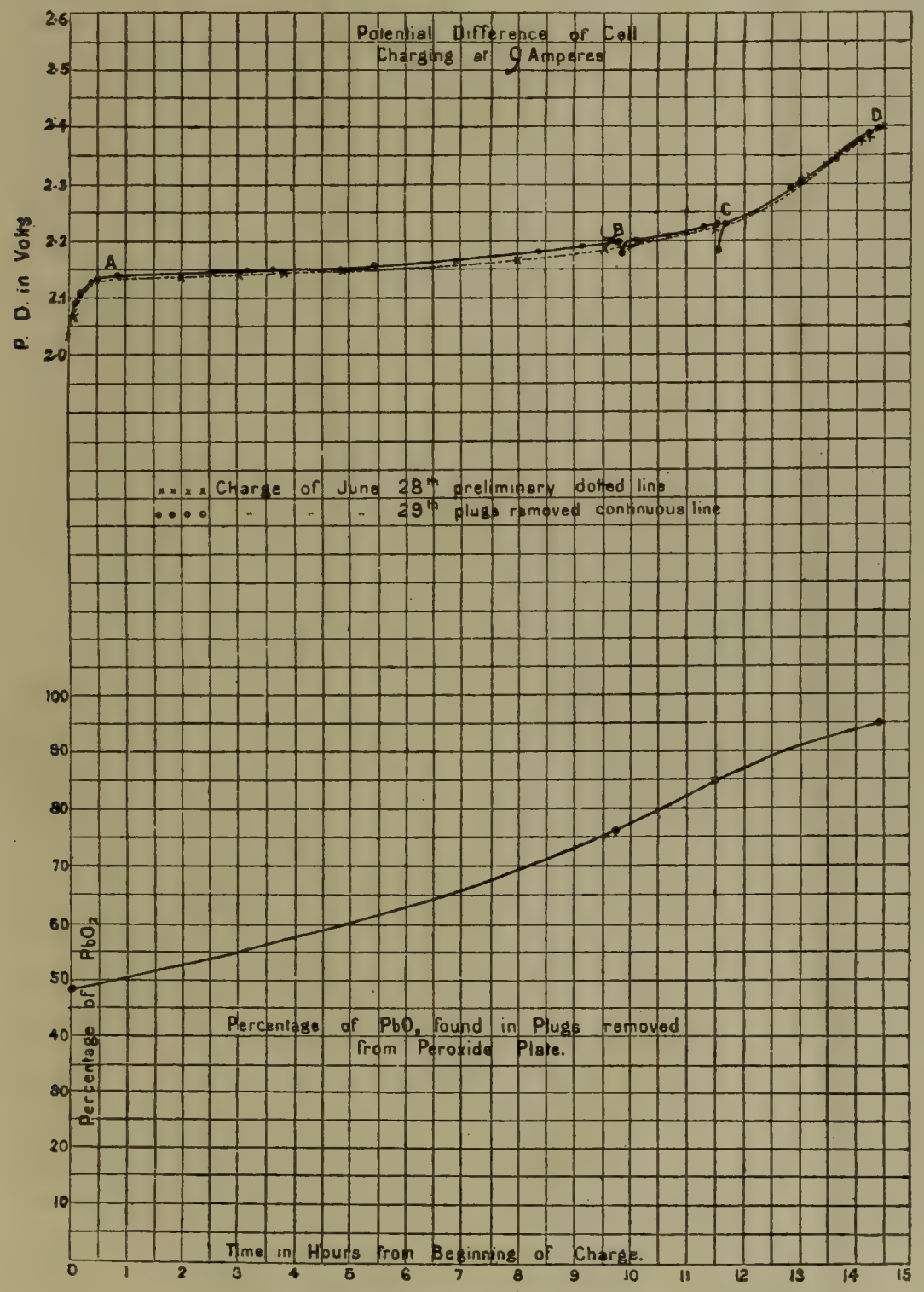


FIG. 2.—CHEMISTRY OF SECONDARY CELLS.

and, to avoid the possibility of error in their subsequent identification, there was noted on the label of each the character of the plates and the position on them from which the plugs were removed, the time, the P. D., and the specific gravity of the liquid in the cell.

(To be continued.)

ELECTRIC LIGHTING FOR BEGINNERS.*

BY THE EDITOR.

Part XVIII.—Incandescent Lamps.

335—What are the distinguishing features of the light from an incandescent lamp, as compared with that from an arc lamp?

The light from an incandescent lamp is steadier and softer than that of an arc lamp.

336—What is the name of the thread-like substance inside of an incandescent lamp bulb?

The filament.

337—What is the substance of the filament?

Filaments are generally made of a carbonized fibre of some sort. Mr. Edison uses bamboo; Sawyer-Man use cotton twine or thread, and in the Bernstein lamps silk ribbon is used. All of these substances are carbonized before they can be used for lamp filaments. Other makers use different materials for filaments.

338—What shape are the filaments?

They are now generally made in the form of a loop. In the earlier practice there were as many forms of filaments as there were makers of lamps.

339—Has carbon always been used as the substance for the filaments of incandescent lamps?

No; platinum was once used to some extent.

340—What are the advantages of carbon over platinum for filaments?

The principal advantages are: 1st, less cost; 2d, greater electrical resistance; 3d, infusibility even at the highest temperatures; 4th, its low thermal capacity, and 5th, its greater power of illumination at the same temperature.

341—What is the electrical resistance of carbon as compared with platinum?

The resistance of carbon is 250 times greater than that of platinum.

342—Is the high resistance any advantage?

Yes; it is necessary for the production of light. With low resistance it would be more difficult to raise the temperature sufficiently to produce the proper amount of light.

343—Is the light due to the resistance?

The light is due to both, the resistance and the current. The interposition of any obstacle, or resistance to the free passage of a current of electricity in a wire causes the production of heat at the point where the resistance exists. The greater this resistance the greater will be the heat developed and consequently the greater will be the light.

344—Does not the current fuse the carbon?

No; carbon is the most refractory substance known.

345—What is the object of placing the filaments in glass bulbs?

To protect them from the air.

346—Is there not air inside the bulb?

No; the air is exhausted and there is a vacuum.

347—What is the object of exhausting the air from the bulb?

To prevent the destruction of the carbon filament.

348—Why does the air destroy the filament?

When a current of electricity passes through a filament in air the oxygen of the air destroys the filament.



FIG. 3.

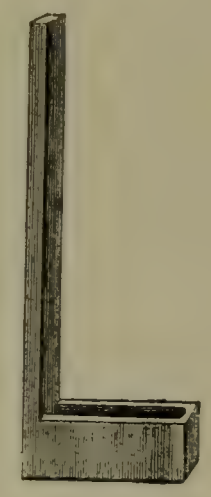


FIG. 4.

349—Then does placing the filaments in a vacuum prolong their life? Yes, very greatly.

450—How long do filaments last in practice?

The average durability of filaments is estimated at from 800 to 1000 hours; or, from three to four months, with an average use of from 8 to 9 hours a day.

351—Does an increase of the current increase the light in an incandescent lamp?

Yes; but it shortens the durability of the lamp?

352—How is the connection between the filament and the circuit effected?

At one end of the bulb are some brass parts. On the exterior surface is a collar or ring which fits into the socket, or lamp holder. Arranged concentrically within this collar or ring, but insulated therefrom, is the projecting end of a brass rod or pin. This pin is firmly embedded in the insulating material and is rigid, as is also the collar. To both the collar and pin are connected metallically short pieces of platinum wire which project within the bulb. To the ends of these two pieces of wire the ends of the carbon filaments are connected. Now, when the lamp is placed in the socket, the brass collar on the lamp bulb is brought into contact, through the fixture, with one of the conducting wires, and the pin on the bulb is also brought into contact with a certain part within the socket, which is electrically connected with the other conducting wire. Thus the circuit is completed.

353—What means is provided for turning the current on and off at will?

A key on the socket, which, by turning, opens and closes the circuit by breaking and restoring connection with the central pin.

354—How is the air exhausted from the bulbs?

By the use of vacuum pumps.

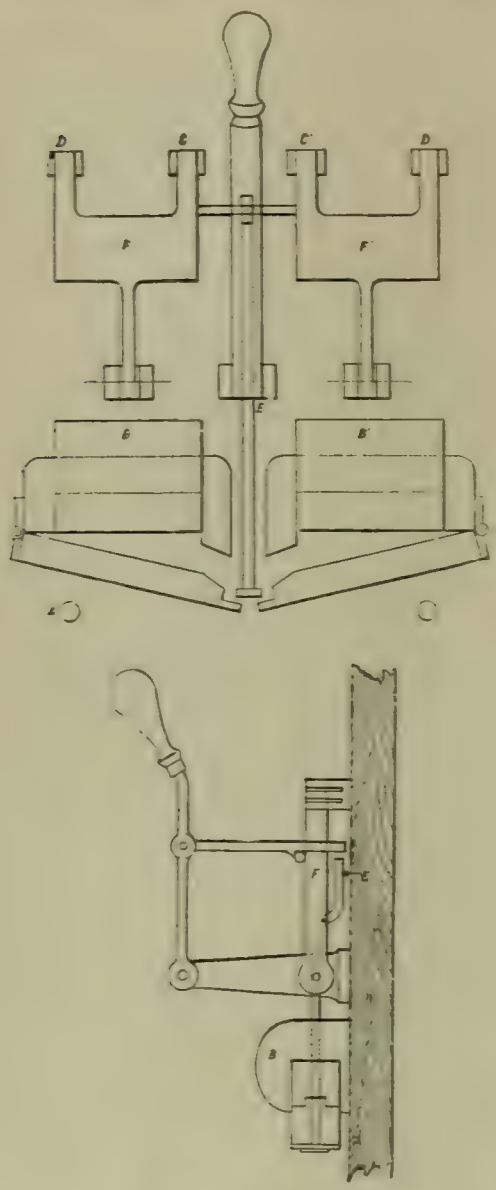
(To be continued.)

* Copyrighted.

MAGNETIC CUT OUT.

The following description and illustrations of the magnetic cut out used at the Manchester Square central station of the Metropolitan Electric Supply Company, London, will be of interest to central station operators in general.

The exciting current passes round the coils of the electro-magnets of this electro-magnetic cut-out. When the exciting current exceeds a certain safe value the attraction of an armature by this electro-magnet releases a double pole switch which is kept locked by a clutch and the switch springs back and opens the circuit of the fields. The exciter board resembles a telephone switch-board. The object of the arrangement is to group the exciters and dynamos. There are four exciters, one of which is sufficient for five dynamos. Hence at full load two exciters have to be operated. On the exciter board there are a



MAGNETIC CUT OUT.

A, A, Exciter Terminals. B, B¹, Magnetic Coils in Exciter Circuits. C, C¹, Contacts on Exciter Circuits. D, D¹, Contacts on Field Circuits of Dynamos. E, Releasing Rod raised by Magnets. F, F¹, Double Pole Switches, forced open by Springs when released.

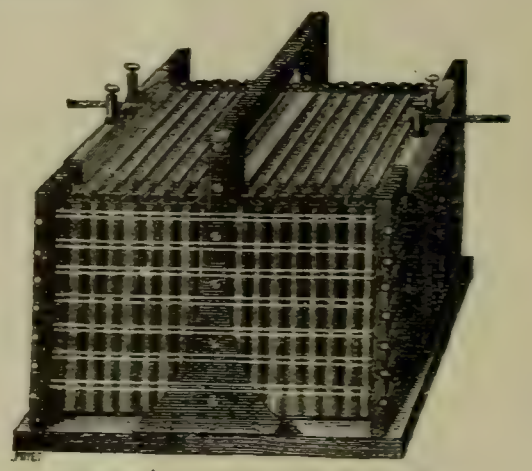
series of vertical and horizontal bars which can be connected by plugs. The vertical bars are connected to the dynamo-field circuits, and the horizontal bars to the exciter poles. Hence by plugging together these strips any exciter can be put into the fields of any dynamo or dynamos arranged in parallel, and the exciters can be arranged so as to work in parallel on one group of dynamos or separately on separate groups. There are the usual rheostats for introducing resistance into the fields of the exciters.

RESISTANCE OF CARBON.—Carbon possesses the remarkable feature of offering less resistance to the passage of an electric current when it is hot than when cold; in other words, its resistance decreases with an increase of temperature.

THE REYNIER ELASTIC ACCUMULATOR.

The following data respecting an accumulator brought out by M. Emile Reynier, of Paris, will be read with interest:

In the original design each cell was contained in a varnished sheet iron vessel lined with india-rubber, and was composed of two positives and one negative, separated by sheets of porous silica, the two end sheets being fluted to increase the space available for the electrolyte, the quantity of which was, however, small. In the latest type of cell M. Reynier uses containing vessels of pure lead, the necessary flexibility being obtained by surrounding the lead cell with an expansible corrugated case. A number of cells are connected in series, and placed between two rigid end pieces drawn tightly together by strong springs. This arrangement gives the active material considerable artificial elasticity, which enables one to obtain a high rate of discharge and to obtain a high output for a given weight. The expansions and contractions of the plates can take place freely without disintegration owing to the action of the springs. There is a difference in length of as much as 6 per cent. between a completely discharged and a fully charged battery. Moreover, the active material being constantly under pressure, there is no need for heavy grid-like supports. Finally, the plates and the cells being held together in this elastic manner, they are able to withstand severe shocks, and are from that point of view alone peculiarly suited to the exigencies of traction work.



REYNIER'S ELASTIC ACCUMULATOR.

The annexed figure represents a storage battery of the latest type. It consists of 16 cells mounted between end pieces of hard wood, strengthened by iron bands. The following are some figures with regard to this particular type of storage battery:

E. M. F. (full)		32 volts.
E. M. F. (at terminals)		28 "
Discharging current		3 to 6 amperes.
Average available energy		150 watts.
Capacity		30 ampere-hours.
Work (available		740 watt-hours.
External dimensions	Length	16"
	Breadth	12"
	Height	12"
Total space occupied (less than)		1.5 cubic feet.
Total weight		110 lb.
Weight per watt-hour		.15 lb.
Watt-hours per lb. of cell complete		6.73 "
Volume per watt-hour		3 cubic inch.

It may be added that the figure for the total weight and total volume include everything, and that the battery is very solidly constructed in view of its employment in electric tramway and similar work.

The above facts and illustration are taken from the London *Electrician*.

ALUMINUM.—The Cowles Electric Smelting and Aluminum Company, of Lockport, N. Y., have been preparing to produce aluminum by a new process. In a recent despatch from Lockport, Mr. Eugene H. Cowles is reported to have said: "We now expect to offer a pure metal made by a new process that is radically different from anything yet known to metallurgists—a process that is ridiculously simple in operation and almost theoretically perfect. By reason of two chemical discoveries it is found that the pure metal can be extracted direct from the clay. This can be done without the use of electrical heat. When operated on as large a scale as that on which iron is produced aluminum will be produced at a cost permitting it to sell at $200 per ton, a price less than the present price of copper. Alterations will be made immediately in our works here to make the metal on a large scale. Capitalists in New York are preparing to build immense new works of probably twenty times the capacity of the Lockport works. One of the large plants will undoubtedly be at Niagara Falls, where 10,000 to 12,000 horse power will be required to operate it. As soon as the plant at Niagara Falls is in operation—say by July, 1892—the world can expect a supply of aluminum at least 99 per cent. fine at prices not to exceed 50 cents per pound."

TO INCREASE ITS MEMBERSHIP.

Mr. Allen R. Foote, secretary and treasurer of the National Electric Light Association, is sending out to the members of the association a letter in which he urges them to induce other persons and concerns in the electrical trade to become members of the association. Mr. Foote encloses with this letter another which is intended to be sent to a prospective member. In this latter letter Mr. Foote invites the recipient to become a member of the association. "In doing this," the letter states, "the association feels that it can give you a full and generous equivalent in return for all you may contribute to, or do for it. It is the ambition of the association to render investments in its memberships, and the expenses of attending its conventions, the best use of money that can be made by any company, firm or person interested in the electrical industries.

"*One thousand members* will endow this association with an influence and prestige that will cause it to rank above every other industrial organization in this country.

One thousand members will endow this association with an income that will enable it to spend *twenty or twenty-five thousand dollars* yearly on the work of its committee, its publications, and general office. It can then investigate, collect, and publish information pertaining to each of the many features of important interest involved in the construction, maintenance, operation, and management of central station plants, and also all questions relating to State or municipal legislation, contracts for service, insurance, and accidents, etc., etc.

With such a membership and such an income, the work this association can do for the benefit of each member will be of a character, reliability, scope, and thoroughness, that is absolutely unattainable in any other way. In doing this work, each member contributes one share and receives in return all that is obtained by the united effort of the *One Thousand*.

ATLANTIC CABLES.—In our last issue we published an article on Atlantic cables, in which we gave some statistics showing the number and length of the various cables crossing the North Atlantic. As we consulted, what we supposed were reliable authorities, for these figures, we accepted them as accurate. We now learn that there were some inaccuracies, and having obtained the correct figures we give them herewith, with the assurance that they may be depended on as accurate: The Anglo American Company has four Atlantic cables, with a total length of 10,095 nautical miles; the Direct Cable Company has one with a length of 3,101 miles; French Company one cable, 3,409 miles in length; the Western Union has two cables 5,107 miles long and the Commercial Cable Company has two with a length of 6,099 nautical miles. Total number of cables 10; total length of same 27,811 nautical miles. In this connection we will take the opportunity to answer a question with reference to the illustration used in the article referred to. The view is that of the shore end of the Direct United States at Rye Beach, N. H.

TELEPHONE PATENT DECISION.

Commissioner of Patents Mitchell, on September 22d last, decided a case of importance and of general interest to telephone people. It was an appeal from the decision of the Examiners-in-Chief denying a patent to William C. Barney, *pro se*, for an alleged new method of telephony.

The decision of the Examiners-in-Chief is based upon two grounds: (1) want of novelty in the method, and (2) want of correspondence between the claims with the operative method employed.

After citing the considerations upon which is founded the conclusion that the alleged new method is wanting in novelty, and giving the reasons for holding that there is a want of correspondence in the claim with the operative method employed, the Commissioner's decision continues:

In appealing to the Commissioner the applicant takes exception to the decision of the Examiners-in-Chief in the following respects, embraced in the reasons of appeal: (1) That their decision sustaining that of the Primary Examiner is based upon a supposed theory and not upon facts well established and admitted by a decision of the Examiners-in-Chief, rendered June 20, 1888, upon the mode of operation of applicant's apparatus. (2) That the Bonta patent, No. 333,816, describes a simple break of the electric circuit once at each full vibration of the tympan, precisely as does the device of Reis, a mode of operation which all scientists and judicial tribunals have declared to be incapable of reproducing articulate speech. so that the Examiners-in-Chief erred in declaring the Bonta patent to be an anticipation of applicant. (3) That the device described in the patent to Randall, No. 235.019, has not the construction or mode of creating electrical disturbances in conductors described in appellant's application.

(1) Is the decision of the Examiners-in-Chief based upon a supposed theory contrary to facts well established and admitted by the Examiners-in-Chief in a previous decision?

That the "supposed theory" is the one commonly acccpted by scientists and approved in judicial decisions probably will not be denied—certainly no successful denial can be made—nor can it be denied that the burden is upon the applicant to show that the theory is contrary to the fact. This burden the applicant voluntarily assumes, and thereupon contends not only that articulate speech can be transmitted by "intermittent impulses of electricity," but that the Examiners-in-Chief have so admitted. Thus he insists that his apparatus has been patented and that it has been recognized by the Examiners-in-Chief in their favorable opinion in the apparatus case to be an "intermittent circuit closer," and he insists also that it has been admitted by the Primary Examiner that his apparatus transmits articulate speech. He then draws the inference that the Office has admitted that articulate speech can be transmitted by "intermittent impulses of electricity." This inference is plainly a *non sequitur*. The burden upon the applicant in order to show that he is entitled to a patent for a method of reproducing articulate speech by "intermittent impulses of electricity" requires him to successfully maintain two propositions: (1) that his apparatus makes and breaks the circuit, and (2) that it is *because* of the "make and break" characteristic that articulate speech is reproduced. If he has established the first proposition, he certainly has not established the second. If the experts of the Office are correct, and their conclusions certainly commend themselves to my judgment, the effect of reproducing speech is due to varying pressure, the initial contacts having been established, and not to the "fine staccato punctuations or discontinuities," in virtue of which the apparatus may properly enough be spoken of as an "intermittent circuit-closer." In the language of the Primary Examiner—"the vital and useful thing is the variation of "resistance during the intervals of contact of "the tympanum and electrodes, and the harmful thing is the break, [and] the reason for the "transmission of articulate speech is not to be "found in the intermittent impulses *per se*."

Without announcing any opinion upon the question whether or not the apparatus of the applicant when operating to transmit speech breaks the circuit, I agree with the Primary Examiner and the Examiners-in Chief that if such is the case the applicant has simply invented an apparatus capable of transmitting speech in spite of that feature, and that the operative principle of the method is not to be found in intermittent impulses, *per se*.

(2) Is the Bonta patent an anticipation, as held by the Examiners in-Chief affirming the Primary Examiner? That is to say does Bonta disclose an apparatus which is capable of transmitting articulate speech by means of a transmitter adapted to produce a "make or break" in the circuit? The grounds upon which the Examiners-in Chief so held have been already quoted.

In reply the applicant insists that the Bonta transmitter is incapable of transmitting articulate speech, unless so adjusted that "makes and breaks" will not occur in the circuit. Bonta states that he has found that it is not possible to transmit articulate speech in a commercially practical manner over a line which is alternately broken and closed by the transmitter, as in the Reis system; that the object of his invention is to so improve the Reis system that articulate speech, as well as other sounds, can be successfully transmitted, and that to this end his invention—

"consists in electrically transmitting vocal articu-"lations and other sounds over a line or sec-"ondary circuit by electric currents induced by "varying as well as breaking the contact "between two electrodes in the primary circuit "associated with the said secondary circuit."

He likewise claims the very art which the applicant would now claim if he (the applicant) included in the statement of his "method" the varying resistance which is present in the operation of his apparatus, and which, to say the least of it, enters into the method by which speech is reproduced.

(3) In view of what has been said I do not deem it necessary to enter into a discussion of the Randall patent. Whether or not it or the Bonta patent is a complete anticipation can be of little importance where, as in this case, there is a signal failure to show that the method claimed, which contravanes the accepted theory of telephonic transmission, is the operative cause of the speech reproduction claimed for the apparatus of the applicant. It is my conviction that, if articulate speech is reproduced by the use of the apparatus of the applicant, the operative method is that employed in all telephonic systems based upon the varying-pressure principle.

The decision of the Examiners-in-Chief is affirmed.

THE RENEWAL OF APPLICATION FOR PATENTS.

Attorney General Miller has rendered to the Secretary of the Interior his opinion in a case which possesses much interest to patentees in general. The opinion is as follows:

DEPARTMENT OF JUSTICE,
WASHINGTON, D. C., Nov. 29, '90.

SIR: Your letter of the 27th ultimo, inclosing a communication from the Commissioner of Patents addressed to you and bearing date October 23, is received.

The case presented for an opinion is as follows:

June 25th, 1887, Charles Nicholson filed an application for Letters Patent for an improvement in motors.

December 9, 1887, Letters Patent were allowed on the application and the applicant was duly notified to pay the final fee as provided by law.

This fee was not paid within the six months prescribed by statute.

December 4, 1889, the applicant paid fifteen dollars as a renewal fee, and renewed his application under section 4,897 Revised Statutes.

December 11 the application was duly allowed and the applicant was notified to pay the final fee under the statute.

This the applicant neglected to do.

June 7, 1890, the applicant filed a second application for renewal accompanied with a renewal fee of fifteen dollars.

The question presented, as limited by the case stated, is whether, under the circumstances detailed, Nicholson is entitled to be allowed Letters Patent upon his application.

Section 4,897, under which this renewal is now sought contains this limitation:

> But such second application must be made within two years after the allowance of the original application.

As the original letters were allowed December 9, 1887, while the application for renewal now claimed under was not filed until June 7, 1890, it is manifest that the statutory limitation had attached before such filing, and that the acts of Nicholson in the premises, after the expiration of the two years, were without effect.

I therefore hold that in the case presented the applicant is not entitled to allowance of Letters Patent.

I do not deem myself called upon to pass upon the question whether a second application for renewal filed within two years after the allowance of the original application, but after the forfeiture of the first renewal application, would be without effect or otherwise, as the facts of the case submitted do not present such a case.

In accordance with the rulings of learned predecessors (9 Opinions of Attorneys-General, 82; *Id.*, 421; 10 do., 220, and other cases), action is necessarily and properly limited to the actual case submitted. Very respectfully,

W. H. H. MILLER,
Attorney General.

The Secretary of the Interior.

INSULATION RESISTANCE.—The total E. M. F. for a certain number of lamps equals the number of lamps multiplied by the E. M. F. required for one lamp. For instance, for ten 45 volt lamps it would be 450 volts, while for ten 25 volt lamps it would be only 250 volts. The higher E. M. F. in a circuit, the greater is the strain between wire and earth. Hence, for a given number of lamps there should be a better and more expensive insulation in the high tension than in the low tension system. To make the leakage proportionally the same in both systems, the insulation resistance should equal $\frac{E \times K}{C}$ where E is the total E. M. F. of the circuit in volts, K a constant, and C the current in amperes. For example: The insulation resistance for 30 lamps with 45 volts and ten amperes would equal $\frac{45 \times 30 \times K}{10} =$ 135 K. With 30 lamps, 25 volts and 18 amperes, the insulation resistance would be $\frac{25 \times 30 \times K}{18} =$ 41.66 K. Or, in other words the insulation resistances of the two systems should be in the ratio of 135 : 41.66 or 3.24 : 1. In fact, the low insulation should be 3.24 times better, or more expensive in the high tension than in the intension system to make it stand the increased strain.

INCANDESCENT LAMP LIFE.—The durability of an incandescent lamp depends largely on the amount of current employed. Increased current produces increased light, but shortens the life of the lamp.

THE ELECTRO MAGNET.*

I now take up the question of winding the copper wire upon the electro-magnet. How are we to determine beforehand the amount of wire required, and the proper gauge of wire to employ?

The first stage of such a determination is already accomplished; we are already in possession of the formulæ for reckoning out the number of ampere turns of excitation required in any given case. It remains to show how from this to calculate the amount of bobbin space, and the quantity of wire to fill it. Bear in mind that a current of ten amperes (*i. e.*, as strong as that used for a big arc light) flowing once around the iron, produces exactly the same effect magnetically as a current of one ampere flowing around ten times or as a current of only one-hundredth part of an ampere flowing around a thousand times. In telegraphic work the currents ordinarily used in the lines are quite small, usually from five to twenty thousandths of an ampere; hence in such cases the wire that is wound on need only be a thin one, but it must have a great many turns. Because it is thin and has a great many turns, and is consequently a long wire, it will offer a considerable resistance. That is no advantage, but does not necessarily imply any greater waste of energy than if a thicker coil of fewer turns were used with a correspondingly larger current. Consider a very simple case. Suppose a bobbin is already filled with a certain number of turns of wire, say 100, of a size large enough to carry one ampere, without over-heating. It will offer a certain resistance, it will waste a certain amount of the energy of the current, and it will have a certain magnetizing power. Now suppose this bobbin to be re wound with a wire of half the diameter; what will the result be? If the wire is half the diameter it will have one quarter the sectional area, and the bobbin will hold four times as many turns (assuming insulating materials to occupy the same percentage of the available volume). The current which such a wire will carry will be one-fourth as great. The coil will offer sixteen times as much resistance, being four times as long and of one fourth the cross section as the other wire. But the waste of energy will be the same, being proportional to the resistance and to the square of the current; for $16 \times \frac{1}{16} = 1$. Consequently the heating effect will be the same. Also the magnetizing power will be the same, for though the current is only one-quarter of an ampere, it flows around four hundred turns; the ampere turns are one hundred, the same as before. The same argument would hold good with any other numerical instance that might be given. It therefore does not matter in the least to the magnetic behavior of the electro magnet whether it is wound with thick wire or thin wire, provided the thickness of the wire corresponds to the current it has to carry, so that the same number of watts of power are spent in heating it. For a coil wound on a bobbin of given volume the magnetizing power is the same for the same heat waste. But the heat waste increases in a greater ratio than the magnetizing power, if the current in a given coil is increased; for the heat is proportional to the square of the current and the magnetizing power is simply proportional to the current. Hence it is the heating effect which in reality determines the winding of the wire. We must—assuming that the current will have a certain strength—allow enough volume to admit of our getting the requisite number of ampere turns without overheating. A good way is to assume a current of one ampere while one calculates out the coil. Having done this, the same volume holds good for any other gauge of wire appropriate to any other current. The terms "long-coil" magnet and "short-coil" magnet are appropriate for those electromagnets which have, respectively, many turns of thin wire and few turns of thick wire. These terms are preferable to "high resistance" and "low resistance," sometimes used to designate the two classes of windings, because, as I have just shown, the resistance of a coil has in itself nothing to do with the magnetizing power. Given the volume occupied by the copper, then for any current density (say, for example, a current density of 2,000 amperes per square inch of cross section of the copper), the magnetizing power of the coil will be the same for all different gauges of wire. The specific conductivity of the copper itself is of importance; for the better the conductivity, the less the heat waste per cubic inch of winding. High conductivity copper is therefore to be preferred in every case.

Now the heat which is thus generated by the current of electricity raises the temperature of the coil (and of the core), and it begins to emit heat from its surface. It may be taken as a sufficient approximation that a single square inch of surface, warmed 1° Fahr. above the surrounding air will steadily emit heat at the rate of $\frac{1}{135}$ of a watt Or, if there is provided only enough surface to allow of a steady emission of heat at the rate of 1 watt* per sq. inch of surface, the temperature of that surface will rise to about 225° Fahr. above the temperature of the surrounding air. This number is determined by the average emissivity of such substances as cotton, silk, varnish, and other materials of which the surfaces of coils are usually composed.

In the specifications for dynamo machines, it is usual to lay down a condition that the coils shall not heat more than a certain number of degrees warmer than the air. With electromagnets it is a safe rule to say that no electromagnet ought ever to heat up to a temperature more than 100° Fahr. above the surrounding air. In many cases it is quite safe to exceed this limit.

The resistance of the insulated copper wire on a bobbin may be approximately calculated by the following rule. If d is the diameter of naked wire, in mils, and D is the diameter, in mils, of the wire when covered, then the resistance per cubic inch of the coil will be:—

$$\text{Ohms per cub. inch} = \frac{960{,}700}{D^2 + d^2}$$

We are therefore able to construct a wire gauge and amperage table which will enable us to calculate readily the degree to which a given coil will warm when traversed by a given current, or conversely what volume of coil will be needed to provide the requisite circulation of current without warming beyond and prescribed excess.

* Abstract from Cantor Lecture delivered before the Society of Arts, London, by Prof. Silvanus P. Thompson.

An Avoidable Disaster.—On November 15th last, the Grosvenor Gallery Central Station, belonging to the London Electric Supply Corporation, was completely destroyed by fire. The station was left in charge of a lineman who, while endeavoring to switch off a converter, failed to firmly fix the plug between the two terminals, which caused the formation of an arc. In less than an hour the fire had completed its destructive work, and the station was in ruins. The instruments and converters were destroyed, and many customers were deprived of their electric light until other arrangements could be made. The blame appears to be primarily with the management in leaving the station in charge of an inexperienced and irresponsible employé. This experience, though costly to the operating company, will serve as a wholesome lesson to others operating electric light stations and plants, and stand as a warning of the danger of leaving such plants in the care of any but experienced persons.

* The *watt* is the unit of rate of expenditure of energy, and is equal to ten million ergs per second, or to 1-746th of a horse-power. A current of one ampere, flowing through a resistance of one ohm, spends energy in heating at the rate of one watt. One watt is equivalent to 4.2 calories per second, of heat. That is to say the heat developed in one second, by expenditure of energy at the rate of one watt, would suffice to warm one gramme of water through 4.2 (Centigrade) degrees. As 252 calories are equal to one British (lb. Fahrenheit) unit of heat, it follows that heat emitted at the rate of one watt would suffice to warm 17½ pounds of water one degree Fahrenheit in one minute; or one British unit of heat equals 1,058 watt-seconds.

FOREIGN NOTES OF INTEREST.

The Popp Compressed Air Company are making everywhere great efforts to obtain a footing for their system in Austria-Hungary.

The London County Council will shortly apply for leave to bring in a bill for the regulation and control—and, if need be, removal—of overhead wires.

M. Fontaine thinks that in 1891 or 1892 the electric lighting in Paris will require for its production motive force equal, in round numbers to 32,000 horse-power.

The State telephone between Stockholm and Malmö has been tested with satisfactory results. This is a very important installation right across the broadest part of Sweden and the Swedish capital is now in telephonic connection with the two principal towns on the west coast, Gothenburg (240 miles) and Malmö (340 miles).

A number of trains, each consisting of an electric locomotive and three carriages, have been running regularly for some days on the City and South London Railway, in order to educate the staff in the working of the electrical plant, the hydraulic lifts, and other matters which are peculiar to the undertaking.

Telegraphic communication between Germany and Italy is to be improved by the construction of a third line between the two capitals. Its length will be 1,210 miles, and it will consist of 3mm. bronze wire, According to the *Elektrotechnische Zeitschrift*, this is the first line from Germany to any foreign country in which bronze wire has been employed.

The Conseil Municipal, Paris, have nominated MM. Mascart, Potier, Hospitalier, Cochin, and Lyon-Alemand as members of the jury which is to examine the electricity meters sent in to compete for the municipal prize of £400 offered for the meter "giving complete satisfaction and equally applicable to alternate or continuous currents."

Several Scandinavian towns have lately claimed the honor of having the largest number of telephones in proportion to their population of any town in Europe or, perhaps, even in the world. Christiania first entered the list, thinking her 2,600 subscribers out of 140,000 inhabitants, that is, 18 or 19 to every 1,000 inhabitants, was at the top of the tree. Stockholm has, however, 6,318 telephone subscribers out of 240,000 inhabitants, or 26 subscribers to every 1,000 inhabitants, but even this has been beaten by a small place. Ballnös, which, with barely 1,000 inhabitants, has 52 telephone subscribers.

Concession has been given for an electric railway in Stockholm, Sweden, from the Gustaf Adolf square to Djursholm, and another has already been taken in hand between Karlslund and Orebro. Electricity is also likely to be gradually adopted as a means of power in a number of industrial establishments, owing to the many waterfalls which exist in Sweden. At some mines in the Vörmland district electricity is about to supersede steam. There is a waterfall at some 10,000 feet distance, which has hitherto been useless, but which will now be utilized, and the installation will also comprise one for electric light in the mines. At Ballnös, Sweden, a small electric central station has been erected, the water of the Ljusnan river supplying the power. The turbine is of 35 horse-power, and the dynamo can supply current to 400 16-candle lamps.

Current for Incandescent Lamps.—Results of numerous tests show that for the 16 candle power lamp an average electro-motive force of 91 91 volts. and a current of .71 of an ampere, which gives 4.07 watts per candle power as the rate of working found to be the most efficient and economical.

CENTRAL STATION LIGHTING.

Mr. Charles H. Yeaman, City Electrical Engineer for Liverpool, England, in a lecture before the Liverpool Engineering Society described the various systems of electric lighting now in vogue in England His remarks on three of the most prominent stations are of sufficient general interest to warrant their reproduction here.

Of the series parallel system at Hastings, Mr. Yeaman said:

"The use of transformers in a high tension circuit is to allow of flexibility and remove any restrictions to supply that otherwise would be imposed on the consumer Hastings is an example of a high tension system without transformers, which has been working most succes fully since 1881, and is now supplying over 1,000 incandescent lamps of 8 C.P. and 3c volts, the lamps being grouped in parallels of 16. This station, prior to the introduction of transformers, constituted the most successful instance of long distance distribution, not merely in this country, but anywhere. Brighton started also as a series-parallel supply, but has lately been altered to Lowrie Hall alternators. The principal feature which strikes one at Hasting is the extreme simplicity of the generating plant. The motive power consists of two 40 H.P. Robey engines and boilers, the engines being belted on to a counter shaft rather below the level of the dynamo platform, and from which the five "Brush" constant current dynamos are driven by endless belts. These machines give 2,coo volts and 10 amperes. One is reserved as a standby, one is used for the arc lamps on the parace, the 30 arcs of 2,000 C.P. loading the machine fairly well up. The glow lamps are used in hotels and private residences, and these machines are run on the same number of separate circuits. The current flowing is proportional to that required by each lamp, multiplied by the number of lamps in parallel, and the pressure is equal to that required by one lamp, multiplied by the number of groups in series.



C = Current for one lamp. E = E M.
E = E.M F. " " C = C N.
N = Number of lamps in parallel. C = Total E M.F.
M = " groups in series. E = Total current.

The principal objection to a constant current supply is the fact that individual lamps of a group are dependent on their neighbors of the group, and no economy results unless the group of 16 lamps are turned off.

There are in Hastings underground circuits aggregating 20 miles of single wire, $\frac{7}{18}$ strand, double G. P. and braided, drawn into 4 inch cast iron pipes, with test boxes every 100 yards. The terminal pressure of the dynamo is regulated by a Brush carbon regulator, which maintains the current constant at 10 amperes, and in the supply circuit is placed an Ayrton and Perry ammeter. The general method is to make a fixed charge per annum, which is settled by agreement.

The machines at Hastings are simple arc lighters, and give a current of 10 amperes suitable for arc lamps; they are used for incandescent lighting by grouping a number of incandescent lamps in parallel, so that they absorb the 10 amperes, and these groups are then treated as single arcs might be by being placed in series, *i. e.*, one after the other.

The three-wire system, as operated by the St. James and Pall Mall Company, London, is described as follows:

"The three-wire system is one attempting to do away with the inter-dependence of the individual lamps, and does not involve transformers, while it retains to a great extent the advantages of high pressure. In this system the number of lamps in series is reduced to two, and the groups in parallel are increased. Edison in America, and Hopkinson in England, have improved and perfected the system, allowing each lamp lighted to be quite uninfluenced by the number of lamps alight elsewhere on the circuit. The practice is now to run two dynamos of equal output—and voltage in series—and between the positive (+) of one and the negative (—) of the other, to string the incandescents in series of two. By this means the pressure is double that of the simple parallel system, and the weight of copper required is only one fourth that of the two-wire network. As, however, the lamps are two in series, turning out one lamp would also extinguish its fellow. To avoid this a neutral wire or equalizer is run from the junction of the two dynamos to the middle connection of the groups of lamps, thus rendering each lamp independent.

The finest example of this method of working is the new station of the Pall Mall and St. James Company in Mason Yard, Duke street, St. James, London. The boiler room and dynamo room have been dug out underneath the yard, and a three-story fire-proof building of white brick is carried on iron girders and pillars in the centre. The station is laid out for a total capacity of 20,000 16-C.P. lamps. Six Davey-Paxman boilers supply steam to 10 Willans central valve engines, capable of developing 210 H P. at 350 revolutions, and two smaller ones capible of developing 80 H.P. The engines are mounted on combination bed-plates, upon the other halves of which the field magnets and bearings of the dynamos are supported, the armatures being coupled direct to the engine shafts. The field magnets of the dynamos are vertical, with poles downwards, and supported by brass brackets from the bed-plates. Regulation is effected by inserting resistance into the magnet circuits, which are shunts on the main. The generating sets are arranged on two rows of six each, one on either side of a central gangway towards which all the commutators of the dynamos are directed. The connections from the dynamos pass through suitable regulating and safety appliances before reaching the switchboard from whence the three-wire feeding network is supplied.

The underground system is an air insulated culvert, and the largest main consists of eight strips of copper 2 inches wide by 0.1 inch thick, forming the (+) and (—) leads, while the neutral wire is formed of four strips the same size. The strips are supported by porcelain insulators, and spaced by means of porcelain jockeys, the whole being carried in a cast iron culvert. This distributing system consists of a complete ring, fed by heavy feeders, and with radial distributors running out beyond the ring. From each feeding point, pilot wires run back to the station, so that the pressure at each point can be ascertained. The pressure on the ring main is kept constant at 107 volts, and houses connected to this main are supplied with 106 volt lamps. Three load diagrams taken towards the end of December, 1889, give evidence of the very high proportion borne by the mean to the maximum demand."

Mr. Yeaman gives this description of the alternating transformer system used at West Brompton, Glasgow and Bournemouth:

"The model station on the alternating system is certainly that of the House-to-House Company, Limited, who, basing their designs on what had been done at Brighton, Hastings, and Eastbourne, have overcome some of the difficulties of a commercial supply with a periodic current. Their station at West Brompton, situate as some say between the 'quick and the dead,' lies between the Metropolitan District Railway and the London and Westminster Cemetery, with a frontage to the Richmond Road. The completed station will contain 12 sets of plants, each capable of supplying 4,000 16-C.P. lamps, the engine and boiler room, offices, workshops, testing rooms, engine and drawing offices, taking up a plot of land, 470 feet × 60 feet. Three of the sets of plant are down; and although powers were only obtained in October last, nearly eight miles of underground mains have been laid, and current is supplied to 7,000 incandescent lamps, increasing by 500 per week on its circuits, and it is running permanently and supplying these by meter. Fowler's horizontal coupled compound engine, of 200 H.P. 30-inch stroke, 88 revolutions per minute, driven by seven cotton ropes, 1½ inch diameter, from a 14-foot flywheel, a Lowrie-Parker dynamo, with fixed armature and rotating field magnets, capable of maintaining an output of 100 units at a speed of 350 revolutions per minute. The E.M.F. is 2,000 virtual volts, and the periodicity 83. The revolving field magnets are supplied with magnetizing current by an exciter driven by four ¾ inch ropes from the shaft of the alternator. This is a series wound Elwell-Parker continuous current machine giving 8 amperes. All wires are brought underground to the testing room, and are brought up at the back of the switchboard, so that it is impossible to touch the high tension connections. The switchboard is constructed in chinaware mounted on ebonite, and connection between the dynamos and mains is made by insertion of the connecting block with four brass pegs. Any circuit can be connected to any dynamo, and it is impossible to short circuit a machine, by reason of the distance of the brass pegs.

The regulation of the dynamo is effected to within 1 per cent. by means of the Lowrie-Hall regulator, which utilizes the thermal effects of the current as a means of maintaining a constant E M.F. across the terminals of the alternator. A thin wire attached at its extremities and weighted at the centre, is connected across one coil of the armature of the alternator, and by its sag allows a rocking arm to make contact with one or other of two tables connected to the two coils of the variable resistance fixed above the wire chamber. The liquid resistance is in shunt with the field magnets of the exciting dynamo, and by weakening or strengthening its field varies the magnetizing current to the alternator, and, therefore the pressure across its terminals. This current at 2,000 virtual volts is distributed underground by means of lead covered cables drawn into gas pipes, 3, 4, and 5 inches diameter, with joint boxes at suitable intervals.

The mains are of special make, being Fowler-Waring cables, manufactured under Tatham's and Waring's patents. The insulation is the highest yet made for cables, being stated as over 3,000 megohms per mile. The insulation consists of fine braidings saturated with a patent solution, and the cable is then lead-covered, and has a coating of hemp over all. The cables are made in five standard sizes to supply 2,coo, 1,500, 1.000, 500 and 250 10-C P. lamps at a distance of 1 mile. The largest cable of this make in use is $\frac{37}{16}$. These cables are not exclusively used by the House-to-House Company but have been found to be the most satisfactory up to the present. It is somewhat curious that lead covered conductors should be found so satisfactory for use, with alternating currents, in this country, as there is a great tendency for a spark to break down the dielectric on account of the induced currents in the lead, and in America elaborate apparatus is inserted to do away with this tendency. The cables were also used to carry the 10,000 volts that Mr. Ferranti proposes to use to convey the electrical energy from Deptford to London, and certainly these have been the only cables that have withstood the voltage employed by the London Electric Supply Corporation for any time, and though they subsequently developed faults, the tension was phenomenal, and no research has up to the present demonstrated what goes on when an abnormal pressure is employed.

Before reaching the switchboard the current

has to pass through a high tension fuse consisting of a long length of fine copper wire. The steam supply to the engines is maintained by six Babcock-Wilcox water-tube boilers, capable of evaporating 5,500 lbs. of water per hour, and requiring not more than 1 lb. of best Welsh coal per 10½ lbs. of water evaporated. Working pressure, 150 lbs. per square inch.

The secondary generators or converters, are coupled in parallel on the high tension circuit, and reduce the high pressure from 2,000 virtual volts in the primary, to 100 virtual volts on the secondary, with a corresponding increase in the amperage. The Lowrie Hall transformer is one of the "core" class, that is, it has two sets of coils and one core. It is built up of thin iron plates, each plate being separately insulated from the rest to prevent eddy currents. On each of the individual cores a primary and secondary coil is wound, part of the core projecting beyond the coils at both ends. The coils are placed side by side, and the plates of the projecting cores are turned over alternately, each pair of plates forms a closed magnetic circuit insulated from the rest, and the two individual cores form one endless magnetic circuit.

One of the principal points in a system of public supply is that of measurement of the quantity of electricity supplied, and this is an especially difficult problem with alternate or periodic currents. Messrs. Lowrie, Hall, and Kollé have succeeded in utilizing the principle of Edison's chemical meter for this purpose, by inserting into the lamp circuit an electrolytic vessel, and cell of constant electromotive force, which will therefore add its difference of potential to one phase, and subtract it from the reversed one, thereby creating a difference in the total quantity that has passed round the circuit positively and negatively. The equivalent therefore is obtained of a continuous current of an amount proportional to the number of lamps that are on the circuit, and the quantity of metal lost by one plate and gained by the other measures the total number of lamp hours or Board of Trade units.

CONDUCTIVITY OF SOLUTIONS OF CADMIUM SALTS.

Herr F. J. Wershoven, a German scientist, has recently been examing the electrical conductivity of aqueous solutions of the cadmium salts. The following resumé of some of the results of his investigations are given in the London *Electrical Review*:

"Wershoven undertook the study of solutions of the chloride, bromide, iodide, nitrate, and sulphate of cadmium, also of potassium cadmium oxide; these were examined within wide limits of concentration and temperature.

It was found that the temperature-coefficients of all these salts of cadmium approximated very closely in extremely dilute solutions to 2.3 per cent. per degree. To this statement, however, the iodide and double iodide of cadmium are exceptions.

The variations of electrical conductivity with the variations of temperature may, in the case of concentrated solutions, be expressed by a linear equation for the chloride, iodide and double iodide of cadmium; an equation of the second degree is, however, required, in order to express these variations in the case of the other salts of cadmium.

Grotrian's figures for electrical conductivity are well known, and have been very generally relied upon, but Wershoven fails to confirm them, and is of opinion that they must not be so implicitly trusted as they have been. He finds that there is sometimes so large a difference as 10 per cent between his results and Grotrian's numbers, and suggests that possibly the preparations used by the latter were not in a sufficient state of purity.

Wershoven enters into a long discussion of the results with respect to molecular conductivity, the rate of transference of the ions, and the supposed complexity of the salt molecules. This is not capable of useful abstraction for our readers; we therefore merely give the conclusions arrived at.

Arrhenius held that in the case of cadmium nitrate the inactive molecules are not complex, but that in the other salts of this metal they do possess a certain degree of complexity. This view is supported by Wershoven, who finds it to agree with the results deduced from his own experiments.

Combined with the well-known values of Kohlrausch for the speed of migration of the anions (*a*), chlorine (*b*), bromium (*c*), iodine, and (*d*) the radicle NO_3, the numbers obtained for extreme states of dilution give the following speeds of the cadmium ion:—

For (*a*) speed = 49.2
" (*b*) " = 50.9 } Mean = 51.
" (*c*) " = 49.3
" (*d*) " = 53.7

The speeds of other ions expressed in the same units are for the following bivalent metals:

Barium:	speed.....	= 51
Zinc:	"	= 51
Magnesium:	"	= 53

During the course of his investigation Wershoven found that a freshly platinized platinum electrode, when immersed in a solution of iodide of potassium, had the effect of coloring the solution at first yellow, and then, in a few minutes, pink.

This interesting result is not, as might perhaps be reasonably supposed, due to the liberation of iodine, for Wershoven could not obtain the characteristic blue colorization with the usual starch-paste test. He considers that it is accounted for by the formation of platinum tetriodide, which dissolves in the solution of potassium iodide. The reaction seems capable of expression by the following equation:

$$Pt\,Cl + 4\,K\,I = Pt_4 + 4\,K\,Cl.$$

In order to obtain this effect it is not necessary to previously immerse the platinum electrode in a solution of platinum chloride; hydrochloric acid alone effects the reaction which indeed may be used as a most delicate test for this acid: it will even give results when the usual reagent nitrate of silver gives no turbidity whatever.

In applying this test, Wershoven recommends thy following method of procedure:

The freshly platinized electrode is washed in distilled water and then dipped repeatedly into potassium iodide solution until it no longer produces any pink coloration. It is then thoroughly washed with aqueous alcohol, then with distilled water, after which it is placed for some time in the solution which is suspected of containing hydrochloric acid. The electrode is again subjected to careful washing with water and then immersed in a dilute solution of potassium iodide. After a little while the pink color will appear. Neither ordinary chloride nor hydrobromic or other acid give the coloration, so the test is quite unique

ELECTRICAL BOOKS.

The Elements of Electric Lighting. By Philip Atkinson, A. M., Ph. D. 260 pages; 104 illustrations. $1.50.

This is an excellent book and includes chapters on Electric Generation, Measurement, Storage and Distribution.

Electricity in Daily Life. $3 00.

This book is just published and is the best of its kind ever produced. It includes chapters as follows: "Electricity in the Service of Man," by Prof. C. F. Brackett, of Princeton College; "The Electric Motor and its Applications," by F. L. Pope; "The Electric Railway of To-day," by Joseph Wetzler; "Electricity in Lighting," by Henry Morton, president Stevens Institute, Hoboken, N. J.; "The Telegraph of To-day," by Charles L. Buckingham; "The Making and Laying of a Cable," by Herbert Laws Webb; "Electricity in Naval Warfare," by Lieut. Walter P. Hughes, U. S. N.; "Electricity in Land Warfare," by 1st. Lieut. John Millis, U. S. A.; "Electricity in the Household," by A. E. Kennelly, and "Electricity in Relation to the Human Body," by Dr. M. Allen Starr.

A, B, C, of Electricity. An explanation of the various ways electricity may be generated and usefully applied. By William H. Meadowcroft. Cloth, 108 pages, 35 illustrations. 50 cents.

Bell Hanger's Hand-Book. By F. B. Badt. Flexible cloth binding. 106 pages, 97 illustrations. $1.00.

The name of this book is unfortunately too narrow in application. The book gives complete information on batteries, of the different kinds, uses and method of application to different classes of work; bell work, including fire alarms, annunciators, etc., and a good deal of instruction about electrical things in general.

Induction Coils, How Made and Used. By Dyer. Boards. 50 cents.

The Electric Motor and its Applications. By Martin and Wetzler. Second edition; 292 large quarto pages, 316 illustrations. $3.00.

This is the only complete and reliable work on this important and interesting subject, and is brought up to date. The second edition has four newly added chapters covering American and European motors, alternating current motors, and the pyro magnetic motor. Anyone interested in electric railway progress will find this work very valuable.

Dictionary of Electrical Words, Terms and Phrases. By Edwin J. Houston. 656 pages, 397 illustions. $2.50.

This book is virtually an electrical cyclopedia, and was compiled after great research and labor. It includes nearly 2,500 distinct words, terms or phrases. It is the most complete work of the kind in existence and has filled a long felt want. One possessing a copy of this book need not remain in ignorance concerning anything pertaining to electricity.

Principles of Dynamo Electric Machines. By Carl Hering. 279 pages, 59 illustrations. $2.50.

This book gives practical directions for designing and constructing dynamos. An appendix contains several articles on allied subjects, and a Table of Equivalents of Units of Measurements.

Practical Information for Telephonists. By T. D. Lockwood. 192 pages. $1.00.

Mr. Lockwood is entirely qualified to give the information contained in this book, and he does it in a manner that is as interesting as it is valuable. Everyone interested in the telephone service should study this book, as it is full of matter, some of which at least will be new to everyone, however familiar he may be with the telephone.

Elementary Treatise on Electric Batteries. By Alfred Niaudet. Translated from the French by L. M. Fishback. 266 pages, 55 illustrations. $2.50

The Galvanometer and its Uses. By C. H. Haskins. Third edition; 74 pages, illustrated. $1.50. A manual for Electricians and Students.

This is an invaluable work for any one whose duties require the use of this very important instrument.

For sale by THE ELECTRIC AGE PUBLISHING CO., *World* Building, New York

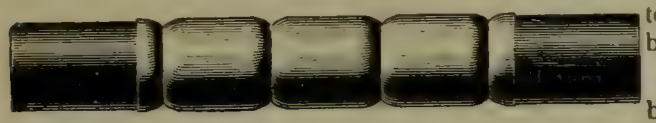
Send for our catalogue of books.

PLATINUM.—The principal source of the supply of platinum is from the Ural Mountains, but it has also been found in the provinces of Choco, and Barbacos, New Granada, and in Brazil. It is also found in San Domingo, on the island of Borneo, in Honduras, among the sands of the Rhine, and in the County of Wicklow, Ireland. The metal is also met with in California, at Rogue River, Ore., in Rutherford County, N. C., and in Canada. Nearly all native platinum is more or less magnetic.

NEW METHOD OF MAKING JOINTS IN WIRE CONDUITS.

The superiority of the Interior Conduit System, not only for all classes of electric light wiring, but for electric bell and annunciator wiring as well, over all other known methods, has been demonstrated and is now universally conceded.

The Interior Conduit and Insulation Company, the pioneers and sole manufacturers of interior conduits, are continually striving to simplify the constructionary methods of their admirable system, and to cheapen the cost of their goods. One of the most striking examples of their energies in this direction is to be found in their new coupling or joint, which we illustrate herewith.



INTERIOR CONDUIT AND INSULATION COMPANY'S NEW JOINT.

The greatest amount of labor expended in the installation of the system is upon the most vital point of the whole, that is upon the joint or coupling.

The methods heretofore employed for making joints have been found satisfactory, but in order to insure perfect work great care had to be exercised on the part of the workman, and it is with the idea of remedying this that the new coupling has been designed and placed upon the market.

The new joint will supplant and entirely dispense with the use of the threading tool, threaded coupling and cementing compound. The sleeve is made of soft galvanized iron and being of a slightly larger diameter than the tube itself fits snugly upon it. The tool, which is made in the form of a pair



PLIERS USED IN MAKING JOINTS.

of pliers, serves to press the two slight corrugations upon the outside of both halves of the sleeve and into the body of tube, but does not in the least injure the latter or alter its internal diameter at that point. Joints so made are impervious to moisture and have great strength.

By the new method joints may be made upon the floor or bench and the lengths of tubing lifted with safety to the wall or ceiling without fear of straining or opening the joints. It is confidently believed that the new tool is destined to become an important factor of every wireman's kit of tools.

HEATING EFFECT.—There is no difference in the heating effect between a continuous and an alternating current.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Ill., Dec. 11, 1890.

Capt. W. L. Candee, of New York, spent a few days in Chicago this week.

The Hercules Electric Company has been formed in Chicago to manufacture and deal in galvanic and electrical apparatus. Capital stock, $25,000. Incorporators: Calvin N. Souther, Phineas L. Hanscom and Hiram F. Smiley.

The Brotherhood of Electrical Mechanics has been incorporated at Chicago for the promotion of benevolence and social intercourse. Trustees: James O'Brien, Harry Wallace, Sam Grimblot and others.

The Bear Magneto Electric Company has been formed at Chicago. Capital stock, $3,000,000; for manufacturing and to do a general light, heat and power business. Incorporators: Simeon J. M. Bear, William R. Northway and Franklin Babcock.

Mr. Charles G. Armstrong, who has occupied the position of assistant manager of the Great Western Electric Supply Company, has severed his connection with that company, and it is rumored will be associated with Mr. Geo. Cutter in the supply business. Mr. Armstrong has just placed several of the elevator signals, of which he is the inventor, in the Auditorium building.

The Central Electric Company are making some changes in their offices which will add greatly to the beauty and convenience of their commodious quarters. The main partition will be moved back and some desks be placed within a railing outside in the main salesroom. The main office will be subdivided into two smaller ones, making the offices of the heads of the house a little more private and retired.

The storage battery car equipped with the Edco system, which was mentioned in this column some weeks ago, is making regular trips on one of the north side lines in this city, and seemingly giving the best of satisfaction. Mr. Hood, the general agent of this system in Chicago, is much pleased with his car. He has just put in a handsome plant in his offices in the Grand Pacific hotel, consisting of 27 storage cells and 5 counter electro-motive cells. These will operate 40 sixteen candle power lamps which will be used for lighting the offices and for exhibition purposes. The electro-motive force of the battery is 50 volts, and the capacity 300 ampere hours.

Mr. W. B. Knight, the well-known consulting engineer of Kansas City, Mo., met with a very serious accident on December 4th. The Chicago and Alton train, in which he was en route for Kansas City, was crashed into near Jacksonville, Ill, by a Wabash freight train, the two roads crossing at this point. The sleeper in which Mr. Knight was, was cut clean in two, and Mr. Knight was badly scalded by escaping steam. He died on December 6th. Mr. Knight was general engineer of the belt line of Kansas City, and was also general manager of the Patton Motor Manufacturing Company of this city. He was connected in some capacity with a number of the railway and street railway lines of this country, and was very widely known.

Rubber goods for electrical purposes, are steadily becoming more numerous, so that it is fitting that the large rubber manufacturers should pay due attention to this class of goods. Not only do some of the largest firms have their agents who cater to the electrical trade, but the Revere Rubber Co. has gone a step farther and established a general Western agency for its electrical department. This will be in charge of George Cutter, who will not only supply any standard forms of electrical rubber wares, but will also design new forms of rubber pieced for use in connection with any electrical appliances for which this material forms a suitable insulation. The Revere Rubber Co., has long been known as extensive manufacturers of high class rubber goods, so that the quality of its wares needs no comment. Couple this fact with the experience of George Cutter in making, repairing and handling electrical goods and it follows that thorough insulation may be expected from such devices as are supplied with their parts through his agency. F. M. I.

ELECTRICITY IN MINES.

In the discussion following the reading of the paper of Mr. E. F. Browne, before the Chicago Electric Club at its meeting a couple of weeks ago, some interesting facts were developed. The subject of the paper, as will be remembered, was "Electricity in Mines and the Proposed Mining and Electrical Display at the World's Fair."

Mr. F. B. Badt stated that the mining department of the Thomson-Houston Company, with which he is connected, is at present constructing for mines a pump in connection with an electric motor which will pump 500 gallons per minute against a head of 1,500 feet. He had recently figured out how many horse power would be required in the electric motor, and found it will be in the neighborhood of 260 to pump 500 gallons per minute against 1,500 feet pressure, about 650 pounds per square inch. In a pump there are quite a number of parts that cannot stand a very high pressure unless they are properly built; and as a matter of fact there are not many pump builders in the United States to-day who are willing to build such a pump and guarantee it.

Mr. Browne, continued Mr. Badt, very properly remarked also that the electric hoist—and we might say electric elevator, which is nothing but a hoist—is not quite what it ought to be, for the reason that too much gearing is required to transmit the fast rotary motion to the drum of the hoist or elevator. He did not know whether Mr. Browne has heard about it, but electricians have been hard at work for over a year to construct what we call a multipolar motor which will run at a very slow rate of speed with direct gearing to the drum

Mr. Bain stated that he had noticed that in very dry mines where the dust flies the insulation is as hard to keep up as it is in a damp one. In fact he would rather put a circuit in a wet than a dry mine. Coal dust is a very good conductor. In putting in electric locomotives for hauling coal they always use a metallic circuit. He did not believe it would be possible to use the ground for either machines or for the motor cars.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 52d meeting of the American Institute of Electrical Engineers will be held at 8 p. m., December 16th, at the rooms of the institute, No. 12 West 31st street, Mr. A. E. Kennelly will read a note on "Inductance and its proposed Unit, the 'Henry.'"

The perfected gramophone will also, on this occasion, be publicly exhibited for the first time in this city and carefully explained by its inventor, Mr. Emile Berliner, accompanied by various reproductions of sound records, and the taking of new ones. An experiment will also be made showing the nature of the etching ground on which the record is secured.

The 53d meeting of the institute will be held at the same hour and place, January 20th, 1891.

ELECTRIC RAILWAY CONTRACTS.—The Short Electric Railway Company of Cleveland, Ohio, have the following contracts for the first ten days in December: Pittsburgh and Birmingham Traction Co., Pittsburgh, Pa; Broadway and Newburgh Street Railway Co, Cleveland, Ohio; Jamestown Street Railway Co., Jamestown, N. Y.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Dec. 11, 1890.

The Hyde Park Electric Company have added 50-light arc machine to their plant.

The electric power plant which the Honatuck lk Co. has been building at Leeds, Mass., for nning motors in their mills, is now in running rder.

The Bell telephone directors have declared e usual quarterly dividend of $3 per share, ayable January 15th, to stockholders on record ecember 31st.

The Tramway Construction Company has een formed in New Haven, Conn., with a capil stock of $20,000, to construct railways in the stern part of that State. E. P. Shaw, of Newuryport, Mass., and S. Harrison Wagner and rank H. Kelley, of New Haven, are directors.

Electric lights are largely used in this city as means of decoration. Houghton and Dutton ave again as they did at the time of the Naonal Convention, used electric lights for ecorative purposes. This time 536 sixteen ndle lights are used, 172 of which are bright lors, the rest white.

The selectmen of Beverly have just decided at the Naumkeag Street Railway Company can ot put in an overhead electric system into everly, and now a movement is on foot at everly Farms in the form of a pet tion, which will k the selectmen to allow the Naumkeag road extend and equip its line with electricity from everly Cove to the Farms.

The Massachusetts Electric Engineers and echanics Association will hold a ball at Odd ellows Hall, Thursday evening, January 29, 91. The hall will be elaborately decorated nd will be illuminated by a large number of candescent lights, furnished for the occasion the courtesy of the Edison Electric Illuminatg Company.

The Union Electric Lighting Company which rnishes the town of Franklin with electric ght, has made a change, and it is now underood to be under control of the Thomson-Housn Company. M. W. Turner, who has been easurer, has sold his interest, and W. A. Carey ow fills his position. H. W. Burgett remains resident of the company and a small portion f the stock is retained in town.

In the common council of Providence, Deember 8, the ordinance permitting the Union . R. Co. to equip two of its street car lines ith the single trolley overhead system of elecic propulsion came to a vote. There had been onsiderable opposition in the hearings, and oth opponents and proponents have sent in petions representing several millions each of taxble property. After considerable discussion e ordinance was defeated—23 to 13.

Some dissatisfaction having been expressed the people of Newton with the police signal ervice the board of aldermen appointed a comittee to investigate the cause. Their report as very satisfactory for the Gamewell Comany, the committee deciding that the work had een done in a thorough manner and that the struments were in every way satisfactory, inlligent care being all that was necessary to the uccessful working of the system

Joseph T. Sayward who has been identified ith the telegraph business for nearly a quarter a century, and for many years prior to his regnation, owing to ill health, last September, as manager of the Gold and Stock Telegraph ompany's central office in the old Board of rade building on State street and at 35 Conress street, died at his home on Ferrin street, harlestown, Saturday, December 6. He was a member of the Ancient Order of United Workmen and of the Telegraphers' Mutual Benefit Association, and leaves a widow and five children.

The New England Telephone and Telegraph Company have erected an iron bridge across Franklin street, connecting the buildings 40 and 50 Pearl street. The bridge is 90 feet above the ground, and will be used by the workmen to draw cables across, and as a foot passage in the work of construction made necessary by the removal of the company to their new building, corner of Oliver and Milk streets. The company do not expect to be in their new quarters before March.

The annual meeting of the Merrimac Valley Railway was held in Lawrence last Tuesday afternoon. W. B. Ferguson of Malden was chosen president. The report of the treasurer showed the gross income for the year ending September 1st, 1890, $80,000 in round numbers, operating expenses $65,000, and that dividends amounting to $6,400 had been paid. The directors took no action on the action of the selectmen of N. Andover, who demanded that the company light the streets of the town in case they are allowed to use electricity as a motive power.

An electric company, known as the Vermont Electric Co., has just been organized in Burlington, Vt. The charter secured by the incorporators is an unusual one, and met with great opposition in the State Legislature. It has valuable privileges, under which the company will soon begin to operate. One of these is the development of the property known as the gorge, near the twin railroad bridges, just above Winooski village, and the transmission electrically of this immense water-power to Burlington, to be used in driving all kinds of machinery. This is no experimental work. A new industry on a broad and permanent foundation has been inaugurated in the establishment of plants for the generating and transmission of power for general use and sale in all units from an eighth-horse-power upward, and for short or long distance transmission from half a mile to 20 miles. It has been voted to increase the capital stock to $100,000.

W. J. P.

NEW CORPORATIONS.

Batesville Water and Electric Light Company, Batesville, Ark., capital, $100,000.

Fuller Watchman's Electrical Detector Company, Chicago, Ill., capital, $200,000, for the manufacture of electrical machinery and appliances to manufacture the detector.

American Conduit and Traction Co., Chicago, Ill., capital, $1,000,000; for the manufacture of electrical conduits, traction devices, etc.

Donaldson Macrae Electric Co., Baltimore, Md., capital, $20,000; for the manufacture of electrical machinery.

Lincoln and Lake Park Electric Railway Co., Lincoln, Neb., capital, $250,000: to construct an electric road to Biglow Park.

Findlay Electric Light and Power Co., Findlay, Ohio: capital, $150,000.

Bellefontaine Electric Light and Power Co., Bellefontaine, Ohio; capital, $25,000.

Owens Manufacturing Co., Milwaukee, Wis.; capital $6,000, for the manufacture of electric light and gas fixtures.

ELECTRIC RAILWAY NOTES.

The Short Electric Railway Company, of Cleveland, Ohio, during the month of November put into operation two electric railways, viz:—The Rochester Railway, Rochester, N. Y., with a mileage 55 miles and with 200 cars; the Watervliet Turnpike Railway, Albany, N. Y., 15 miles with 16 cars.

ELECTRIC LIGHT NOTES.

The electric light plant at Wilmerding, Pa., the new town near Pittsburg, where the Westinghouse air brake works are located, is now being increased from a capacity of 1,500 to 2,000 lights.

The electric light plant on the new steamer "Spree," of the North German Lloyd Company, consists of four dynamos, each with a capacity of 350 incandescent lamps. The entire light of the ship is done by electricity.

Since the first of December the Westinghouse Electric and Manufacturing Company has received contracts for alternating current electric lighting apparatus for a capacity of 5,650 incandescent and 120 arc lights. Olean, N. Y., has contracted for an increase of its plant, and when the new apparatus has been installed the plant will have 1,400 incandescent lamps capacity.

The Pennsylvania railroad company is rapidly increasing the number of electric light plants along its lines, where a good light is of the greatest consequence and advantage to the railroad. Some time ago the Westinghouse Electric and Manufacturing Company installed a plant of its alternating current arc light apparatus at the Altoona shops. The operation of that system has given such satisfaction that the railroad management lately decided to have a similar plant put up at Wall station, which is one of the most important points on the entire Pennsylvania railroad system. The plant will have a capacity of 120 arc lamps.

The alternating current electric lighting plant of the Missouri Electric Light and Power Co., in St. Louis, Mo., has grown so rapidly that it has now become one of the largest central station plants of alternating current electric lighting in the United States. The company was organized in the early part of 1887 with apparatus of a generating capacity of 12,000 lights. This was the first contract for Westinghouse alternating current apparatus which had come from St. Louis. The other systems of incandescent lighting of the larger companies in America were already in operation in that city, but nevertheless the Missouri company found a very ready demand for its lights and the success of the plant was assured from the very start. This fact very soon manifested itself when the management found that the supply at the central station was not sufficient to satisfy the demand any longer and an increase had to be made in the generating capacity. A 3,000-light Westinghouse alternating current dynamo was added and for a time the immediate wants of the company's patrons for lighting were complied with; but it was only temporary, and then the company added two more 3,000-light Westinghouse alternating current dynamos to the capacity of the station. The company now has a generating power by which it was enabled to furnish 21,000 sixteen C. P. incandescent lamps which made it the largest electric lighting plant in St. Louis, but the new system of lighting had by this time gained such a popularity among the people of the city that the supply was again taxed to its utmost capacity until a few days ago, the Westinghouse company received another contract for the installation of one of its three thousand light apparatus. This will give the Missouri Electric Light and Power Company alternating current apparatus with a generating capacity of 24,000 incandescent lamps, which makes it the largest alternating current central station plant in America west of the Allegheny Mountains.

TEMPERATURE OF THE VOLTAIC ARC.—It is very difficult to ascertain the temperature of the electric arc, and it has been variously estimated. The positive carbon is probably heated to a temperature somewhere between 2,400° and 3,900° C., and the negative to between 2,100° and 2,500° C.

THE ELECTRIC AGE'S ILLUSTRATED ELECTRICAL PATENT RECORD.

ELECTRICAL PATENTS ISSUED DECEMBER 9, 1890.

442,104. Electric Signal for Engines. Michael Conley, Chicago, Ill., assignor of two thirds to James C. Ricketson and Frederick B. Ricketson, Milwaukee, Wis. Filed Oct. 3, 1889.

442,114. Electric Gate. Harleigh Gillette, Highland Park, Ill. Filed July 19, 1890.

442,115. Tanning by Electricity. Lorentz A. Groth, London, England. Filed May 19, 1888.

442,126. Electrical Vote-Recorder. Sylvanus D. Locke, Hoosick Falls, N. Y. Filed May 7, 1889.

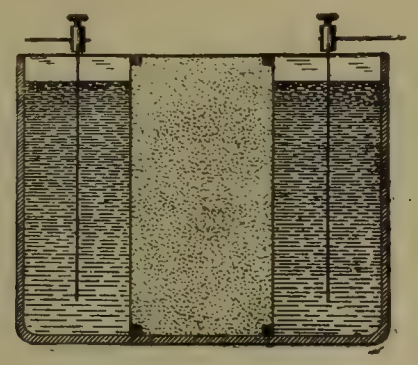
442,139. Multiple Telegraph or Telephone. Abner M. Rosebrugh, Toronto, Canada, assignor to the American Bell Telephone Company, Boston, Mass. Original application filed Nov. 27, 1886. Divided and this application filed June 6, 1887. Patented in England.

442,140. Circuit for Electric Railways. Frank W. Sabold, Albany, N. Y. Filed Sept. 22, 1890.

442,143. Multiple-Switch Board System. Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Oct. 15, 1888.

442,144. Telephone-Exchange Apparatus. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Nov. 23, 1888.

442,145. Multiple-Switch-Board System. Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Nov. 23, 1888.



NO. 442,203.—SEPARATING-DIAPHRAGM FOR ELECTROLYTIC CELLS.

442,146. Telephone-Exchange Apparatus. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Company, same place. Filed Dec. 10, 1888.

442,162. Underground Electric Conduit. Homer H. Young, Kansas City, Mo. Filed June 23, 1890.

442,173. Electric Motor or Dynamo-Electric Machine. Charles E. Dressler, New York, N. Y. Filed Apr. 14, 1890.

442,203. Separating-Diaphragm for Electrolytic Cells. Isaiah L. Roberts, Brooklyn, assignor of one-half to Thomas H. McGraw, Poughkeepsie, N. Y. Filed Mar. 14, 1889. Renewed May 5, 1890.

442,208. Speed-Regulator for Electric Motors. William W. Schiffmann, St. Paul, Minn. Filed Apr. 28, 1890.

442,232. Attachment for Span-Wires for Suspended Electric Conductors. Frank Mansfield, New York, N. Y. Filed Apr. 26, 1890.

442,267. Telegraphy. Edward B. Ives, New York, N. Y., assignor to James M. Seymour, same place. Filed Feb. 24, 1890.

442,270. Device for Attaching Incandescent Electric Lamps to Gas-Fixtures. Norman Marshall, Boston, Mass., assignor to the Star Electric Company, Philadelphia, Pa. Filed June 11, 1890

442,287. Incandescent Lamp Socket. Geo. W. Hunt and Albert E. Rich, Brooklyn, N. Y. Filed Oct. 29, 1890.

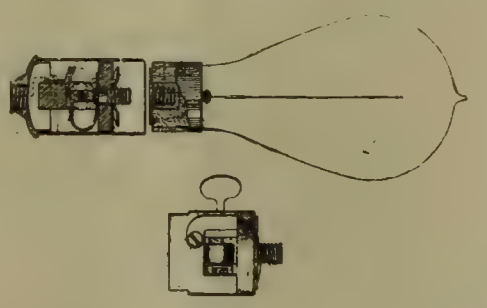
442,382. Electrolytic Apparatus. Isaiah L. Roberts, Brooklyn, assignor of one-half to Thos. H. McGraw, Poughkeepsie, N. Y. Filed July 13, 1888.

442,333. Apparatus for Use in Electrolysis. Isaiah L. Roberts, Brooklyn, assignor of one half to Thos. H. McGraw, Poughkeepsie, N. Y. Filed Aug. 11, 1890.

442,336. Carbon Electrode and Method of Making the Same. Isaiah L. Roberts, Brooklyn, assignor of one-half to Thos. H. McGraw, Poughkeepsie, N. Y. Filed Feb. 14, 1890. Renewed Oct. 22, 1890.

442,338. Relay. Jens G. Schreuder. Edgewood, Pa. Filed July 16, 1890.

442,342. Telephone Toll Station. John W. Vaughn, Jersey City, N. J., assignor to the Vaughn Automatic Machine Company of New York. Filed April 24, 1890.



NO. 442,287.—INCANDESCENT LAMP SOCKET.

442,365. Electric Traction Increasing System. Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place. Filed July 28, 1890.

442,370. Electric Connector. Wm. H. Garland, Weymouth, Mass. Filed Sept. 19, 1890.

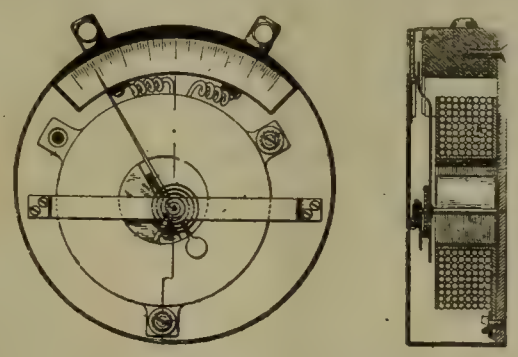
442,383. Non Interference Fire Alarm Signal Box. Preston V. Merrifield, Grand Rapids, Mich., assignor to John Perry, Harry W. Long, and Jacob Kleinhaus, all of same place. Filed March 7, 1890.

442,385. Electric Leak or Flow Detector. Gustave S Neu, New York, assignor of one-half to Charles H. Simmons, Brooklyn, N. Y. Filed March 20, 1890

442,390. Secondary Battery. James K. Pumpelly, Chicago, Ill. Filed Feb. 10, 1890.

442,396. Electrolytic Apparatus. Isaiah L. Roberts, Brooklyn, N. Y., assignor of one-half to Thomas H. McGraw, Poughkeepsie N. Y. Filed Mar. 14, 1889.

442,407. Electric Railway. Merle J. Wightman, Hartford, Conn. Filed Apr. 1, 1885.



NO. 442,423.—METHOD OF AND APPARATUS FOR MEASURING ELECTRIC CURRENTS.

442,415. Pulley Attachment for Electric Lamps. Thos. H. Brady, New Britain, Conn. Filed July 14, 1890.

442,423. Method of and Apparatus for Measuring Electric Currents. Stanley C. C. Currie, Philadelphia, Pa., assignor by mesne assignments, to the United Gas Improvement Company, same place. Filed Dec. 26, 1889. Patented in England.

442,446. Trolley Wire Hanger. Henry H. Luscomb. Boston, Mass., assignor to Charles Tennant Lee and the Gould & Watson Company, both of same place. Filed Sept. 19, 1890.

442,452. Ceiling-Block. Harry T. Paiste, Philadelphia, Pa. Filed Feb. 26, 1890.

442,459. Electric Motor and Frame. Albert Schmid, Allegheny, assignor to the Westinghouse Electric Company, Pittsburg, Pa. Filed Aug 1, 1890.

442,472. Holder for Electric Lamps and Hoods. George L. Batchelder, Bloomington, Ill. Filed May 5, 1890.

442,473. Electric Bell. Charles B. Beers and William B. Tuttle, Bridgeport, Conn. Filed Nov. 16, 1889.

442,475. Slot-Switch for Conduit Systems of Railways. Francis O. Blackwell, Boston, Mass., assignor to the Thomson-Houston Electric Company. Filed Oct. 27, 1890.

442,497. Printing Telegraph. William W. Taylor, Mansfield, Mass., assignor of one-half to Ellen Maria Leavens, Providence, R. I. Filed May 26, 1890.

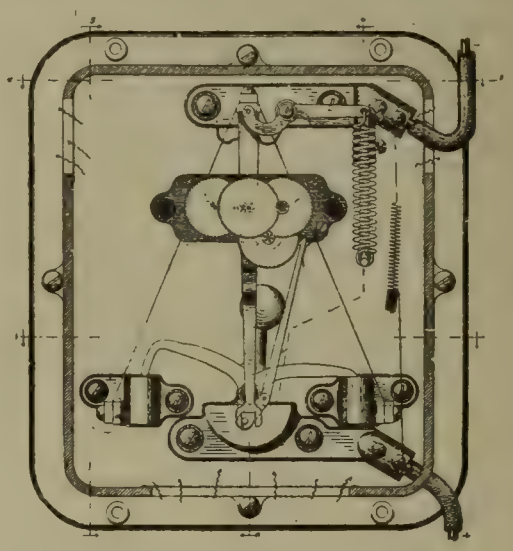
442,501. Electric Meter. James J. Wood, Brooklyn, N. Y. Filed Nov. 3, 1888.

442,516. Galvanic Battery. Clarence E. Dutton, Jr., Washington, D. C. Filed Sept. 6, 1890.

442,575. Conductor for House Lighting. William H. Eckert, New York, and William H. Gregory, Brooklyn, N. Y. Filed Sept. 15, 1890.

442,577. Shade and Reflector for Electric or other Lights. William S. Fraser, Pittsburg, Pa. Filed Apr. 16, 1890.

442,580. Electric Arc Lamp. William B. Henderson, Crafton, assignor of one-half to John



NO. 442,501.—ELECTRIC METER.

T. Birch, Pittsburg, Pa. Filed Aug. 4, 1890.

442,588 Electric Switch. Norman Marshall, Boston, Mass. Filed June 11, 1890.

442,594. Electrolytic Apparatus. Isaiah L. Roberts, Brooklyn, assignor of one half to Thomas H. McGraw, Poughkeepsie, N. Y. Filed Oct. 22, 1890.

THE WESTINGHOUSE COMPANY'S AFFAIRS.—A press despatch from Pittsburgh, on the 10th inst., says: The committee of local bankers recently appointed to investigate the financial standing of the Westinghouse Electric Company finished its labors to-day. Its report is understood to be favorable. The committee determined that the electric company stocks are worth over $25 per share, and decided to advance the $500,000 recently requested by Mr. Westinghouse, on condition that the parties making the loan have the privilege of naming the general manager for the company. The full Board of Managers of the Westinghouse Electric Company, at its meeting this morning, resolved to request the stockholders, at their meeting this afternoon, to issue $3,000,000 of preferred stock.

MICA MINE.—A party of miners have discovered and staked out a mica mine in the Northwest territory of the Dominion of Canada. The ledge shows a width of 40 and a height of 40 feet on the side of the mountain. Some fine samples were secured and brought in, the largest of which was about 10 × 18 inches surface, and almost as clear as crystal. Cubes of almost 2 feet were exposed in places.

ARMATURES.—The drum armature requires less wire than the cylinder to produce the same electro-motive force, because the end connections in the former are generally shorter than the internal connections in the latter type; but when constructed to give a high electro-motive force. it has this practical defect, that at the ends the different wires cross each other in many layers. This is objectionable for two reasons. In the first place wires, between which a great difference of potential exists, are brought close together, whereby the liability to short circuits is increased, and in the second place, repairs are very difficult, because in order to reach any particular wire, all those coils which are wound over it must first be removed. In the cylinder and disc armatures, on the other hand, neighboring wires on the outside as well as on the inside are never at a great difference of potential, and each coil can be removed and replaced without disturbing the rest of the winding.

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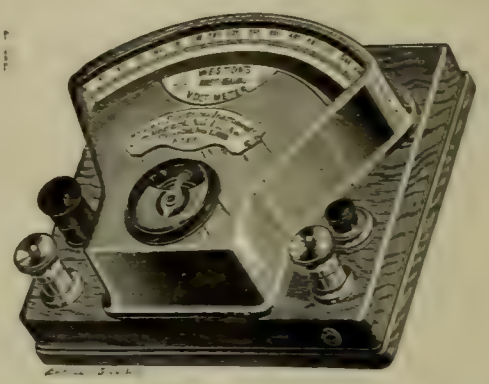
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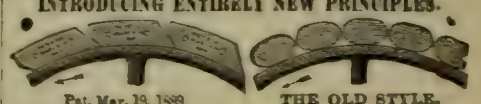


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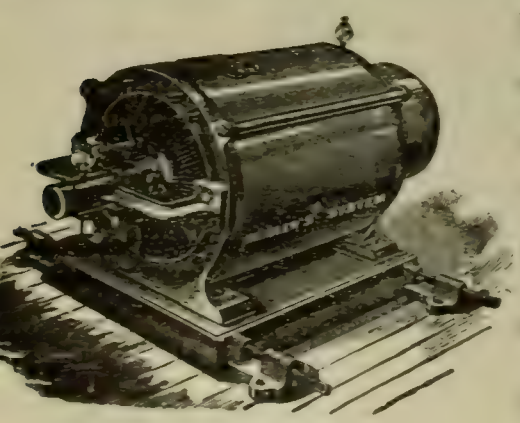
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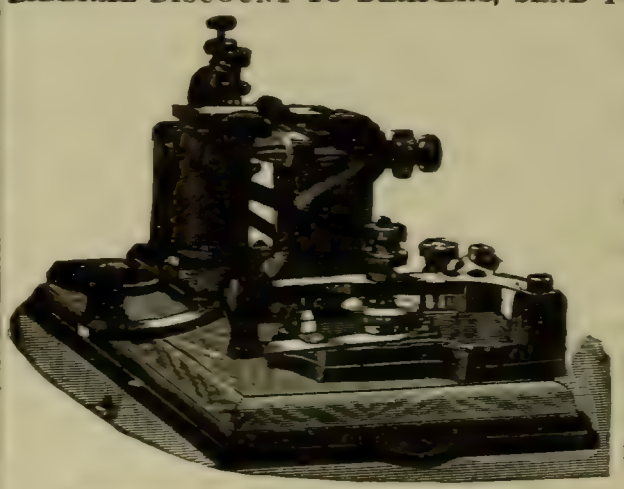
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OUR HOLIDAY GREETINGS.

The ELECTRIC AGE wishes each and all of its friends and readers a Merry Christmas and a happy and prosperous New Year.

ELECTRIC RAILWAY IN VIENNA.—Two Austrian engineers have been sent to London to look into the operation of the City and South London Railway which was recently opened, and described in the ELECTRIC AGE. Their report will be considered in connection with the projected Metropolitan Railway in Vienna, and if the system is adopted a high compliment will be paid to the eminent English electricians who planned and built this remarkable road.

ELECTRICITY IN COMPETITION WITH STEAM ON RAILWAYS.—For the first time in history, we believe, the steam railways have been made to feel the power of its coming rival the electric railway. The electric road between St. Paul and Minneapolis has been opened, and, according to our Minneapolis letter, the steam roads have already begain to feel the effects of it. The fares by the steam routes will have to take a big drop to equal those on the electric line, and even then the steam roads will be handicapped because they run only from station to station, whereas the electric line runs all over the two cities.

ELECTRO-MAGNETS.—The Cantor lectures recently delivered by Prof. Silvanus P. Thompson before the Society of Arts, in London, on the electro-magnet were of unusual interest and importance. They represent the result of great research on this important subject, and the effect will be that text books on electricity will have to be, to some extent, remodelled on the new and latest basis as laid down by the professor in these lectures. Recently we published some facts and fallacies concerning electro-magnets deduced by Prof. Thompson after his investigations. Incidentally his lectures contain much other valuable information. In this issue we publish an abstract from one of these lectures on the subject of electro-magnets for use with alternating currents, which is both timely and of extreme interest. The language Prof. Thompson uses is plain, and some of the phenomena of alternating currents are stated with such clearness that it whets the reader's appetite for more.

INDUCTION.—We give in this issue an abstract of the paper read by Mr. A. E. Kennelly at the meeting of the Institute of Electrical Engineers on the 16th instant, on "Inductance and its Proposed Unit, the Henry." It is an able paper and for the first time the term "Henry" is used to signify the unit of inductance. This abstract in connection with that from Prof. Silvanus P. Thomson's lecture on the Electro-Magnet, which we also publish on another page, will be found of great value and interest.

ELECTRIC RAILWAYS IN BROOKLYN.

A move of considerable significance and importance was made in Brooklyn, December 15th. President William Richardson, of the Atlantic Avenue Railroad Company, petitioned the Brooklyn Alderman to grant him the privilege of substituting electric for horse power on the lines of his company. President Richardson is fully alive to the importance of the electric railway, and, if he can help it the people of Brooklyn will not be deprived of the enjoyment of the many advantages that electric railways bring.

That he is progressive and sincere in his efforts is evident when we refer to the words he used in his opening address at the convention of the Street Railway Association in Buffalo last October. There he said, "I am so thoroughly convinced that electricity is the coming power for street railways (except on heavy grades where the cable is best suited) and that it will prove so effective as a means of rapid transit for cities, that I believe this is the last convention that will ever seriously consider horses for the operation of street railways.

Rapid transit in growing cities is becoming a necessity. While municipal corporations in the larger cities, for many reasons, are slow to grant new privileges to corporations, and in the case of electricity they are very closely scanned and criticized, it will soon become self-evident that a municipal body can grant no greater boon to its middle and laboring classes than to provide them with the means of rapid and cheap transportation to and from homes in the suburbs where they can live under a clear sky and in a health-giving atmosphere. When the people of a city understand clearly the great benefits of rapid transit, by electricity or other improved motive power, over horses, they will demand that their city authorities grant such rights as will enable street railway companies to operate by the most improved methods."

There is no uncertain sound to these utterances. The people of Brooklyn should aid Mr. Richardson in his effort to give his patrons first-class service. There is no doubt that the new method of propulsion would be appreciated by the citizens as it is free from all of the objections urged against the use of horses, and it possesses many features which appeal to the finer tastes.

The action of the Brooklyn Aldermen on this petition will be watched for with much interest. They will act wisely if they grant the petition.

CHICAGO'S CABLE CARS.—Quite recently the operation of the Chicago cable car system was to a large extent suspended by the breaking of the cable. This caused great annoyance and inconvenience to working people, as the stoppage occurred while they were on their way to business. The breaking of cables is one of the weak points of the cable system, and is liable to occur at any moment, particularly when traffic is heavy. Another difficulty has been experienced within the past few days. According to a despatch from Chicago, the freezing weather has had the effect of narrowing the slot above the cable on the West Side Cable Road through pressure on each side of the open subway. It became too narrow in places for the grips to pass, and numerous trains were brought to a standstill. There was a general blockade as a result, and hundreds of passengers were compelled to walk. Electricity ought to be brought to the rescue in Chicago street car travel.

THE WESTINGHOUSE TROUBLES.—It is regrettable that the vast and important interests of the Westinghouse Electric Company should become entangled as they have. It is a concern that stands preeminently to the fore, and the reputation of its head is great. It is therefore hoped that the company will successfully tide over its embarrassment and finally settle on a more solid basis. From all reports it is quite evident that the company had "too many irons in the fire." It is a risky thing to do in any line of business, to engage in ventures outside of the legitimate field of operations. Business experience is full of examples of this sort, and such risks are continually being taken by business men who should be more circumspect. The Westinghouse Company is a great concern, but its greatness lies in its legitimate line of trade. It should go slow in considering outside matters. Everybody knows what it can do in its proper sphere, and to that its operations should be wholly confined. If the officers become entangled with outside affairs, the company will surely suffer.

SPACE FOR THE ELECTRICAL EXHIBITS AT THE WORLD'S FAIR.

We are in receipt from Mr. George R. Davis, director general of the World's Columbian Exposition, of a copy of a circular sent out by him to all manufacturers of electrical supplies and appliances, etc., throughout the country. The idea is to erect upon the exposition grounds a special building to be entirely devoted to the electrical exhibits. In drawing the plans for this building it is necessary to obtain as far as practicable an estimate of the space which will be required. This is the object of the circular, and it is hoped that all interested will give the matter prompt attention. The following is a copy of the circular:

"For the purpose of ascertaining approximately the amount of space that will be required for the electrical exhibits, and as it is contemplated to erect a building to be used exclusively for this purpose, I have the honor to request the following information:

1st. Do you propose to make an exhibit?

2d. If so, the approximate amount of space you will require.

3d. The amount of steam, if any.

A reply to above questions will not be considered as an application for space, but an estimate on which to base calculations for building.

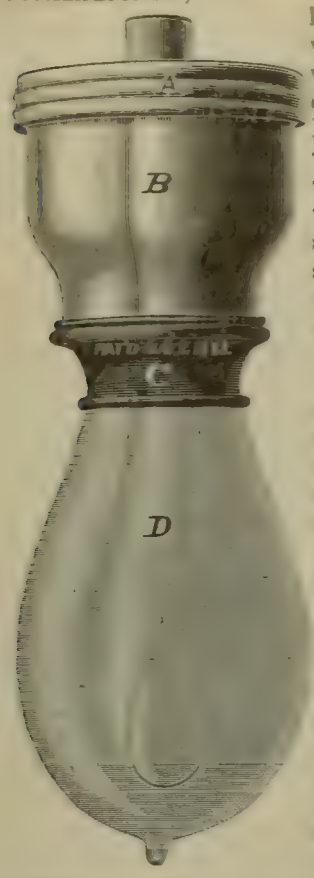
It is desirable that this information should be received within the next two weeks."

THE WORLD'S FAIR.—The electrical department at the World's Fair in Chicago, in 1893, will be known as Department J. On another page we print the classification of exhibits in this department, and its completeness will be at once noticed. Everything involving electricity has been provided for and it is gratifying to note the enterprise of the committee and its promptness in taking hold of and settling the problem.

TRANSFORMATION OF ENERGY.—Heat produces electricity, and electricity produces heat; magnetism produces electricity, and electricity magnetism; light produces electricity, and electricity light.

MOISTURE-PROOF SOCKET PROTECTOR.

Among the recent specialties of The McCreary Electrical Specialty Company, 18 and 20 Cortlandt street, is a moisture-proof incandescent lamp socket protector which will be of value where lamps are used in damp or wet places. Indeed the protector is valuable on any lamp wherever it may be, in a wet or a dry place. The accompanying figure shows the appearance of this device. A is a metal cap containing a rubber gasket; B is a metal shell covering all kinds of lamp sockets; C is a rubber neck covering the opening where the lamp is inserted.



The advantages claimed for this protector are: 1st, it is a thorough protection of the socket from moisture; 2d, the light is unobstructed; 3d, it will fit any lamp or socket, and it is removable without injury to either; 4th, it is easily adjusted, durable and inexpensive. This new protector obviates all difficulties connected with protecting and adjusting lamps, as nothing has to be removed but the rubber neck, and it is as easily adjusted as the lamp.

ELECTRIC LIGHT NOTES.

Mansfield, Pa., is one of the latest towns in western Pennsylvania to operate a central station plant for electric lighting. The Westinghouse alternating current system will be installed in the plant.

The Westinghouse Electric and Manufacturing Company is now installing a central station electric lighting plant, at Berlin, N. H., with the Westinghouse alternating current apparatus. The plant will commence operations with 750 sixteen c.p. lights capacity.

The incandescent electric light is rapidly supplanting the gas lamps out west. The Keokuk Electric Light and Power Company (Ia.), after having established a central station electric lighting plant, of the Westinghouse alternating current system last year, has just made another contract with the Westinghouse Electric and Manufacturing Company for the supply of two dynamos. With this addition the Keokuk plant will have a capacity of 2,250 sixteen c.p. lamps.

The Aransas Pass Electric Light and Power Company, of Aransas Pass, Texas, which only a few months ago started up a plant of 500 alternating current incandescent lights, has already discovered the electric light is what the people want and that they will have it. Hence the company has added an arc light plant to its central station. The apparatus operated is of the alternating current system of the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa.

The Albion Electric Company, of Albion, N. Y., where an electric light plant of five hundred lights has been operated about a year, is now compelled to increase its capacity. The central station is operating the Westinghouse alternating current system, and the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., has received an order for its apparatus of 750 lights capacity which will immediately be installed at the Albion plant.

One of the most successful central station plants of incandescent electric lighting is the one established last spring at Windsor Locks, Conn. The electric light company of that town commenced operations at that time with a 500-light dynamo of the Westinghouse alternating current system. Since then the capacity of the plant has been increased twice, and to-day the company is able to furnish more than four times the amount of light of its original capacity. The Westinghouse Electric and Manufacturing Company is now engaged with the installation of a 750 light alternating current dynamo.

THE BAIN BREAK INSULATOR.

The insulator illustrated herewith is designed to take the place of the ordinary crude devices that have been used as break insulators. The new insulator is made of one piece of porcelain, carefully glazed, and is so simple as to require scarcely a word of explanation; while its great strength and perfect adaptability are sure to commend themselves to all practical construction men. This insulator will be found especially useful, also, for suspending arc lamps from iron



THE BAIN BREAK INSULATOR.

cranes, insulating guy wires, and particularly for insulating span wires in electric railroad work.

The Central Electric Company, of Chicago, control the patent and are placing the device upon the market.

Electric Light Lines.—The experience in Pittsburg during the severe storm, December 17, when electric light wires were broken down by the weight of sleet and snow which had accumulated upon them, is full of suggestions. In many cases overhead lines are constructed in a very careless and unsubstantial manner, and it is not surprising that they give way under severe strains. It may be argued that these great strains are of very rare occurrence and that for ordinary conditions of weather the lines are constructed with sufficient strength and care. This may be so, but all lines should be constructed so that they could be depended on to resist the greatest strain that is ever likely to be put upon them through the changes of the seasons. They should be constructed well in the first place, and the saving in repairs and tinkering would soon make up the difference in the first cost. It is a dangerous thing to have electric light wires come down on the heads of the citizens in the crowded streets of cities, and it was fortunate that this was not the result in Pittsburg, although two horses suffered death by being struck by the wires.

Better Light for New York.—Greater brilliancy will probably attend the opening of the new year in New York than characterized the opening of the present year. The electric light companies and the Gas Commission have for some time been at loggerheads regarding the price per lamp for electric light, and the electric light companies have finally agreed to accept the city's figure of 40 cents per lamp, per night. The companies asked 43 cents per light, but the Commission considered that figure too high. In those districts where subways are laid the electric light will be turned on. At the present time there are but 800 electric lights in operation for street lighting. Before the wire and pole crusade, last spring, there were 1,275 street lamps in use.

ELECTRIC RAILWAY NOTES.

The Citizens Traction Company, of Pittsburg, Pa., a street car corporation which operates about seven miles of cable lines in that city, has decided to extend one branch of its line from Butler street to Sharpsburg for a distance of three miles. This extension will be operated by the electric overhead wire system. The contract for the equipment of the cars with motors has been awarded to the Westinghouse Electric and Manufacturing Company. As the power house will not be completed for some time yet, the road will not go into operation until the spring.

In Montclair, N. J., a beautiful suburb of New York, there exists a great necessity for a street car line, and application has been made to the Town Committee for a franchise to operate an overhead electric road. During the pendency of the application, Mr. C. R. Truex, assistant general manager of the Accumulator Company, of this city, sent a communication to the Town Committee setting forth the advantages of the system of his company. He also guaranteed that the operating expenses of the accumulator system would be as cheap, if not cheaper, than where the cars are propelled by horses. The Accumulator Company, it will be remembered, had an Edco car on exhibition and in operation in Buffalo during the Street Railway Convention recently and many friends were made for the system. The same car is now in regular operation on a Chicago line, where, from all reports, it is giving the best satisfaction.

THE SHAVER TELEPHONE.

The Shaver Corporation have recently erected a combination bank system and exchange of seventeen stations, at the new works of the Westinghouse Air Brake Company, at Wilmerding, Pa.

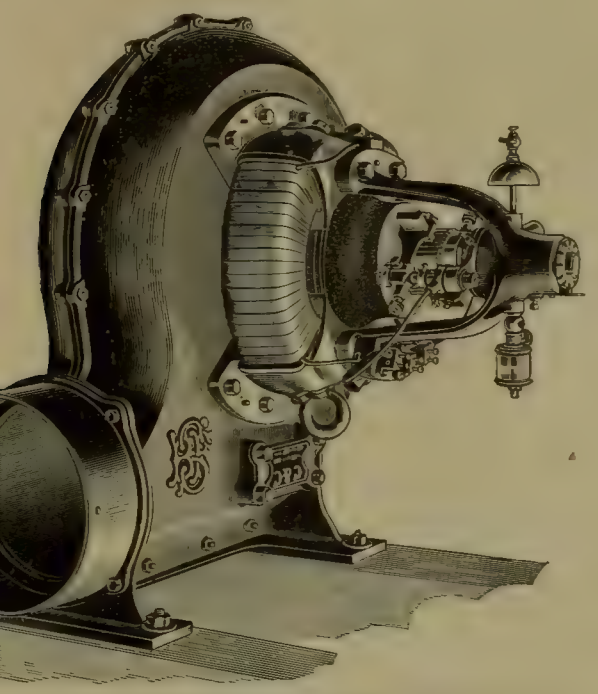
The company has also received orders to fit up the state, war, and navy departments building, at Washington, with their telephones, and also to establish an exchange at Skowhegan, Me., with a capacity of 100 lines.

An exchange of eighty-five stations is to be erected by the Shaver Corporation, at Charlottesville, Va.

One of the most satisfactory plants of telephones installed by the Shaver Corporation is that at the twine factory of Travers Bros., 526 to 558 West 52d street, this city. This factory is one of the noisiest in the city, but no difficulty on that account is experienced in using the telephones.

C. & C. ELECTRIC MOTOR.

The C. & C. Electric Motor Co., less than twelve months ago, manufactured the first of its blower and motor combinations with which most people versed in electrical appliances are now familiar. This apparatus was primarily designed for use in dynamo and engine rooms of steamers and in other places where it is essential to produce a rapid and thorough ventilation and where the space is circumscribed. Owing to the extreme compactness of the machine it may be placed in the smallest room and proves a most powerful exhaust. The apparatus was first used on the U. S. S. Baltimore, and Capt. Schley com-



C. & C. MOTOR AND BLOWER COMBINATION.

manding that ship declared in a letter written to the C. & C. Company that it gave "perfect satisfaction." The installation on the Baltimore has been followed by others on the Chicago, Charleston and Petrel, and three more blower combinations are now under construction by the C. & C. Company for others of our new cruisers. The Italian navy, not to be left behind, ordered two of these blowers some few months ago and after giving the apparatus a thorough test, have recently, through their agents in Milan, placed a further order with the C. & C. Co. for nine, including six of the No. 7 or largest size machines.

ELECTRICITY AT THE WORLD'S FAIR.

The following is the classification of electrical exhibits, as found in the report of the committee on classification which has been approved by the National Commission of the World's Fair:

DEPARTMENT J.—ELECTRICITY.

Group 116, *Apparatus to Illustrate the Phenomena and Laws of Electricity and Magnetism.*

Class 703. Statical electricity.
Class 704. Dynamical electricity.
Class 705. Thermal electricity.
Class 706. Magnetic electricity.
Class 707. Magnets, temporary and permanent.
Class 708. Direct and induction coils.
Class 709. Galvanometers.

Group 117, *Thermo Electric Batteries*

Group 118, *Electric Batteries: Secondary or Storage Batteries.*

Group 119, *Machines and Appliances for producing Electrical Currents by Mechanical Power—Dynamos.*

Class 710. Dynamos of direct current.
Class 711. Dynamos of alternating current.
Class 712. High and low voltage.
Class 713. Commutators.

Group 120, *Transmission and Regulation of the Electrical Current.*

Class 714. Cables, wires and insulators; rheostats, switches, ammeters, resistance boxes, indicators and meters, voltmeters, hydrometers, and converters.
Class 715. Safety and protective appliances, arresters, etc.
Class 716. Lightning rods and ornaments, insulators, rods, cables and "grounds."

Group 121. *Electric Motors and their Applications.*

Class 717. Movement of machinery in various industrial operations.
Class 718. Pumping and hoisting from mines.
Class 719. Propulsion of railway cars, street railway cars, mining cars, propellers, etc.

Group 122, *Lighting by Electricity.*

Class 720. The arc system and its fixtures, appliances, etc.
Class 721. The incandescent system, its fixtures, lamps and appliances.

Group 123, *Heating by Electricity.*

Class 722. For warming and heating apartments.
Class 723. For heating flat-irons and other objects in industrial operations.

Group 124, *Electro-Metallurgy and Electro-Chemistry.*

Class 725. Electrotyping.
Class 726. Electroplating, gilding and nickeling.
Class 727. Electric deposition of iron and other metals.
Class 728. Electric deposition of metals as a means of extracting them from ores or alloys.
Class 729. Electric furnaces.

Group 125, *Electric Forging, Welding, Shaping, Tempering, Brazing, etc.*

Claas 730. Apparatus and methods of forging, bending, twisting, making angles or straightening metals and metal work.
Class 731. Apparatus and methods of welding and joining iron, steel and other metals.
Class 732. Brazing, soldering, tempering, etc.

Group 126, *Electric Telegraph and Electric Signals.*

Class 733. Various systems of transmitting and recording.
Class 734. Electric chronographs.
Class 735. Annunciators.
Class 736. Burglar alarms.

Group 127, *The Telephone and its Appliances.*

Class 737. Cables; construction; underground work.
Class 738. Protection of strong current apparatus.
Class 739. Switchboards.
Class 740. Transmitting apparatus.
Class 741. Receiving apparatus.
Class 742. Signaling apparatus.
Class 743. Subscriber's apparatus; numbers, code, registers, etc.

Group 128, *The Phonograph.*

Class 744. Receiving and recording apparatus.
Class 745. Apparatus for the reproduction of recorded sound and articulate speech.

Group 129, *Electricity in Surgery and Therapeutics.*

Class 746. Electric Cauteries and apparatus.
Class 747. Apparatus for application of the electric current as a remedial agent.
Class 748. Apparatus for the destruction of life.

Group 130, *Application of Electricity in various ways not before specified.*

Class 749. Ignition of explosives; gas lighting, etc.
Class 750. Control of heating apparatus by electricity, as applied to steam and hot air pipes and registers.
Class 751. Electric Pens.
Class 752. Application in Photography.

Group 131, *History and Statistics of Electrical Invention.*

Class 753. Objects illustrating the development of the knowledge of electricity and of the application of electricity in the arts.
Class 754. Collections of books and publications upon electricity and its application.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 52d meeting of the American Institute of Electrical Engineers was held on the evening of December 16th, at the society's rooms, No. 12 West 31st street, and was largely attended.

After the transaction of some routine business Mr. A. E. Kennelly read a paper on "Inductance and its Proposed Unit, the Henry," an abstract of which will be found on another page.

Mr. Emile Berliner then described the instrument of which he is the inventor, the gramophone, and practically demonstrated the process of preparing and etching the zinc plates, which are the counterpart of the wax cylinder on the phonograph.

A recorder and a reproducer were exhibited on the platform and the inventor entertained the audience for some time with some choice music, instrumental and vocal. By the aid of a large funnel the sounds were reproduced with remarkable volume, and the notes were heard in every part of the room.

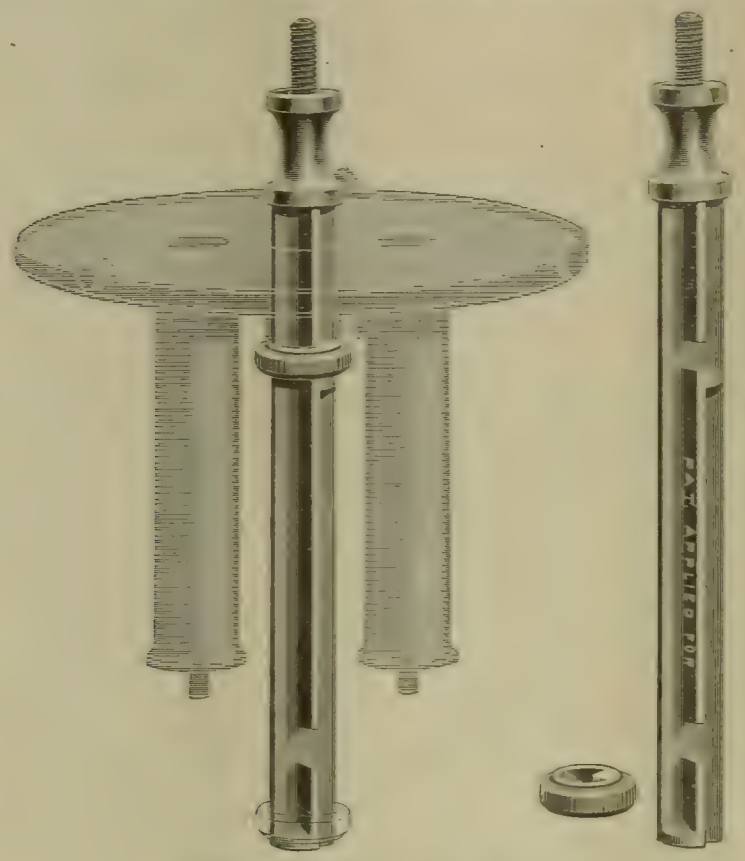
At the regular monthly meeting of Council, held December 16th, the following associate members were elected: P. H. Alexander, president, Alexander, Barney and Chapin, New York City; Charles E. Dressler, maker of scientific and electrical apparatus, College of the City of New York, New York City; E. L. French, draughtsman, Mather Electric Co., Manchester, Conn.; Arthur Handley, electrical engineer, Electrical Engineering Co. of Ireland L't'd, Dublin, Ireland.; George Mayer, mechanical draughtsman, Edison General Electic Co., New York City; Wm. F. Murphy, electrician, Spartanburg Electric Light and Power Co., Spartanburg, S. C.; F. B. H. Paine, consulting electrical engineer, Chas. Pain and Sons, New York City; Chas. Lane Poor, tutor, College of the City of New York, New York City; Samuel Sheldon, *A. M. Ph. D.*, professor of physics and electrical engineering, Polytechnic Institute, Brooklyn, N. Y.; Wilfred J. Spruson, member of the firm of Hepburn and Spruson, consulting engineers and electricians, Sydney, Australia; M. C. Sullivan, 150 Broadway, New York City; John Waring, consulting electrician, The Perkins Electric Co., Manchester, Conn.

At the same meeting the following associate members were transferred to full membership, their applications having been approved by the Board of Examiners at its meeting held December 3d: Harold Binney, assistant in the practice of patent law, 245 Broadway, N. Y. Wm. Herbert Donner, designing draughtsman and electrical engineer, T.-H. Electric Co., Lynn, Mass.; Reginald A. Fessenden, assistant electrician, U. S. Electric Co., Newark, N. J.; Dr. Cary T. Hutchinson, electrical engineer, New York; Dr. Frederic A. C. Perrine, supt. insulated wire department, Roebling's Co., Trenton, N. J.; Henry Laws Webb, asst. electrician, Metropolitan Telephone and Telegraph Co., New York; Townsend Wolcott, consulting electrician, Brooklyn, N. Y. The total membership of all classes is now 500.

LONG RECORD.—The longest record for any one arc lamp in constant use, in street service, is three years and nine months. During this period no adjustment whatever was necessary, other than the ordinary cleaning by the trimmer.

CUTTER'S GLOBE-HOLDER FOR ARC LAMPS.

In trimming arc lamps, much time is often lost either because the globe is fixed and in the way, or because the arrangement for slipping it down while the carbons are being renewed is imperfect. Thus in the case of the Thomson-Houston double carbon lamps, the globe-holder slides on a brass tube and is held in place by a screw pressing against this tube. To insure the grip of the screw, the trimmers will often use their pliers on it, and in a short time the tube becomes indented or even split, the screw is bent and sticks and the ring no longer slides freely. All this causes a loss of time in trimming the lamp and does not tend to improve the good humor of the trimmers. As a simple substitute for this bothersome arrangement, George Cutter of Chicago, has brought out a device of which we give an illustration. As the cut shows, a rod with a star-shaped cross-section is used instead of the tube, while the screw is replaced by a ring which is adapted to engage the rod at two points. When in use the globe-holder proper rests on this ring, which is knurled so as to be readily



GLOBE HOLDER FOR ARC LAMPS.

turned with the fingers. A slight raising and turning of the ring allows it to drop to the end of the rod, thus lowering the globe out of the way. After the lamp is trimmed, the ring is raised again and a quarter turn brings it back to its original position, where it supports the globe-holder securely. To remove this entirely the ring is slipped down until opposite the lower notch in the rod, where both the ring and the globe holder can be taken off together. The globe can then be replaced and the holder slipped back and clamped in place in an instant. Thus it takes but a moment to lower the globe where it will be out of the way, to raise it again into position, or to remove it altogether. Such a labor-saving device ought to pay for itself in a short time, and as it is simple and well made will probably outlast the rest of the lamp. As it fits any T.-H. double carbon lamp, it will find a ready market wherever these are used. Mr. George Cutter is pushing this device from his office at 333 "The Rookery," Chicago.

INCREASING E. M. F. OF DYNAMOS.—In dynamos if either the strength of field, the velocity, or the length of wire be doubled, the resulting E. M. F. will be doubled, the number of lines cut per second being increased two fold.

NEW YORK NOTES.

The Elektron Manufacturing Co., have recently sold to Messrs. Warfel & Geist of Lancaster, Pa., 30 H. P. in Perret electric motors. These machines will be supplied with current by the Edison Electric Illuminating Co., of Lancaster, and will furnish power for all the machinery in the large brick building recently completed by Messrs. Warfel & Geist, including large Hoe presses for printing the daily and weekly *New Era*, as well as all the job presses, which go to make up one of the best and largest printing establishments in the state. Messrs. Warfel & Geist have had experience with several other motors, but after a thorough investigation and a visit to Brooklyn and New York, where they witnessed the motors in operation, placed their contract for Perret machines. The following is a sample of the testimonials now being received by The Elektron Manufacturing Co.

MINNEAPOLIS, MINN., Dec. 3, 1890.

MR. F. J. RENZ, Agent:

Dear Sir.—In reply to yours of the 3d, in regard to testimonials, will say that I am so well pleased with the Perret Motor *in all respects* that I will permit your people to write anything they see fit over my name, providing it is *all in favor* of the *Perret*, and I will do all I can in my way to help you in Minneapolis.

Yours respectfully,

F. G. WARD,

Manager The Great Atlantic and Pacific Tea Co.

W. H. Gordon & Co., 115 Broadway, are selling large quantities of the Star Electrix Specialties for which they are the general selling agents. The sockets especially have been in great demand, and the factory has been put to its utmost capacity to keep up with the orders, and numerous ones are booked for future delivery. This firm is also prepared to furnish promptly orders for the switches and cut-outs of which they are now fully stocked. R. J. G.

THE SUBWAY CASE.—Argument was continued a few days ago in the suit of the "tax-payers" to prevent the Board of Control from making a contract with the Empire City Subway Company. The Board, with the assent of the Consolidated Subway Company, proposes to divide the subway business, and turn over to the Empire City Company the construction of subways for low tension wires. The argument was not concluded.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
1001 OPERA HOUSE BLOCK,
CHICAGO, Ill., Dec. 18, 1890.

Mr. William Hood, of the Accumulator Company, is in New York.

Mr. D. T. Everts, assistant manager of the Simplex Electrical Company of Boston, is in the city this week among friends and business acquaintances.

The Cedar Rapids and Marion Railway, and the Cedar Rapids Street Railway, of Cedar Rapids, Iowa, have been transferred to a syndicate of local capitalists, who propose converting both roads into electric lines. The officers of the Cedar Rapids and Marion Railway are: P. E. Hall, President; W. D. Douglas, Vice-President; John S. Ely, Secretary; George W. Bever, Treasurer; and the officers of the Cedar Rapids Street Railway are: S. E. Hall, President; John S. Ely, Secretary; Geo. W. Bever, Treasurer.

CHICAGO ELECTRIC CLUB.—On last Monday evening the Chicago Electric Club substituted a "social" in the place of the regular meeting, and the result was so satisfactory that it is likely the "social" will be a feature of the club hereafter. Messrs Degenhardt and Buckley were the committee having charge of the programme of the evening, which was enough to insure its unqualified success. The Mandolin Club furnished music, Prof. Broadfoot gave several recitations, and Messrs. Degenhardt and Buckley furnished an interesting entertainment in the form of an illustrated paper on "Electricity." The club announces a series of four parties to be given during the winter, the first to take place December 26th. Kinsley's Banquet hall, next door to the club parlors will be used for dancing.

F. M. I.

NEW CATALOGUES.—The Columbia Incandescent Lamp Company, of 1912 and 1914 Olive street, St. Louis, have just issued their catalogue of incandescent lamps. The company manufactures incandescent lamps to fit any socket. They also make a special lamp for electric street cars. The company's lamps have a reputation for long life, maintenance of candle-power and high efficiency, and the factory is equipped with all the latest improved mechanical apparatus and instruments used in the manufacture of incandescent lamps. The catalogue is very neatly gotten up and well illustrated.

The Electric Merchandise Company, 11 Adams street, Chicago, is out with a sheet giving "a few specialties" in their line. These include gravity switches, fuse boxes, lightning arresters, platform gate for street cars, etc., etc.

INSTITUTE OF ELECTRICAL ENGINEERS.—This flourishing society is constantly increasing in membership and has just reached the 500 mark. It is the leading society of electricians in the United States and embraces within its membership almost every electrician of prominence in the country, and many in other countries. It is filling an important place in the development of electrical knowledge, and we hope its prosperity and usefulness will continue to enlarge.

LOST OPPORTUNITIES.—An exchange says; it is astonishing by what narrow margins some people escape making large fortunes. It is reported that Prof. Alexander Graham Bell tried again and again to persuade Senator Don Cameron to buy a one-half interest in his invention for $10,000. Cameron thought Bell a half witted dreamer, refused to put up a dollar, and finally gave orders that Bell should no longer be admitted to his office. The half-interest to-day would pay a handsome interest of $10,000,000. The Westinghouse air-brake was hawked about the country for $500 for the half-interest, with no takers.

NOTES ON THE CHEMISTRY OF SECONDARY CELLS.*

By Prof. W. E. Ayrton, Vice-President; C. G. Lamb, B. Sc., and E. W. Smith, Associates.

(*Continued from page 7, issue of December 20.*)

III. — Appearance of Plates at Removals of Plugs.

The following notes were made by Mr. Robertson and ourselves at the successive removals of the plugs :

Charging.

Positive Plates. Negative Plates

Point A on Curve 1.† Terminal Potential Difference, 2.134 volts. Specific Gravity of Liquid, 1.178.

Positive Plates.	Negative Plates
The upper part of the plates had a greyish-brown color, and presented the appearance of being coated with a very thin film of white sulphate. The lower part of the plates was of a reddish-brown color. The plugs at the top were hard, while those at the bottom were quite soft.	The plugs at the top were the softest.

Point B on Curve 1.† Terminal Potential Difference, 2.2 volts. Specific Gravity of Liquid, 1.198.

Positive Plates.	Negative Plates.
The plates had entirely lost their whitish appearance, and showed a uniform reddish brown color, darker than the previous color of the bottom of the plates.	The plugs both at the top and at the bottom harder than before, those at the top having hardened more than those at the bottom.

Point C on Curve 1.† Terminal Potential Difference, 2.234 volts. Specific Gravity of Liquid, 1.201.

Positive Plates.	Negative Plates.
The previous charges increased in amount.	The previous charges increased in amount.



Fig. 5.



Fig. 6.

Point D on Curve 1.† Terminal Potential Difference, 2.4 volts. Specific Gravity of Liquid, 1.206.

Positive Plates.	Negative Plates.
The plates had the rich deep brown color of lead peroxide, except where they were covered with the ebonite separators: there the color was lighter. The plugs at the top were slightly the softest, while those at the bottom were much the same as at the beginning.	The plugs had a brilliant metallic lustre, and looked quite silvery when first removed from the plates. The plugs at the top were now the hardest.

Discharging.

Positive Plates. Negative Plates.

Point A′ on Curve 2.† Terminal Potential Difference, 1.998 volts. Specific Gravity of Liquid, 1.205.

Positive Plates.	Negative Plates.
The plugs at the top were harder than those at the bottom.	The plugs had the brilliant metallic lustre observed at the end of the charging.

Point C′ on Curve 2.† Terminal Potential Difference, 1.850 volts. Specific Gravity of Liquid, 1.180.

Positive Plates.	Negative Plates.
The plugs had become much harder.	The plates had become decidedly white, and the plugs were white right through.

Point D′ on Curve 2.† Terminal Potential Difference, 0.6 volt. Specific Gravity of Liquid, 1.175.

Positive Plates.	Negative Plates.
The plugs had become extremely hard, especially at the bottom.	The plugs were somewhat softer.

Point E′ on Curve 2.† Terminal Potential Difference, 0 volt. Specific Gravity of Liquid, 1.172.

Positive Plates.	Negative Plates.
The plugs had become so hard that they splintered, and bits flew about on trying to remove them.	

The bubbling of gas from the negative plates ceased when the terminal potential difference on discharging fell to 1.85 volts (point C′ on curve 2), and it began again when the terminal potential difference fell to somewhere near zero.

The following figures (5 and 6) give an idea of the way in which we found the hardness of the top and bottom plugs of the positive and negative plates respectively to vary during a normal charge. The figures are not drawn to scale, as we had no standard of hardness beyond our sensations, hence the figures only profess to be qualitative sketches from which mental pictures can be obtained. Distance measured upways from O A indicates roughly the degree of hardness; distance measured downwards, the degree of softness.

It will be seen that during the charging the variation in the hardness of the plugs is far greater at the top than at the bottom of the plates, and consistently with this fact Mr. Robertson's analyses show that, on the whole, the rate of chemical action at the top of the plates is greater than at the bottom. The difference in the hardness, however, is far more marked than the difference in the chemical action. For example, while the plugs at the top of the positive plates are, during the earlier part of the charging, much harder than those at the bottom, no such striking difference is observable in the percentage of lead peroxide contained by these plugs. The cause of this we are examining experimentally at the present time.

Characteristic Curves.—It is possible to represent all the important properties of a dynamo machine by curves, and since these properties give it a distinct character by which it differs from other machines of different type, these curves are called characteristics. The relations between current, electro-motive force, speed, horse-power, efficiency, and so forth, can all be represented graphically, but the curve most commonly used is that giving the electro-motive force as a function of the exciting power of a constant speed. In the case of a series dynamo the exciting power is proportional to the current, and if we plot the currents on the horizontal and corresponding electro-motive forces created in the armature coils on the vertical, we obtain what is commonly known as the internal characteristic. The external characteristic is a curve representing the electro-motive force at the terminals of the dynamo, and the distance between corresponding points on the two curves represents the loss of electro-motive force occasioned by the internal resistance of the machine.

Starting Motors.—To start a shunt motor it is necessary to arrange the switch in such manner that the field becomes excited before the current is allowed to flow through the armature, and to avoid excessive sparking or heating of the armature. In cases where the motor has to start with the load on, additional resistances must be placed into the armature circuit, which are again cut out as soon as the motor has attained some speed.

*Read before the English Institution of Electrical Engineers, November 13th.

†See diagrams on pages 6 and 7, issue of December 20.

COMPOUND-WOUND DYNAMOS.

Let the field magnet of a dynamo machine be wound with two coils one of fine high resistance wire coupled direct to the brushes, and the other of stout low resistance wire, coupled in series with the brushes and the external circuit. If the latter be open, no current passes through the main or series coils, and the magnetism of the machine is entirely due to the exciting power of the shunt coils. If the machine is properly designed, this amount of magnetism should produce an internal electro-motive force exactly equal to that which it is desired to maintain at all currents in the internal circuit, provided the dynamo is driven at a constant speed. If a current is permitted to flow through the armature, the electro-motive force measured at the brushes is naturally somewhat less than that created within the armature coils on account of losses through resistance and self-induction, the loss increasing with the current. To compensate for this loss it is necessary to increase the internal electro-motive force, and this is accomplished by an increase in the strength of the magnetic field. This is brought about automatically by the main current itself, which assists the shunt current in exciting the field magnets. In a correctly compounded machine the increase of magnetization due to the main coils is sufficient, and no more than sufficient, to keep the external electro-motive force constant at all currents which can safely be passed through the machine. We say the machine is accurately compounded for constant terminal pressure.

Now it is easy to see that we can overdo the thing, by putting on somewhat finer shunt wire, which will lower the electro-motive force when the machine works on open circuit or on a circuit of high resistance; and by increasing the number of main coils so as to make the exciting power of the main circuit preponderate over that of the weaker shunt. In this case the increase of internal electro-motive force will more than counterbalance the loss through self-induction and resistance, and the result will be that up to a certain limit the external electro-motive force will rise as the current increases. Such an over-compounded machine could therefore be used as a generator the receiver being an ordinary shunt machine, and we would thus obtain a system of transmission of energy at constant speed.

Theoretically this is quite correct, but in practice there arises a difficulty due to the fact that the polarity of a compound machine can easily be reversed, especially if the influence of the main coils is considerably greater than that of the shunt coils.

Transmission of Energy.—Among the early applications of electric transmission of energy, may be mentioned the pumping arrangements in use since 1883, at a mine in Thallern, in Austria. Previously to the introduction of elecricity, a six-horse power portable engine, placed at the bottom of the pit, was employed to work a centrifugal pump delivering sixty-six gallons a minute through 850 yards of tubing to a height of 200 feet. Now the engine has been replaced by an electro-motor, the power being supplied by a dynamo on the surface which gives a current of fifteen amperes at a pressure of 500 volts. This represents an electrical energy of 10.2 horse power, and, allowing eighty per cent. for the commercial efficiency of the generator, the total energy expended comes to 12.8 horse power. The energy represented in water lifted is four-horse power, if we do not count friction in the tube; including friction, it probably amounts to over six-horse power. The commercial efficiency of the installation, including the two dynamos and the centrifugal pump, is therefore about 50 per cent.

Stored Energy.—As a means of storing energy to be afterwards converted into a current of electricity, the secondary battery stands alone.

NEW PUBLICATIONS.

BIBLIOTHECA POLYTECHNICA: A Directory of Technical Literature—A Classified Catalogue of all Books, Annuals and Journals published in America, England, France and Germany, including their Relation to Legislation, Hygiene and Daily Life. Edited by Fritz von Szczepánski. First Annual Issue. Crown 8vo., cloth. New York: The International News Company, 83 and 85 Duane street. 75 cents.

This work will be of much value to students of the sciences. Much industry and care have evidently been bestowed in its preparation, and the catch-words are printed in English, French and German, which makes the book of extraordinary value. There is a demand for such a work as this and it ought to find a ready sale.

MINNEAPOLIS NOTES.

A new company has recently been organized here for the purpose of constructing and operating an electric railway for freight and passenger business between this city and Anoka. The line is to be 18 miles in length and will have a full equipment of passenger and freight rolling stock. Thomas Lowry and Col. McCrory are said to be heartily in the new concern.

Another company, with its object the running of a street car line, has already been incorporated in this city. The company intends building a double track electric line between Golden Valley (a suburb of Minneapolis) and this city. The names of the incorporators are at present undivulged, but the road is a sure thing as work has already been begun.

The Loan and Trust Company's building in this city is being rewired throughout with Habirshaw wire. This building, only a few years' old, was a standing monument of the crude, unsafe, early methods of wiring. Nothing was used but paraffined wire. There was not a foot of rubber covered wire in the building and there were grounds from top to bottom.

A new electric company has entered the field within the last few days in Minneapolis, it being that of Hoffman and Metsgar, dealers in electrical appliances of all kinds. Their office is at 20 and 22 South Fourth street, and even at this early period of their career report plenty of business.

A new fire alarm is soon to be put upon the market which promises to do away with many of the faults of apparatus of this description. Unlike other alarms this is worked on the closed circuit system and not only is able to automatically designate the exact position of a fire but gives an alarm independent of the fire alarm. Any number of buildings may be fitted up on the same line, all working together, yet independent and distinct. Further details of construction and working will be found in the AGE at a later date.

The incorporation of a company for the manufacture and sale of electrical apparatus is being seriously talked of among the representative business men of the city and from present indications will soon become a settled fact.

The use of motors, in all sorts of shops, seems to have had a great impulse within the last few weeks, no less than 19 having been set in four weeks and a promise of as many more before '91.

There is much complaint of the unsteadiness of the incandescent light supplied by the two companies here. These fluctuations go on day and night and apparently the speed of the engines has nothing to do with it.

The Minneapolis-St. Paul Electric Line was opened a few days ago with cars every 10 minutes. The distance (10 miles) is at present covered in about an hour, but with the new motor the distance will be made in 30 minutes. The railroad companies plying between the two cities see ruin, as far as this traffic is concerned, staring them in the face, and rumor has it that they will soon drop the fares from 50 cents round trip to 25, and even at 20 cents they will be handicapped, as, by the transfer system, one may ride from any part of Minneapolis to any portion of St. Paul for 10 cents, or *vice versa*.

TELEPHONE NOTES.

The daily papers, in the absence of other important electrical news, are freely discussing the probability of war between the Western Union Telegraph Company and the Long Distance Telephone. These papers indulge in considerable speculation in this direction and predict that in 1896 the telephone company will be a formidable rival of the Western Union in the legitimate telegraph field. It is stated that the telephone company intends to use their wires for telegraphic purposes as well as for the telephone, and that both methods of communication will be carried on simultaneously over the same wires.

The new exchange building of the Chesapeake and Ohio Telephone Company in Baltimore is said to be the most complete in the entire country. The engineering work was done on plans gotten up by the American Telegraph and Telephone Company, better known as the "Long Distance Telephone," and the result is the best flexible underground plant to be found anywhere in the country. The system of drawing in and out is perfect and complete, and the telephone people are very proud of this monument to scientific skill. The capacity of the underground system is 10,000 wires, and the wires can be inserted and withdrawn with remarkable facility.

According to a recent statement of the Bell Telephone Company there was an increase of 33,684 telephones under rental during the eleven months ending November 20, 1890. The total number of telephones in use at that date was 478,425. At the same time, in 1889, there were 439,860 telephones under rental.

NEW COMPANIES INCORPORATED.

Electrical Machine Co., Chicago, Ill.; capital, $5,000; to manufacture electrical machines.

Love Electric Traction Co., Chicago, Ill.; manufacture of electrical appliances, etc.

Cambridge Accumulator Co., Saco, Me.; capital, $500,000; to manufacture electric accumulators, etc.

Simplex Motor Co., Portland, Me.; capital, $500,000; to manufacture electric motors for stationary and locomotive purposes.

Michigan Traction and Electric Co., Saginaw, Mich.; capital, $100,000; to manufacture street cars, etc.

Plainfield Gas and Electric Company, Plainfield, N. J.; capital; $175,000.

Troy Telephone and Telegraph Co., Troy, N. Y.; capital, $250,000; to construct a line from Troy to Albany and other places.

Lancaster Electric Light Co., Lancaster, O.; capital, $15,000.

ELECTRIC CONDUCTORS.

One of the most important details to be considered in connection with an electric light plant is the means to be adopted for transferring the energy from the generator to the lamp. In telegraphy it is a matter of secondary importance whether the line connecting the sending and the receiving stations measures 3,000 or 4,000 ohms in resistance, the number of primary cells employed for working the wire being simply varied according to this resistance. Consequently, unless a high speed system of working is to be adopted, good iron wire answers every purpose, for it is a fairly good conductor, it is mechanically strong, and it is cheap. For high speed working, copper is resorted to because the electro-magnetic inertia of iron is too great to permit the necessary rapidity of current alternation.

In electric lighting, copper is always employed for the conductor. The current to be carried is usually very strong or heavy, and it is imperative that the loss of energy due to the resistance of the conductor should be brought down to the lowest practicable limit. Were iron to be employed, it would be necessary to give it six times the sectional area of the copper to contain the same conductivity, and an iron wire or rod of such dimensions as it would be frequently necessary to employ would be too rigid for handling and bending. It would be necessary to make it in definite lengths and then to connect these lengths together at the place where they are to be used. But such a rod would also present very many additional difficulties in the way of insulation, and add considerably to the cost of that portion of the work. In fact, an insulated iron conductor would be considerably more expensive than one of copper offering the same resistance. The recently extended use of rapidly alternating currents is another reason against the employment of iron conductors.

The choice of materials for electrical conductors of any kind is really limited to the two metals above mentioned, viz., copper and iron, so that for electric lighting work we have no alternative but to use copper.

Now, as in overcoming the resistance of a conductor, electrical power is wasted, and as it costs money to develop electrical power, it is evident that in any commercial system such waste must be kept down to a minimum. This can be done by simply reducing the resistance; that is, by increasing the size of the conducting wires; but as this also is an expensive matter, care must be taken that the addition thus made to the expenditure in conductors is not so excessive as to more than counterbalance the cost of the power continually being saved. It has been laid down as a general rule, that, for the transmission of any given current, the size of the conductor most economical to employ is one offering such a resistance that the cost of the energy wasted per annum in heating the conductors, should be equal to the interest per annum on the original outlay upon them. Knowing the average current to be transmitted, it becomes easy to find the average electrical horse power wasted in a conductor of any given resistance; but the cost of developing a horse power depends upon many conditions, principally local, such as the cost of fuel, attendance, rental, repairs, prime cost, and efficiency of the plant. And with regard to the conductors themselves, it must be remembered that it is not merely a question of the quantity and price of the copper employed, but also of the insulation and laying.

ELECTRIC POWER IN ZINC.—If the battery is properly handled, the oxidation of one ton of zinc will produce 1,340 electrical horse-power hours of current, giving in glow lamps the light of 333,000 candles, and in arc lights 1,665,000 candles, which last is 55 times as much light as can be produced from one ton of coal, or 10,000 cubic feet of gas. It can then be wholly recovered as sulphate of zinc crystals by an extremely simple and inexpensive process; and these can again be converted, after oxidation, into metallic zinc, and used over and over again in the battery.

HEAT DEVELOPMENT.—The generation of heat by friction is coincident with that of electricity, and the heat continues to increase long after the electric development has attained its maximum. If the friction be sufficiently increased in the case of a solid body, as a metal, light is developed, the metal becoming incandescent. Thus, by the agency of friction, certain phenomena are produced, the first of which we call electricity, the second heat and the third light.

ELECTRO MAGNETS.*

ELECTRO-MAGNETS FOR USE WITH ALTERNATING CURRENTS.

When you are designing electro-magnets for use with alternating currents, it is necessary to make a change in one respect, namely, you must so laminate the iron that internal eddy-currents shall not occur; indeed, for all rapid acting electro-magnetic apparatus it is a good rule that the iron must not be solid. It is not usual with telegraphic instruments to laminate them by making up the core of bundles of iron plates or wire, but they are often made with tubular cores, that is to say, the cylindrical iron core is drilled with a hole down the middle, and the tube so formed is slit with a saw-cut to prevent the circulation of currents in the stance of the tube. Now when electro-magnets are to be employed with rapidly alternating currents, such as are used for electric lighting, the frequency of the alternations being usually about 100 periods per second, slitting the cores is insufficient to guard against eddy-currents; nothing short of completely laminating the cores is a satisfactory remedy. I have here, thanks to the Brush Electric Engineering Company, an electro-magnet of the special form that is used in the Brush arc lamp when required for the purpose of working in an alternating-current circuit. It has two bobbins that are screwed up against the top of an iron box at the head of the lamp. The iron slab serves as a kind of yoke to carry the magnetism across the top. There are no fixed cores in the bobbins, which are entered by the ends of a pair of yoke plungers. Now in the ordinary Brush lamp for use with a steady current, the plungers are simply two round pieces of iron tapped into a common yoke; but for alternate current working this constuction must not be used, and instead a U-shaped double plunger is used, made up of laminated iron, rivetted together. Of course it is no novelty to use a laminated core; that device, first used by Joule, and then by Cowper, has been repatented rather too often during the past fifty years to be considered as a recent invention.

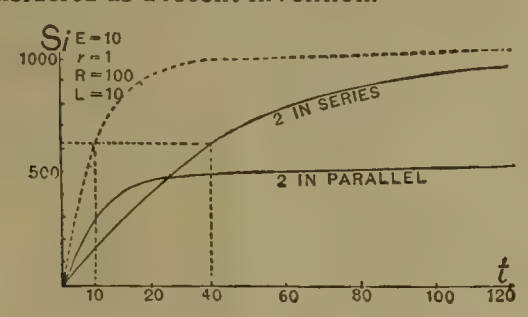


FIG. 1.—CURVES OF RISE OF CURRENT.

The alternate rapid reversals of the magnetism in the magnetic field of an electro-magnet, when excited by alternating electric currents, sets up eddy-currents in every piece of undivided metal within range. All frames, bobbin tubes, bobbin ends, and the like must be most carefully slit, otherwise they will overheat. If a domestic flat-iron is placed on the top of the poles of a properly laminated electro-magnet, supplied with alternating currents, the flat-iron is speedily heated up by the eddy-currents that are generated internally within it. The eddy-currents set up by induction in neighboring masses of metal, especially in good conducting metals, such as copper, give rise to many curious phenomena. For example, a copper disc or copper ring placed over the pole of a straight electro-magnet so excited is violently repelled. These remarkable phenomena have been recently investigated by Prof. Elihu Thomson, with whose beautiful and elaborate researches we have lately been made conversant in the pages of the technical journals. He rightly attributes many of the repulsion phenomena to the lag in phase of the alternating currents thus induced in the conducting metal. The electro-magnetic inertia, or self-inductive property of the electric circuit, causes the currents to rise and fall later in time than the electromotive forces by which they are occasioned. In all such cases the impedance which the circuit offers is made up of two things—resistance and inductance. Both these causes tend to diminish the amount of current that flows, and the inductance also tends to delay the flow.

* Abstract from Cantor Lecture delivered before the Society of Arts, London, by Prof. Silvanus P. Thompson.

ELECTRO-MAGNETS FOR QUICKEST ACTION.

I have already mentioned Hughes's researches on the form of electro-magnet best adapted for rapid signalling. I have also incidentally mentioned the fact that where rapidly varying currents are employed, the strength of the electric current that a given battery can yield is determined not so much by the resistance of the electric circuit, as by its electric inertia. It is not a very easy task to explain precisely what happens to an electric circuit when the current is turned on suddenly. The current does not suddenly rise to its full value, being retarded by inertia. The ordinary law of Ohm in its simple form no longer applies; one needs to apply that other law which bears the name of the law of Helmholtz, the use of which is to give us an expression, not for the final value of the current, but for its value at any short time, t, after the current has been turned on. The strength of the current after a lapse of a short time, t, cannot be calculated by the simple process of taking the electromotive force and dividing it by the resistance, as you would calculate steady currents.

In symbols, Helmholtz's law is:—

$$i_t = \frac{E}{R}\left(1 - e^{-\frac{R\,t}{L}}\right)$$

In this formula i_t means the strength of the current after the lapse of a short time t; E is the electromotive force; R the resistance of the whole circuit; L its coefficient of self-induction; and e the number 2.7183, which is the base of the Napierian logarithms. Let us look at this formula; in its general form it resembles Ohm's law, but with a new factor, namely, the expression contained within the brackets. This factor is necessarily a fractional quantity, for it consists of unity less a certain negative exponential, which we will presently further consider. If the factor within the brackets is a quantity less than unity, that signifies that i_t will be less than E÷R. Now, the exponential of negative sign, and with negative fractional index, is rather a troublesome thing to deal with in a popular lecture. Our best way is to calculate some values, and then plot it out as a curve. When once you have got into the form of a curve, you can begin to think about it, for the curve gives you a mental picture of the facts that the long formula expresses in the abstract. Accordingly we will take the following case. Let E=10 volts; R=1 ohm; and let us take a relatively large self-induction, so as to exaggerate the effect; say let L=10 quads. This gives us the following:—

t (sec.)	$+\frac{R\,t}{L}$ e	i_t
0	1.	0.
1	1.105	0.950
2	1.221	1.810
5	1.649	3.936
10	2.718	6.343
20	7.389	8.646
30	20.08	9.501
60	403.4	9.975
120	162800.0	9.999

In this case the value of the steady current, as calculated by Ohm's law, is 10 amperes; but Helmholtz's law shows us that with the great self-induction, which we have assumed to be present, the current, even at the end of thirty seconds, has only risen up to within 95 per cent. of its final value; and only at the end of two minutes has practically attained full strength. These values are set out in the highest curve in Fig. 1, in which, however, the further supposition is made out that the number of spirals S in the coils of the electro-magnet is 100, so that when the current attains its full value of 10 amperes, the full magnetizing power will be Si=1000. It will be noticed that the curve rises from zero at first steeply and nearly in a straight line, then bends over, and then becomes nearly straight again, as it gradually rises to its limiting value. The first part of the curve—that relating to the strength of the current after *very small* interval of time—is the period within which the strength of the current is governed by inertia (*i.e.*, the self-induction) rather than by resistance. In reality the current is not governed either by the self-induction or by the resistance alone but by the ratio of the two. This ratio is sometimes called the "time constant" of the circuit, for it represents the *time* which the current takes in that circuit to rise to a definite fraction of its final value. This definite fraction is the fraction $\frac{e-1}{e}$; or in decimals, 0.634. All curves of rise-of-current are alike in general shape—they differ only in scale; that is to say, they differ only in the height to which they will ultimately rise, and in the time they will take to attain this fraction of their final value.

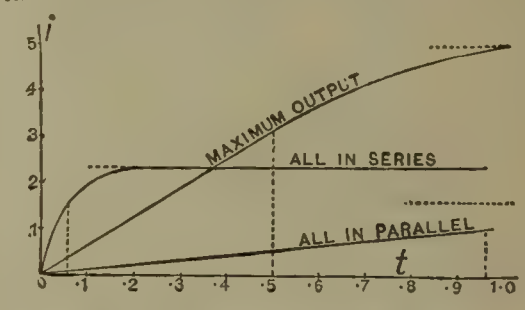


FIG. 2.—CURVES OF RISE OF CURRENT WITH DIFFERENT GROUPINGS OF BATTERIES.

Example (1).—Suppose E=10; R=400 ohms; L=8. The final value of the current will be 0.025 ampere, or 25 milliamperes. Then the time constant will be 8÷400=$\frac{1}{50}$ sec.

Example (2).—The P. O. standard "A" relay has R=400 ohms; L=3.25. It works with 0.5 milliampere current, and therefore will work with 5 Daniell cells through a line of 9,600 ohms. Under these circumstances, the time-constant of the instrument on short circuit is 0.0081 sec.

It will be noted that the time-constant of a circuit can be reduced either by diminishing the self-induction or by increasing the resistance. In fig. 1 the position of the time-constant for the top curve is shown by the vertical dotted line at 10 seconds. The current will take 10 seconds to rise to 0.634 of its final value. This retardation of the rise of current is simply due to the presence of coils and electro-magnets in the circuit; the current as it grows being retarded because it has to create magnetic fields in these coils and so sets up opposing electromotive forces that prevent it from growing all at once to its full strength. Many electricians, unacquainted with Helmholtz' law, have been in the habit of accounting for this by saying that there is a lag in the iron of the electro-magnet cores. They tell you that an iron core cannot be magnetized suddenly; that it takes time to acquire its magnetism. They think it is one of the properties of iron. But we know that the only true time-lag in the magnetization of iron—that which is properly "viscous hysteresis"—does not amount to any great percentage of the whole amount of magnetization, takes comparatively a long time to show itself, and cannot therefore be the cause of retardation which we are considering. There are also electricians who will tell you that when magnetization is suddenly evoked in an iron bar there are induction currents set up in the iron which oppose and delay its magnetization. That they oppose the magnetization is perfectly true, but when you carefully laminate the iron so as to eliminate eddy-

currents, you will find, strangely enough, that the magnetism rises still more slowly to its final value, for, by laminating the iron you have virtually increased the self-inductive action and increased the time-constant of the circuit, so that the currents rise more slowly than before. The lag is not in the iron, but in the magnetizing current, and the current being retarded, the magnetization is, of course, retarded also.

CONNECTING COILS FOR QUICKEST ACTION.

Now let us apply these most important, though rather intricate, considerations to the practical problems of the quick working of the electro-magnet. Take the case of an electro-magnet forming some part of the receiving apparatus of a telegraph system, in which it is desired to secure very rapid working. Suppose the two coils that are wound upon the horseshoe core are connected together in series. The coefficient of self-induction for these two is four times as great as that of either separately; coefficients of self-induction being proportional to the square of the number of turns of wire that surround a given core. Now if the two coils, instead of being put in series, are put in parallel, the coefficient of self-induction will be reduced to the same value as if there were only one coil, because half the line current (which is practically unaltered) will go through each coil. Hence the time constant of the circuit when the coils are in parallel will be a quarter of that which it is when the coils are in series; on the other hand, for a given line-current the final magnetizing power of the two coils in parallel is only half what it would be with the coil in series. The two lower curves in fig. 1 illustrates this, from which it is at once plain that the magnetizing power for very brief currents is greater when the two coils are put in parallel with one another than when they are joined in series.

Now this circumstance has been known for some time to telegraph engineers. It has been patented several times over. It has formed the theme of scientific papers which have been read both in France and in England. The explanation generally given of the advantage of uniting the coils in parallel is, I think, fallacious namely, that the "extra currents" (*i.e.*, currents due to self-induction), set up in the two coils are induced in such directions as tend to help one another when the coils are in series, and to neutralize one another when they are in parallel. It is a fallacy, because in neither case do they neutralize one another. Whichever way the current flows to magnetism, it is opposed in the coils while the current is rising, and helped in the coil while the current is falling, by the so-called extra-currents. If the current is rising in both coils at the same moment, then, whether the coils are in series or in parallel, the effect of self-induction is to retard the rise of the current. The advantage of parallel grouping is simply that it reduces the time-constant.

BATTERY GROUPING FOR QUICKEST ACTION.

One may consider the question of grouping the battery cells from the same point of view. How does the need for rapid working, and the question of time constant, affect the best mode of grouping the battery cells? The amateur's rule which tells you to so arrange your battery that its internal resistance should be equal to the external resistance, gives you a result wholly wrong for rapid working. The supposed best arrangement will not give you (at the expense even of economy) the best result that might be got out of the given number of cells. Let us take an example and calculate it out and place the results graphically before our eyes in the form of curves. Suppose the line and electro-magnet have together a resistance of 6 ohms, and that we have 24 small Daniell's cells, each of electromotive force, say, one volt, and of internal resistance, 4 ohms. Also let the coefficient of self-induction of the electro-magnet and circuit be 6 quadrants. When all the cells are in series the resistance of the battery will be 96 ohms, the total resistance of the circuit will be 102 ohms, and the full value of the current 0.235 ampere. When all the cells are in parallel the resistance of the battery will be 0.133 ohm, the total resistance 6.133 ohms, and the full value of the current 0.162 ampere. According to the amateur rule of grouping cells so that internal resistance equals external, we must arrange the cells in four parallels, each having 6 cells in series, so that the internal resistance of the battery will be 6 ohms, total resistance of circuit 12 ohms, full value of current 0.5 ampere. Now the corresponding time constants of the circuit in the three cases (calculated by dividing the co-efficient of self-induction by the total resistance) will be respectively—in series, 0.06 sec.; in parallel, 0.96 sec.; grouped for maximum steady current, 0.5 sec. From these data we may now draw the three curves, as in Fig. 2, wherin the abscissæ are the values of time in seconds, and the ordinates the current. The faint vertical dotted lines mark the time constants in the three cases. It will be seen that when rapid working is required the magnetizing current will rise, during short intervals of time, more rapidly if all the cells are put in series than it will do if the cells are grouped according to the amateur rule.

When they are all put in series, so that the battery has a much greater resistance than the rest of the circuit, the current rises much more rapidly, because of the smallness of the time constant, although it never attains the same ultimate maximum as when grouped in the other way. That is to say, if there is self-induction as well as resistance in the circuit, the amateur rule does not tell you the best way of arranging the battery. There is another mode of regarding the matter which is helpful. Self-induction, while the current is growing, acts as if there were a sort of spurious addition to the resistance of the circuit; and while the current is dying away it acts of course in the other way, as if there were a subtraction from the resistance. Therefore you ought to arrange the battery so that the internal resistance is equal to the real resistance of the circuit, plus the spurious resistance during that time. But how much is the spurious resistance during that time? It is a resistance proportional to the time that has elapsed since the current was turned on. So then it comes to a question of the length of time for which you want to work it. What fraction of a second do you require your signal to be given in? What is the rate of the vibrator of your electric bell? Suppose you have settled that point, and that the short time during which the current is required to rise is called t; then the apparent resistance at time t after the current is turned on is given by the formula:—

$$R_t = R \times e^{\frac{R}{L}t} \div \left(e^{\frac{R}{L}} - 1 \right)$$

SHORT CORES *versus* LONG CORES.

In considering the forms that are best for rapid action, it ought to be mentioned that the effects of hysteresis in retarding changes in the magnetization of iron cores are much more noticeable in the case of nearly-closed magnetic circuits than in short pieces. Electro-magnets with iron armatures in contact across their poles will retain, after the current has been cut off, a very large part of their magnetism, even if the cores be of the softest of iron; but so soon as the armature is wrenched off the magnetism disappears. An air-gap in a magnetic circuit always tends to hasten demagnetizing. A magnetic circuit composed of a long air-path and a short iron-path demagnetizes itself much more rapidly than one composed of a short air-path and a long iron-path. In long pieces of iron the mutual action of the various parts tends to keep in them any magnetization that they may possess; hence they are less readily demagnetized. In short pieces, where these mutual actions are feeble or almost absent, the magnetization is less stable, and disappears almost instantly on the cessation of the magnetizing forces. Short bits and small spheres of iron have no "magnetic memory." Hence the cause of the commonly received opinion amongst telegraph engineers that for rapid work electro-magnets must have short cores. As we have seen, the only reason for employing long cores is to afford the requisite length for winding the wire which is necessary for carrying the needful circulation current to force the magnetism across the air-gaps. If, for the sake of rapidity of action, length has to be sacrificed, then the coils must be heaped up more thickly on the short cores. The electro-magnets in American patterns of telegraphic apparatus usually have shorter cores, and a relatively greater thickness of winding upon them, than those of European patterns.

ILLUMINATION BY ARTIFICIAL LIGHTS.*

BY S. ALFRED VARLEY.

The conclusion which was arrived at by Sir C. G. Stokes, Lord Rayleigh and Sir William Thomson as the result of carefully-conducted observations on the respective penetrating powers of oil lights, gas lights, and the electric light through hazy atmospheres, is that the electric light, as exhibited at the South Foreland, has greater penetrating power than the light produced from burning oil or gas.

The purpose of this article is not to criticise in any way the efficiency of the electric light for lighthouse purposes, but to direct attention to certain matters bearing on the subject of general illumination. The object of all artificial illumination is to enable us to see in the absence of sunlight, but the part played by our optical organ seems to the writer to have been very generally overlooked in public discussions on the efficiency of the different systems of artificial illumination.

The amount of light which the earth receives at any given spot is much greater in the summer than in the winter; the light at mid-day is also greater than, say, an hour before sunset; but we nevertheless see practically as well on a bright winter's day as we do in the summer, and we see in the afternoon of a summer's day equally as well as we do at mid-day, the reason being that the pupil of the eye automatically adjusts itself to the amount of light received.

Now, when arc lights are employed for the purpose of general illumination, the brilliancy of the light causes the pupil of the eye to contract, and consequently their actual efficiency is really very much less than that indicated by a photometer.

It would be very interesting if a series of experiments were carried out to determine the penetrating power of quantity, as distinguished from the quality of the light.

The oldest living electrician, as long as he can remember, has been familiar with the terms, quantity, and intensity as applied to electricity, and he has clearly grasped the relationship of the one to the other in electrical phenomena; but the same can scarcely be said of the influence which the quantity of matter in a state of combustion has on the penetrating power of luminous rays through the atmosphere, apart from the actual intensity of the combustion itself.

The penetrating capabilities of a large quantity of burning matter of low intensity were forcibly brought home to the writer in his daily journeys as a schoolboy over Blackfriars Bridge. He was so much impressed with the apparent brilliancy of the lights on the coal-lighters as seen from the bridge on a winter's evening, that he went down to the river bank to ascertain their source, and to his great surprise he found what appeared to be very brilliant lights when viewed from a distance were only smoky coal fires burning in iron baskets.

The apparent brightness of open coal fires, when viewed from a distance in a dark night, is

*London *Electrical Review*.

undoubtedly in no small degree to be attributed to the behavior of the optical organ itself. The pupil of the eye under such circumstances is very fully dilated, and consequently receives a large pencil of rays, and these rays being of low intensity, they do not irritate the eye and cause the pupil to contract. Now, it is within our experience that a large number of rays of low intensity entering the eye produces a similar effect on the retina, as a smaller number of light rays of higher intensity, and if the fact be taken into consideration that luminous rays of low refrangibility, such as those which a coal fire burning in the open air produces in abundance, are not nearly so much obstructed as rays of light of higher refrangibility (especially when the atmosphere is hazy), then the apparent superior brilliancy to a coal fire as seen from a distance over that of a gas flame, or even an electric light, is easily accounted for.

The writer well remembers his attention being directed to a very brilliant light in the distance in the middle of a high road, which impressed the eye as being very much more brilliant than the gas lamps, and he found the light proceeded from the turnpike man's fire grate, an ordinary coal fire, which was not a very brilliant one.

In the year 1860, or thereabouts, a company, actively promoted by the late Sir Charles Bright, was formed for lighting the streets, &c., with the oxyhydrogen limelight, and the company lighted for a short time, experimentally, old Westminster Bridge. So far as general illumination was concerned, the system proved to be a complete failure, the impression produced being that the bridge was dotted with a number of bright and pretty stars, but that the illumination of the bridge was being affected by the ordinary gas lights.

In the year 1874, speaking from memory, the late Robert Sabine, Mr. Gatehouse, and the writer were experimenting at the British Telegraph Company's works with a Gramme machine of the—at that time—largest size manufactured. The electric lamp was in a glass room on the top of the building looking towards the south, and the day was fine, but the sky was covered with light clouds through which the sun shone.

We had a long wedge of semi-opaque neutral tinted glass for looking at the arc with, the surfaces of the wedge were ground flat and polished, the thinner end being a knife-edge and the thicker end being about half an inch thick. When looking through the wedge at about two inches from the thinner end the electric light was just visible to the eye, and a little higher up it became wholly obscured. Now the writer found to his surprise that when he looked at the sun through this wedge the sun could be seen through a considerably greater thickness of the semi-opaque glass than the electric light was capable of penetrating. It occurred to him afterwards that the wedge was possibly largely composed of opaque matter, and that the light passed through what was practically a number of fine pin holes, and that, as when looking at the arc, the glass wedge was not more than 7 or 8 inches from it, the greater percentage of the rays struck the glass at an angle and passed consequently through a greater thickness than they would have done if the rays had been parallel as was the case when looking at the sun. At the same time, it seems somewhat remarkable that the sun's rays after passing through 95,000,000 miles of space, and then through clouds and our atmosphere, should have greater power to penetrate semi-opaque matter than an electric arc light which was only a few inches from the glass wedge.

Everyone who has witnessed a great fire must have been impressed with its powers to illuminate. The writer had the good fortune to see the great fire which occurred in Tooley street, now a good many years ago. The dome of St. Paul's, the Monument, and the buildings on the Middlesex side of the river were lighted up magnificently, owing to the quantity of light as distinguished from the intensity of the combustion.

Now the writer would very much like to see systematic experiments carried out to ascertain the respective penetrating powers of coal fires, gas lights, and the electric light through hazy atmospheres, and he would not be surprised if the results obtained from such experiments went to show that, under special conditions, it would be more economical for the purpose of illuminating distant objects, for a given amount of coal to be burned in an open fire grate than to burn a similar quantity in a steam engine, and from the energy developed, produce an electric light.

EASTERN NOTES.

BRANCH OFFICE OF THE ELECTRIC AGE,
74 FEDERAL STREET,
BOSTON, Dec. 18, 1890.

Prominent Maine business men are planning to build an electric road from Thomaston through Rockland to Camden. There is opposition to the road in Thomaston and Camden and it is especially strong in the latter place.

The electric light station which is now being erected in Holyoke, Mass., by the Holyoke Water Power Co., will be equipped with four water wheels of 250-horse power each, two 400-horse power engines and a reserve force of another 350-horse power engine. There will be boilers to the amount of 1,500-horsepower.

The Concord, N. H., Gas and Electric Light Company have just put in a 300-horse power boiler feed heater at their station.

A committee from the Manchester, N. H., Board of Trade have examined the plant and business of a Boston electric supply manufactory which proposes to locate in that city if sufficient inducements are offered.

The New Haven (Conn.) Electric Company are erecting a large brick chimney at their plant which, when complete, will be 125 feet high and will cost about $7,000. The company will, in connection with the new chimney, make various other changes and improvements.

The directors of the Northern Electric Company have decided to apply to the Connecticut State Legislature, this winter, for a charter under which they can organize a separate company for the purpose of lighting the streets of Manchester, furnishing electric power, and, if deemed advisable, building and operating a tramway between Manchester and South Manchester. The incorporators of the new company are N. T. Pulsifer, M. S. Chapman, H. G. Cheney and Robert Cheney.

At a meeting of the Salem board of aldermen, held last Thursday evening, the Naumkeag Street Railroad Company was refused permission to lay a double track to the Willows. Permission was also refused the Essex Electric to extend its tracks to the Willows.

The Electric Light Company at Worcester, Mass., has established itself in its new quarters. In place of the old direct current the alternating current system is now in use for all incandescent lamps throughout the city. The new plant is supplied with 19 dynamos—17 for arc lights and two for incandescents. Everything is now in good running order.

The Eastern Electrical Supply and Construction Co. have made arrangements to handle the goods of Alexander, Barney & Chapin, of New York.

The Lynn Brass Foundry has just made for the Thomson Electric Welding Company, two copper castings supposed to be the largest ever made. They weigh 1,500 pounds, and are to be used in the welding machines being erected for the United States government for the navy yards.

W. F. Sherman, a well-known inventor in connection with rapid transit on street railways, died at his home in Lowell last Tuesday morning. He was the incorporator of the Sherman Electric Railway, of Chicago, the Denver Mine Railway, the Overhead Electric Power Co., the Insulator Clutch and Transmitter Co., and the Non-Friction Axle Co. He leaves a widow and three sons.

The Thomson-Houston Electric Company is experiencing difficulty because of the scarcity of pattern makers. The company has so much business on hand that it is having to look for pattern makers in every direction.

The East Chattanooga (Tenn.) Land Company has given twenty-five acres of land to the local Thomson-Houston Electric Light and Power Company, and the latter will erect a large and handsome station on it forthwith.

The length of the Essex Electric road, running from Salem to Peabody, Mass., is four and four-tenths of a mile and has cost $13,627 per mile.

Fourteen of the Robinson radial car bodies which will be used by the West End Railway Company are completed, and thirty-five more are well under way. These bodies are twenty-five feet in length, and will seat comfortably sixteen passengers on each side. The long Jones cars are being wired and turned out of the shops very fast. These cars are a great improvement over the ordinary motor car, as there is no up and down motion, and they glide along smoothly and easily. By means of these cars the tow car will be done away with entirely.

At a meeting of the Boston Board of Aldermen last Monday, the Boston Electric Light Company was granted permission to erect thirty poles, of the "Providence" pattern, in the streets of Boston. The petition of the same company for a license to erect and use stationary steam engines of 600 horse power in a building to be erected at 853–857 Albany street was laid over until the next meeting, in order to give the aldermen an opportunity to visit the proposed location. This was made necessary by the remonstrance of some fifty-two people, who thought the establishment of a station at that point would injure the surrounding property.

W. J. P.

TRADE NOTES.

The changes which the quarters of the Empire City Electrical Company are undergoing will make this establishment the most complete of its kind in the city. The company will occupy the premises Nos. 15 and 17 Dey street. The selling department will be on the ground floor of No. 15, and No. 17 will be devoted exclusively to offices. The two departments are connected by a large archway cut through the partition. The various offices in No. 17 are fitted up with handsome oak railings and partitions. The panels of the latter consist of frosted glass, and altogether the interior finish is most pleasing. The walls are very tastily papered, and electric lights will, of course, illuminate the entire establishment. The basements of the two buildings are connected in the same manner as are the two stores, and will be devoted to the storage and shipping of goods. The cellar, which is below the basement, will be used for storage. All the various departments are connected with each other by telephone, which method is vastly superior to speaking tubes as a means of communication between different parts of a building. The extension of their quarters will greatly facilitate the handling of the large stocks of goods the company keeps on hand, and will enable them to be better able to fill their orders with greater despatch.

Dr. Aron's electricity meter received a gold medal at this year's Exhibition at the Palais de l'Industrie, Paris.

NDUCTANCE AND ITS PROPOSED UNIT, THE HENRY.*

The development of the discovery of electro-agnetic induction has practically created ectrical engineering, for it is to machinery perating by electro-magnetic induction that e owe nearly every branch of electrical in-ıstry except, perhaps, telegraphy, the fore-nner of all: and the condition of modern ectrical engineering is such that the units and menclature relating to steady currents and rmanent magnets is insufficient for practical quirements, and the conditions developed by riable currents and magnets demand the es-blishment of engineering practical units for e purpose of convenience in expression and mputation.

Foremost among these required units is that inductance, or as it is commonly called the co-ficient of inductance. This inductance is a operty fully as essential to every electric con-ıcting circuit as resistance and electro static pacity, and the inductance of a circuit when nveying variable currents is often a far more portant factor in regulating the flow than the mic resistance. In fact we know that Ohm's w does not apply to a circuit so long as the rrent is unsteady, unless the inductance of the rcuit or the counter electro-motive force it in-lves be introduced into the expression.

In conformity with the conventional and so-lled absolute units of electro-magnetism, an ductance is a length and theoretically can al-ays be computed from the geometrical rela-ons of a circuit; that is to say, if the distance each point from all other points of a circuit measured, or inferred, in inches or centi-etres, the inductance of the circuit will be me definite number of inches or centimetres, pable of being determined by a possible if not convenient process of summation. If the cir-it, however, is associated with iron or other agnetizable matter, then the magnetic permea-ility of the environment will enter the terms summation as a multiplier. In the absolute ntimetre-gramme second system of units, in-ctance will be necessarily expressed in centi-etres, and the centimetre is thus the natural entific unit, although unsuited to the require-ents of electrical engineering.

The induction of a circuit or portion of a cir-it, is the ratio between the total induction rough it to the current producing it. Thus ring a simple helix of five turns carrying a rrent of two units, and assuming that 1,000 es of force† passed through the central turn, which owing to leakage, only 900 thread the xt adjacent on each side, and again only 800 rough the end turns, there would be 800+900 1,000+900+800 or 4,400 linkages of lines th the wire, and this being with 2 units of cur-nt there would be 2,200 linkages with unit rrent. and consequently the self inductance of e helix would be 2,200 centimetres.

The fact that such helices are used in galva-meters, and that the magnetic force at any int within them is admitted to be proportional the strength of the traversing current, renders evident that had the current in this case been e unit, 2,200 lines linked with the coil would tually have been produced. Supposing, how-er, that the helix had been wound upon an n core, the total number of linkages with the me two units of current would have been eatly increased, perhaps twenty-fold or to ,000 and the inductance then by the same rule ould be 44,000. In this case one unit of cur-nt would not in all probability reduce the mber of linkages to 44,000, the exact number ould depend upon the characteristic curve of the n core, and the degree of saturation, so that would now be necessary to state the conditions of the measurement along with the result, in order to convey a clear and definite meaning.

It appears anomalous at first sight to state the above inductances in centimetres when they are derived from the number of lines of force, but it is to be remembered that the total number of linkages is divided in each case not by a mere numeric, but by a current, and this question can be proved to be a length in the existing system of dimensions.

In the same way the mutual inductance of two conductors is the ratio of the total induction through one of them to the strength of current in the other producing it. Suppose two coils of copper wire to be held in free space far from iron, and let one of them be traversed by a steady current of say four units. Of all the lines of force issuing from this coil, suppose 500 pass through the other coil For simplicity, imagine the second or recipient coil to be composed of eight turns so disposed that the 500 lines pass through all in succession. There will then be 4,000 linkages of lines with that coil, and the mutual inductance of the two will be 4,000 ÷ 4 or 1,000 centimetres. It is interesting to notice that the same result would be reached if the second coil had the current and the linkages were counted in the first, the pair being mutually conjugate in this respect provided they reside in a medium of constant permeability.

Thus far we have only considered the centimetre or absolute unit, whose unfitness for practical use is evident, since the smallest inductance that is at present known to engineering amounts to several thousand, while the average values met with are counted in millions of centimetres. It would of course be possible to name suitable units from the metrical system of lengths, but it is the proposal of this Institute to adopt the word Henry as the practical unit, in honor of the man, who beyond all doubt, was among the foremost to extend the knowledge thus far possessed of self and mutual inductance.

If the selection of the practical unit were entirely free and subservient only to practical requirements, so that its magnitude should express ordinary values in digits with fewest decimals on the one hand, or large numbers on the other, there seems most reason to believe that the thousandth of the earth-quadrant or myriametre would be the most eligible.

Proposed Name	Length	Number of Centimetres	Unit
Henry.....	Earth Quadrant	1,000,000,000	Practical Unit
		100,000,000	
		10,000,000	
Millihenry....	Myriametre	1,000,000	
	Kilometre	100,000	
	Hectometre	10,000	
Microhenry..	Decametre	1,000	
	Metre	100	
	Decimetre	10	
	Centimetre	1	Absolute Unit

Of course large iron machines employing many turns of wire linked by dense magnetic fields, would have inductances more appropriately expressed in earth quadrants, which might then be termed the Kilo-henry, just as we now have the Watt, and Kilowatt but there is one restriction which makes such a selection undesirable, and that is the hitherto unbroken system of practical units itself. This practical system is a sub scheme of the great international C. G. S. system and especially planned for adaptability to practical requirements. It is derived from that parent system by the substitution for the unit of length, one thousand million centimetres in place of one centimetre, and for the unit of mass an impalpable entity definite only in thought, the one-hundred millionth of a milligramme in place of the gramme. By this substitution in the C. G. S. electromagnetic units, we obtain the hitherto unbroken system of the volt, ohm, ampere, coulomb, joule, watt and farad. Even these units are not always the most convenient, witness for example the microfarad in common use, whose prefix is maintained simply in deference to the harmony of the system, for the farad is a capacity that exists only in imagination; the capacity of the earth itself being only about 700 micro-farads, and of the sun, or rather a sphere having the apparent dimensions of the sun, being only about 76,000 microfarads. On the other hand a proposition has lately been made to infringe the system by making the volt, the ampere and the watt, ten times their present values, on the ground of practical convenience. However, at the present time it would surely be unadvisable to attempt the precedent of infringing a system that has hitherto been supported by time, custom, and international Congress.

In this practical system, the unit of inductance must be 1,000 million centimetres. That is an earth-quadrant or the distance from the pole to the equator, measured on the meridian of Paris. Strictly speaking it is only the quadrant of the French standard earth, which is about one-hundredth of one per cent. shorter than the acknowledged actual earth-quadrant, according to the best determinations, but the fact of the latter being 10,001 kilometres instead of 10,000, is a matter of precision in definition only and in no way affects the practical unit.

The practical range of inductances is second only to that of resistances, and the latter we know from a few microhms up to thousands of megohms. The smallest inductances are those of Hertz resonators which descend to the order of metres. Excluding these, however, the smallest are perhaps met with in measuring instruments intended to have negligibly small inductance, such as doubly wound resistance coils, Cardew voltmeters, and the like. These descend to the order of decametres, and can generally be expressed as such without prefixing decimal points. It is evident that the term microhenry would suitably apply to their designation. At the other end of the scale we find large induction machines linking dense fields with many turns of wire, and reaching inductances of hundreds or even thousands of henrys. Intermediate between these limits, there exists a large class of circuits having many turns but little iron, or clad in iron with few turns of wire, and these seem to be expressed by the term millihenry, equivalent to the myriametre.

With the object of setting forth the advantages to be derived from the use of this nomenclature, it may be permissible to adopt it provisionally in describing the measurements that follow. These measurements have been made on different types of apparatus at different times and by different methods, so that they represent mean values from several observations in many cases, but allowance must be made for the variations of standard and type.

In telegraphy, the inductance of an ordinary Western Union 140-ohm relay is about three henrys with the armature drawn well back, and nine henrys with the armature pressed against the poles, in the latter case, of course, the magnetic reluctance of the iron circuit is a minimum, and the same current in the coils causes three times as many lines to circulate through the iron. At the position of the armature in ordinary adjustment the inductance is about five henrys.

The inductance of an ordinary standard *low* relay is from 200 to 500 millihenrys, according to the position of the armature relatively to the poles.

The inductance of an ordinary sounder is similarly from 25 to 50 millihenrys. These inductances are the values obtained with only a few milliamperes through the coils, and since the path of the induction is largely through iron, the inductance varies with the strength of the current used. Practically, however, the variation is small within the range of current at which instruments usually operate.

SUBMARINE TELEGRAPHY.

The inductance of a mirror speaking galvanometer of the ordinary type having 2,250 ohms was found to be 3.6 henrys.

TELEPHONY.

The inductances met with in the ordinary long

Abstract from paper read by A. E. Kennelly before the merican Institute of Electrical Engineers, December 19th, o.

† The term line of force is here used in the sense of a line of ; the distinction being necessary when the lines pass ough iron.

distance telephone apparatus are as follows :

The call bell 80 ohms and 1.4 henrys.

The magneto armature 550 ohms, and from 2.7 henrys with the plane of the coil in the line joining the poles, to 7.3 henrys when the iron core joins the poles, the plane of the coil being then at right angles to the magnetic flux.

The induction coil primary 0.28 ohm and 3.5 millihenrys.

Secondary 164 ohms, and 734 millihenrys.

The mutual inductance between the coils 60 millihenrys.

The Bell telephone receiver 75 ohms and from 75 to 100 millihenrys. The removal of the diaphragm from an ordinary telephone of this type reduces the reluctance about 35 per cent. All these inductances are to currents of a few milliamperes only. As regards the inductance of aerial line wires, it is to be regretted that measurements are not yet forthcoming, and indeed the experimental determination is attended with some difficulty, owing to static capacity and imperfect insulation. In the absence of direct measurements, theory indicates that the inductance of overhead copper wires depends upon the elevation above the ground as well as upon the diameter. In the case of iron wires as used in telegraphy, the permeability of the iron enters as an additional factor. The following tables of inductance for copper wires, is based upon a formula first given by Clerk Maxwell.* It is to be hoped that experimental evidence may shortly be collected corroborating these results :

TABLE OF INDUCTANCES OF COPPER ÆRIAL LINE WIRE, PER KILOMETRE AND MILE, FOR DIFFERENT DIAMETERS, AND ELEVATIONS ABOVE GROUND.

Diameter of Wire.		Elevation above ground 400 cms. or 13.1 feet.		Elevation above ground 700 cms. or 23. feet.		Elevation above ground 1000 cms. or 32.8 feet.		Elevation above ground 1300 cms. or 42.7 feet.	
		Millihenrys or Myriametres.		Millihenrys or Myriametres.		Millihenrys or Myriametres.		Millihenrys or Myriametres.	
Centimetre	Inches	Per Kilometre	Per Mile	Per Kilometre	Per Mile	Per Kilometre	Per Mile	Per Kilometre	Per Mile
0.10	0.039	1 986	3.196	2.109	3.393	2.170	3.493	2.222	3.576
0.20	0.079	1.848	2.974	1.960	3.154	2.031	3.268	2.083	3.352
0.30	0.118	1.766	2.842	1.878	3.022	1.950	3.138	2.002	3.222
0.40	0.158	1.709	2.750	1.821	2.930	1.892	3.045	1.945	3.130
0.50	0.197	1.664	2.678	1.776	2.858	1.847	2.973	1.900	3.058
0.60	0.236	1.628	2.621	1.740	2.800	1.811	2.914	1.863	2.998
0.70	0.276	1.596	2.569	1.709	2.750	1.780	2.865	1.833	2.950
0.80	0.315	1.570	2.527	1.682	2.706	1.754	2.823	1.806	2.906
0.90	0.354	1.547	2.489	1.659	2.669	1.730	2.785	1.783	2.870
1.00	0.394	1.526	2.456	1.638	2.635	1.709	2.750	1.761	2.834

The inductance of iron wires, in the absence of measurements, is almost too doubtful to justify calculation, being perhaps 10 times more than the inductance of copper wires under similar conditions. The difficulty in their case lies in assigning the proper value of permeability.

ELECTRIC LIGHT AND POWER.

Dynamos and dynamo-electric machinery are of course generally characterized by large inductances.

The inductance of the field magnets of a dynamo may have any value depending on the size and voltage of the machine from one henry up to 900 henrys.

The inductance of an armature may similarly vary from 20 millihenrys up to 50 henrys between brushes. One millihenry is a fair average value of the inductance of one section of an armature. Armature inductances depend not only on the strength of the measuring current, but also upon the strength of the field, and whatever influences the permeability of the core.

The inductance of an alternating transformer varies from a primary of 400 millihenrys, a secondary of one millihenry and mutually 20 millihenrys with a transformation ratio of 20, up to corresponding values perhaps one hundred times as great.

APPARATUS. THE INDUCTANCE OF RUHMKORFF COILS.

The smallest medical coil in ordinary use has five millihenrys in its primary, 100 millihenrys in its secondary, and 20 millihenrys mutually between them.

A large induction coil, 19 inches long and eight inches in diameter, has 0.145 ohms and 13 millihenrys in its primary, 30,600 ohms and 2,000 henrys (by two concordant methods of measurement) in its secondary, and 163 henrys mutually between them.

The inductance of a mirror galvanometer may vary from a few millihenrys up to 10 or more henrys according to its resistance. Two henrys is a fair average for an astatic mirror galvanometer of 5,000 ohms.

An ordinary electric bell of 2.5 ohms resistance was found to have an inductance of 12 millihenrys.

There is one point in connection with the self and mutual inductance of induction coils and transformers, that deserves attention owing to the confusion that occasionally arises concerning it. It may be, perhaps, best represented by a numerical example. Let a closed Faraday ring of iron 100 centimetres in mean circumference and 20 square centimetres in uniform cross section, be closely wound with a primary coil of 2,500 turns in one layer, followed by a secondary coil of 7,500 turns also in one layer. If now two amperes be maintained steadily through the primary, the magnetic force in the iron will be $4\pi/10$ times the ampere turns per centimetre of the iron circuit or $4\pi/10 \times 2 \times 2500 \div 100$ or 62.85. The permeability of wrought iron at this force being, say 250, the induction developed per square centimetre will be 250×62.85 or 15,713 lines, and the total induction enclosed by the primary coil, neglecting the space occupied by the wire itself will be $20 \times 15{,}713$ or 314,250 lines which traverse every turn of both windings. The linkages with the primary will be $2500 \times 314{,}250$, or in round numbers 786,000,000 and referred to one absolute unit of current (ten amperes), five times this number, or an inductance of 39.30 million centimetres, that is, 3 93 henrys. Similarly the linkages of these lines with the secondary will be 2,358 millions, and for ten amperes of primary current 11,790 millions of centimetres mutual inductance or 11.79 henrys. Next suppose the primary current interrupted, and a current steadily established in the secondary sufficient to produce the same magnetic force in the iron, thus avoiding the complication of a changing permeability. As the secondary has three times as many turns, the current effecting this will be two-thirds of one ampere. The total induction through the iron will now be the same as before and therefore the linkages will be equally numerous. The self-inductance of the secondary will be $2{,}358{,}000{,}000 \div \frac{2}{3}$, or 35,370,000,000 centimetres, that is 35.37 henrys. The mutual inductance will similarly be $786{,}000{,}000 \div \frac{2}{3}$, or 11.79 henrys as before. It will be found on carrying the reckoning to the necessary degree of accuracy, that this mutual induction 11.79 is the square root of the product of the two self-inductances, 3.93×35.37.

Examination of the steps in this calculation will show that this proposition must hold for all closed magnetic circuits uniformly magnetized to the same degree when the space occupied by the windings is not taken into account. Under the opposite conditions of open and especially of short iron cores, with large winding spaces, the condition usually falls, and the mutual inductance may be greater or less than the square root of the self inductances multiplied together.

Another reason in favor of selecting 1,000 million centimetres as the value of the practical unit or henry, is the desirability of having the time constant of an electromagnetic circuit expressed directly in seconds by its practical units, as in the case of electrostatic circuits, rather than revert to a unit of inductance that would yield the time constant in milliseconds or other fractional period of time. The time constant of a simple electromagnetic circuit, a circuit having inductance and resistance but negligibly small electrostatic capacity, is defined as the ratio of its inductance to its resistance, that is of its henrys to its ohms. It is an important function and its consideration presents some remarkable analogies between inductance and electrostatic capacity that it is interesting to trace.

Imagine an inductance coil without iron to be supplied with a steady current from an electromotive force of 50 volts. Let the inductance of the coil be three henrys, and its resistance 10 ohms. Ohm's law determines the strength of the current to be five amperes. Now short circuit the terminals of the coil very suddenly by a wire across its terminals of negligible resistance. The current in the coil does not stop instantly, but under the name of extra current is maintained in the coil by reason of its inductance. According to theory, the last dregs of the current will never entirely vanish from the coil, although after the first few seconds the remainder is exceedingly small. The very first instant after short circuiting, the current continues at five amperes by its electro-magnetic momentum but being unsupported, its energy is lost thermally in overcoming the coil's resistance, and it immediately falls.

In falling, the lines of force linked with the circuit and sustained by the current, are drawn in, cutting the coil as they re ede, thus creating a counter E. M. F. tending to prolong the current, and this process of dwindling current with reduction of opposition from the reserve of inductance, descend together. The total quantity of electricity that will flow through the circuit under the conditions specified, may fairly be called the charge or discharge of the coil, and it can be readily proved that this charge is equal to the quantity that would be conveyed by the initial discharging current, acting uniformly during a time equal to the time-constant of the circuit. In this case the discharge commenced at five amperes, and the time-constant is 0.3 second, so that the total discharge will be that due to the flow of this current in 0.3 seconds, that is 1.5 coulombs.

REGULATOR.—The storage battery is very useful as a regulator for maintaining a constant potential difference on a variable circuit which is being worked by a dynamo machine.

ARC LIGHT WIRE.—An arc light wire should never be concealed. This is a good rule to keep prominently in mind.

* Clerk Maxwell, "Electricity and Magnetism," 2d Edition, Vol. I. p. 293.

TRANS-PACIFIC CABLE.

There are strong arguments for participation by the United States Government, says the Worcester, Mass., *Gazette*, in the plans for a trans-Pacific telegraph cable to connect the coast of the continent with Samoa, Hawaii, and Australia. The President has just urged Congress, in his Message, to take action to prevent the mail-carrying Pacific steamships from changing the American terminus of their voyages from Australia and the Pacific islands from San Francisco to Vancouver, in British Columbia. Senator John H. Mitchell, of Oregon, now urges Congress to take a hand in the plans for a cable under the Pacific, and predicts that the cable will certainly be soon laid, and that if the United States holds aloof from the project, the cable will be laid under British and Canadian auspices, and its eastern terminus will be in British Columbia. Men of affairs in the Northwest have special reasons for knowing and appreciating the dangers of allowing the ports of British Columbia to gain steamship advantages over the United States Pacific ports. They and the President make these dangers clear to the people of the rest of the country. They have a strong line of argument in the evident social, political, commercial and military value there would be in a Pacific cable landing within United States territory.

ASBESTOS AS AN INSULATOR.—Great things were at one time expected of asbestos for commutator insulation purposes, but it proved to be a good absorbent of oil and was charred by the sparking, while the adhesion of metallic particles abraded from the bars and brushes soon developed a greater or less amount of short-circuiting with its concomitant evils. A somewhat similar result attended the use of simple air-spaces for insulating the bars, for the metallic dust or scrapings accumulated sooner or later at the bottom of the spaces, which, being numerous, were necessarily narrow.

OBITUARY.—William F. Sherman, an inventor well known in connection with rapid transit on street railways, died at Lowell on December 16th, aged sixty-five. He was the incorporator of the Sherman Electric Railway of Chicago. the Denver Mine Railway, the Overland Electric Power Company and other companies.

The factory for the manufacture of submarine cables, which the General Telephone Company is constructing at Calais, France, is finished. The building of this factory is, from a national point of view, of real importance, since, up till now, England alone possessed a monopoly of submarine cable-making.

THIS SPACE

RESERVED FOR THE

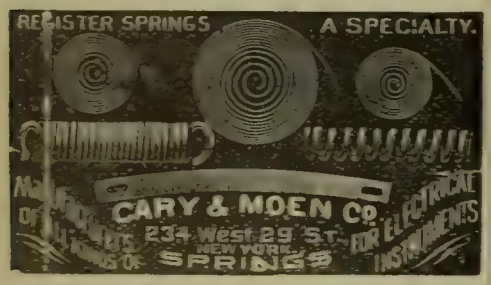
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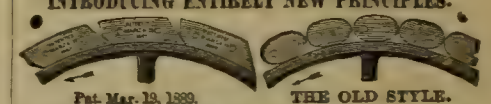


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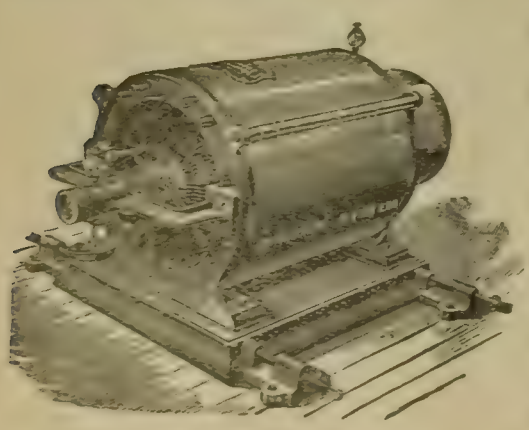
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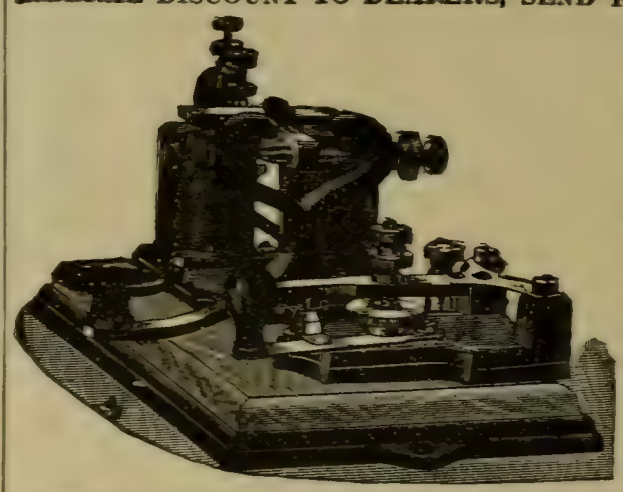
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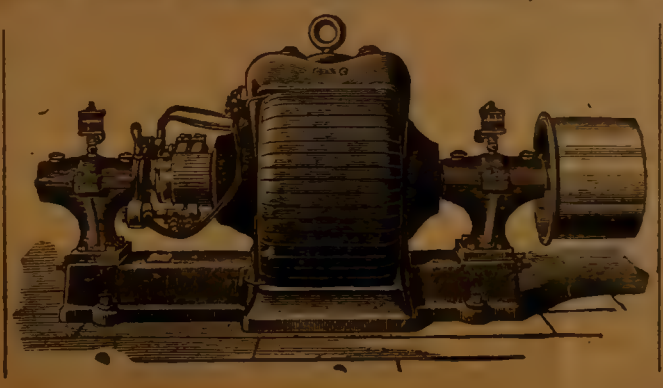
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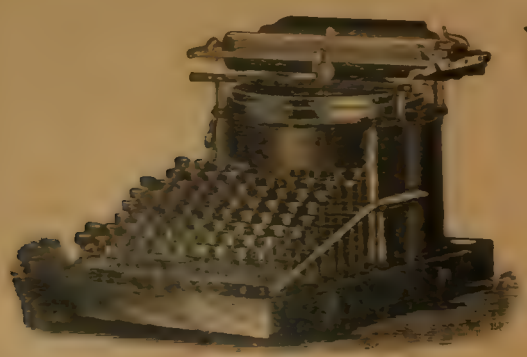
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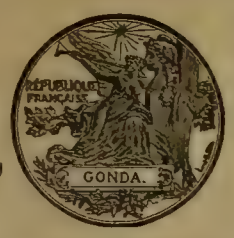
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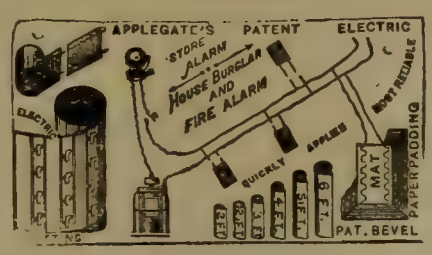
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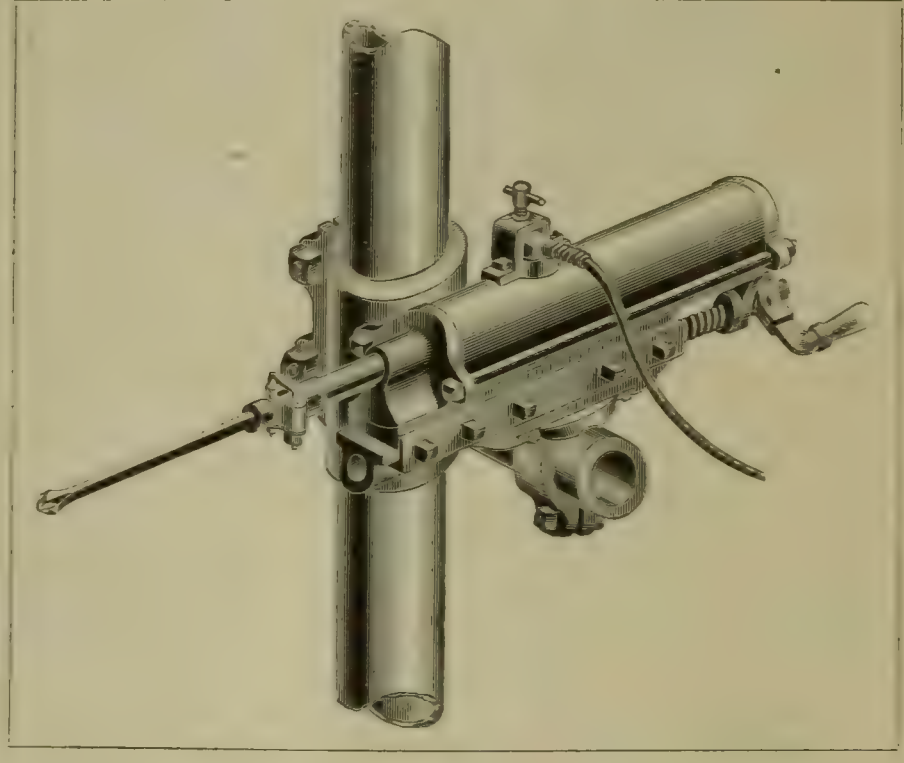
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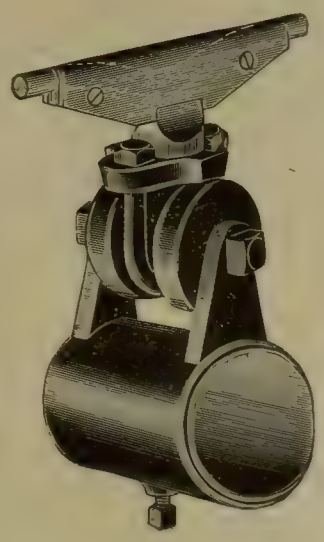
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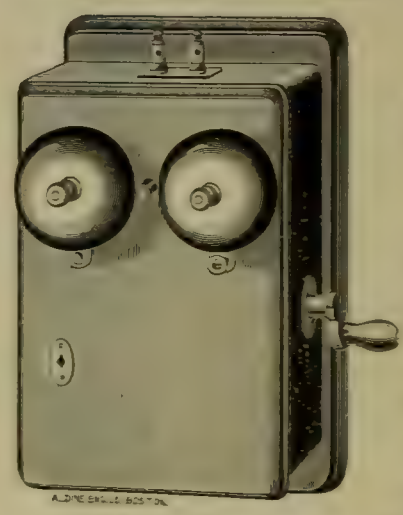
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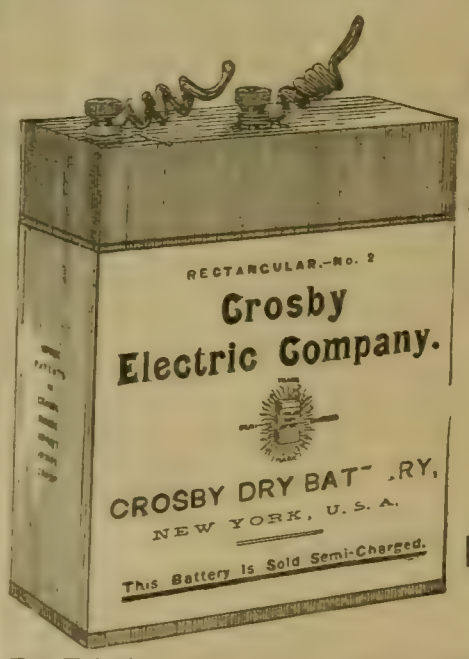
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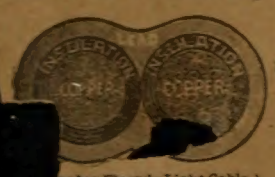
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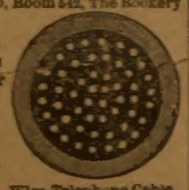
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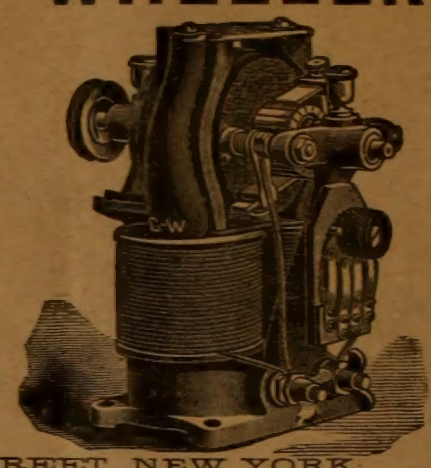


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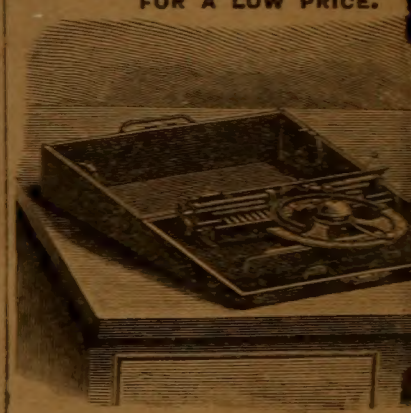


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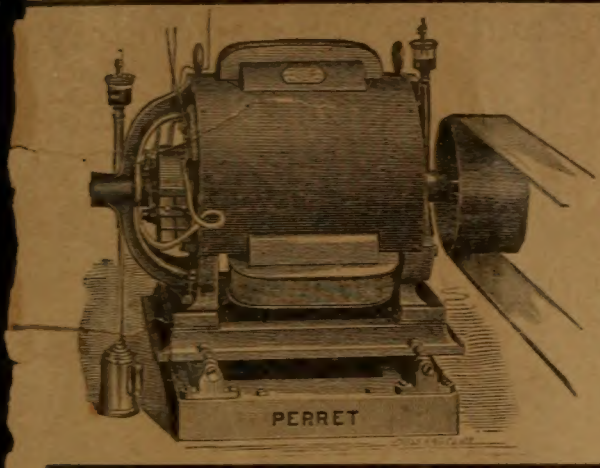
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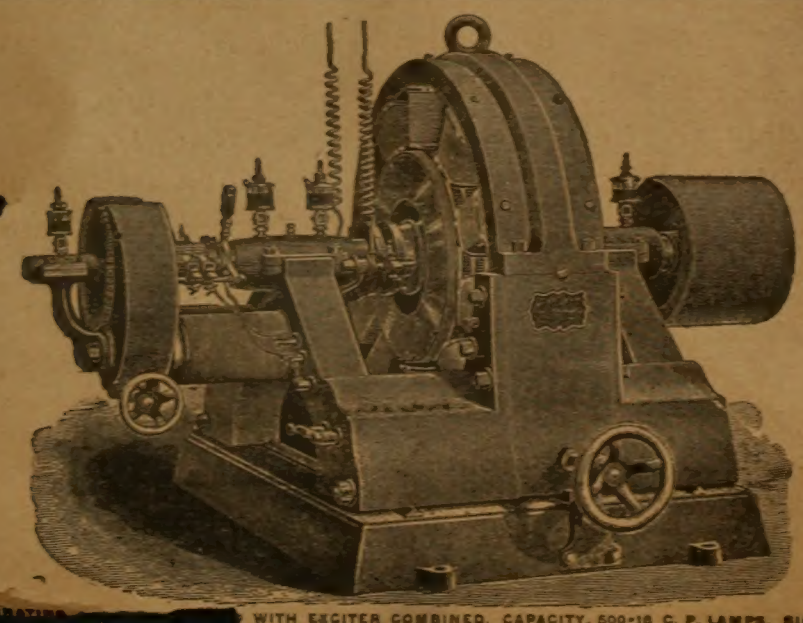
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